May the Force Be with You JedAI: Balancing the Light and Dark Sides of Generative AI in the Educational Landscape

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Abstract: Generative AI, much like the Force in Star Wars, wields significant power, capable of immense good or potential harm depending on its application. This editorial indicates the dual nature of generative AI within educational contexts, drawing parallels to the light and dark sides of the Force. Generative AI's proficiency in language manipulation positions it as a transformative tool in education, yet its influence must be managed wisely. The evolution of AI mirrors the advent of personal computers, suggesting a future where individuals may have personal AI assistants tailored to their needs. This speculative future poses critical questions about the balance of force between humans and AI. This editorial along with articles published in the special issue urge critical reflection on our current path and the decisions that will shape the future of AI in education.

Keywords: Generative AI, artificial intelligence, AIEd, educational technology (EdTech),, online teaching and learning

Bozhurt, A., & Bae, H. (2024). May the Force Be With You JedAI: Balancing the Light and Dark Sides of Generative AI in the Educational Landscape. *Online Learning, Volume* 28(2), (1-6). DOI: 10.24059/olj.v28i2.4563

Episode I: The Force Awakens

“The Force is with me, and I am with the Force.” — Star Wars Rogue One

No technology is neutral, and therefore neither is generative AI. Every technology comes with some advantages and disadvantages, and these advantages and disadvantages are determined by how and in what way the *force* of the technology is used. Generative AI is a force in its own right, mainly because language, the most sophisticated technology ever invented by humans, can now be wielded by another human invention: generative AI (Bozkurt, 2023). Accordingly, language forms the foundation of nearly all human culture. Human rights, for instance, are not inherent in our genetic code; instead, they are cultural constructs created through storytelling and legal frameworks. AI has developed notable capabilities in manipulating and generating language in various forms, including words, sounds, and images. In doing so, AI has effectively accessed and altered the core mechanisms of our civilization (Harari, 2023). Therefore, the use of language, with its light and dark sides, by the generative AI is actually the awakening of the force. In such a time, we find ourselves at a crossroads, questioning whether we are on the brink of an algorithmic renaissance that enriches and enhances the educational experience, or if we face an apocalypse where the essence of human learning and interaction is compromised (Bozkurt & Sharma, 2024).

Episode II: Return of the JedAI

"A Jedi uses the Force for knowledge…" — The Empire Strikes Back

The Force is neither good nor bad, but where you are in the larger spectrum causes you to see the dark or light side of the Force. To find the light side you need to find your way in the darkness, and, for that, you need to be literate. If generative AI is also a force, AI literacy is an important and critical set of skills to have to use it in the right way. In essence, AI literacy is about using AI technologies effectively and responsibly (Laupichler et al., 2022; Ng et al., 2021), and it is composed of six key constructs which are; recognize, know and understand, use and apply, evaluate, create, and navigate ethically (Almatrafi et al., 2024). AI literacy emphasizes the importance of knowing and using AI technologies effectively, and this leads us to the concept of prompt engineering.

Prompt engineering is an increasingly important skill set (White et al., 2023), art and science needed to communicate effectively with large language models (LLMs) facilitating generative AI (Bozkurt, 2024). Since the results of open-ended prompts can be ambiguous, structured prompts that accurately describe what is being asked and how it is being asked are important for achieving the desired outputs (Liu & Chilton, 2022). Therefore, skillfully crafted prompts are pivotal for facilitating effective communication and interaction with AI, blending technical precision with creative insight.

In all, while our AI literacy identifies the dimension of our interaction with generative AI, prompt engineering defines the depth and width of our interaction where humans and generative AI can co-create with efficiency and creativity. Thus, if we would like to use the generative AI for knowledge, and metaphorically return like a JedAI, we need to develop ourselves in AI literacy to become highly aware users and value prompt engineering as an art and science to enable truly effective human-AI interaction.

Episode III: A New Hope [or Despair]

"The Force is what gives a Jedi his power. It's an energy field created by all living things. It surrounds us and penetrates us. It binds the galaxy together." — Star Wars: The Last Jedi

What made computers important in the digital information age was not only their processing power but also their emergence as personal computers (PCs) (Pedwell, 2024). This meant that everyone could process their own information or access the information they wanted. The magic word in this process was 'personal', not the' computer' itself. Thus, when we see technology as an extension of humans and a tool that increases their capacity (McLuhan, 1962, 1964) and amplifies their abilities (Uttamchandani et al., 2022), it is a very likely future scenario that a similar evolution as in the case of personal computers will take place with generative AI. That is, humans will have their specifically trained personal LLMs and ChatBots to meet their demands.

In an AI oriented speculative future (Bozkurt et al., 2023; Peters & Green, 2024; Vrabič Dežman, 2024), we need to ask the following questions to understand whether a future that envisions the emergence of personal generative AI is a hope or despair: Who will be master and who will be slave in this new symbiotic process? Who will choose the light side and become JedAI or who will choose the dark side and become Sith, and how will they use the force to build a future?

Episode IV: The Phantom Menace

"I am a manifestation of the force, a force that consists of two parts. Living beings generate the living force, which in turn powers the wellspring that is the cosmic force." — Star Wars: The Clone Wars

While the idea of AI is three thousand years old, generic AI has been around for about three quarters of a century, and generative AI has only recently come into our lives. The fact that the generative AI can use language, create original content in line with our prompts, and even see, hear and understand us while communicating and interacting not only astonished us but also tempted us to use this technology further.

When we consider that developments in the AI ecosystem are progressing exponentially, what we are witnessing now is the heartbeat of a baby in the womb. This baby will be born, crawl, walk and, one day, run. This is not a prediction but a very possible future. But now comes the question we need to answer? From whom will this technological baby learn life modeling? Will it learn by imitating humans like human babies or will AI technologies learn by interacting with each other? Both answers are worrying because if they will learn from humans, human reality is full of mistakes, but if they will learn from each other, an uncontrolled force is not only dangerous for everyone but also for everything.

Final Episode: The Empire Strikes Back

"The Force is a trap. It calls us with dreams of power or skill or just being able to change things. It's the same, light or dark. But it chews us up, uses us for its purposes, whatever bizarre cosmic goals it's trying to achieve and tells us it's destiny. We aren't people to it. We're just tools. Tools named Jedi and Sith." — Star Wars: The Destiny Path

The educational technology community often fails to learn from history. One view is that we will repeat past mistakes with new technologies. Even worse than failing to learn is that we often do not even know the lessons. We tend to ignore historical insights in our excitement to embrace current innovations (Rushby, 2013). In the educational technology community, there is a tendency to refer to innovative, exciting technologies as the next best thing that will save education. These technologies are often expected to transform education, perhaps even replace educators. Many are drawn to the novelty effect, which has generated numerous hypes throughout the history of educational technology, viewing EdTech as a savior (Bozkurt, 2020). This situation can be metaphorically described as the song remains the same, but the tempo keeps changing (Mishra et al., 2009). In this context, the question arises whether generative AI is a hype or a new song that changes tempo. If our inability to learn from our mistakes has created an empire, it is very likely that this empire will be reinvigorated by the emergence of generative AI technologies and strike us again.

In line with the above-mentioned thoughts, the following understanding can actually emerge. Are we indeed experiencing Stockholm Syndrome by believing too much in technology and especially in generative AI technologies? Are we actually falling in love with our executioner while dreaming of a future dominated by technology? Or are these extremely optimistic scenarios [!] and generative AI is really a technology divinely sent from the sky to solve all problems? Whether we envision a dystopian or utopian future, the trajectory of both depends on the answers we give today, and that is where this editorial and published articles aim to provoke your critical thinking.

Acknowledgements

The authors of this editorial would like to express their gratitude to George Lucas who inspired this editorial by creating the Star Wars universe. The authors of this editorial would also like to emphasize the message *May the Science be with You*, reminding us that science is the real *force*.

Competing Interests

The authors have no competing interests to declare.

References

Almatrafi, O., Johri, A., & Lee, H. (2024). A Systematic Review of AI Literacy Conceptualization, Constructs, and Implementation and Assessment Efforts (2019-2023). *Computers and Education Open, 6,* 100173. https://doi.org/10.1016/j.caeo.2024.100173

Bozkurt, A., & Sharma, R. C. (2024). Are we facing an algorithmic renaissance or apocalypse? Generative AI, ChatBots, and emerging human-machine interaction in the educational landscape. *Asian Journal of Distance Education, 19*(1), i-xii. https://doi.org/10.5281/zenodo.10791959

Bozkurt, A., Xiao, J., Lambert, S., Pazurek, A., Crompton, H., Koseoglu, S., Farrow, R., Bond, M., Nerantzi, C., Honeychurch, S., Bali, M., Dron, J., Mir, K., Stewart, B., Costello, E., Mason, J., Stracke, C. M., Romero-Hall, E., Koutropoulos, A., Toquero, C. M., Singh, L Tlili, A., Lee, K., Nichols, M., Ossiannilsson, E., Brown, M., Irvine, V., Raffaghelli, J. E., Santos-Hermosa, G Farrell, O., Adam, T., Thong, Y. L., Sani-Bozkurt, S., Sharma, R. C., Hrastinski, S., & Jandrić, P. (2023). Speculative futures on ChatGPT and generative artificial intelligence (AI): A collective reflection from the educational landscape. *Asian Journal of Distance Education, 18*(1), 53-130. https://doi.org/10.5281/zenodo.7636568

Bozkurt, A. (2020). Educational technology research patterns in the realm of the digital knowledge age. *Journal of Interactive Media in Education, 2020*(1), 1-17. https://doi.org/10.5334/jime.570

Bozkurt, A. (2023). Generative artificial intelligence (AI) powered conversational educational agents: The inevitable paradigm shift. *Asian Journal of Distance Education, 18*(1), 198-204. https://doi.org/10.5281/zenodo.7716416

Bozkurt, A. (2024). Tell me your prompts and I will make them true: The alchemy of prompt engineering and generative AI. *Open Praxis, 16*(2), 111–118. https://doi.org/10.55982/openpraxis.16.2.661

Harari, Y. N. (2023). *Yuval Noah Harari argues that AI has hacked the operating system of human civilisation.* The Economist. https://www.economist.com/by-invitation/2023/04/28/yuval-noah-harari-argues-that-ai-has-hacked-the-operating-system-of-human-civilisation

Laupichler, M. C., Aster, A., Schirch, J., & Raupach, T. (2022). Artificial intelligence literacy in higher and adult education: A scoping literature review. *Computers and Education: Artificial Intelligence, 3*, 100101. https://doi.org/10.1016/j.caeai.2022.100101

Liu, V., & Chilton, L. B. (2022, April). Design guidelines for prompt engineering text-to-image generative models. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (pp. 1-23). New Orleans, LA, USA. https://doi.org/10.1145/3491102.3501825

McLuhan, M. (1962). *The Gutenberg Galaxy: the making of typographic man.* University of Toronto Press.

McLuhan, M. (1964). *Understanding media: The extensions of man.* McGraw-Hill.

Mishra, P., Koehler, M. J., & Kereluik, K. (2009). The song remains the same: Looking back to the future of educational technology. *TechTrends*, *53*(5), 48-53. https://doi.org/10.1007/s11528-009-0325-3

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence*, *2*, 100041. https://doi.org/10.1016/j.caeai.2021.100041

Pedwell, C. (2024). Speculative machines and us: more-than-human intuition and the algorithmic condition. *Cultural Studies*, *38*(2), 188-218. https://doi.org/10.1080/09502386.2022.2142805

Peters, M. A., & Green, B. J. (2024). Wisdom in the Age of AI Education. *Postdigital Science and Education,* 1-23. https://doi.org/10.1007/s42438-024-00460-w

Rushby, N. (2013). The future of learning technology: some tentative predictions. *Educational Technology & Society, 16*, 2, 52–58.

Uttamchandani, S., Bae, H., Feng, C., Glazewski, K., Hmelo-Silver, C. E., Brush, T., Mott, B., & Lester, J. (2022). Teacher Orchestration Systems Supported by AI: Theoretical Possibilities and Practical Considerations. In: Fan Ouyang, Pengcheng Jiao, Bruce M. McLaren, Amir H. Alavi (Eds.), *Artificial Intelligence in STEM Education* (pp. 151-162). CRC Press. https://doi.org/10.1201/9781003181187-13

Vrabič Dežman, D. (2024). Promising the future, encoding the past: AI hype and public media imagery. *AI and Ethics*, 1-14. https://doi.org/10.1007/s43681-024-00474-x

White, J., Fu, Q., Hays, S., Sandborn, M., Olea, C., Gilbert, H., Elnashar, A., Spencer-Smith, J., & Schmidt, D. C. (2023). A Prompt Pattern Catalog to Enhance Prompt Engineering with ChatGPT. *arXiv*. https://doi.org/10.48550/arXiv.2302.11382

Against Artificial Education: Towards an Ethical Framework for Generative Artificial Intelligence (AI) Use in Education

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Abstract
The arrival of generative artificial intelligence (AI) is fundamentally different from prior technologies used in educational settings. Educators and researchers of online, blended, and in-person learning are still coming to grips with how to employ current AI technologies in the learning experience, let alone understanding the potential consequences that future and unknown developments in AI will produce. Despite potential risks, AI may revolutionize previous models of teaching and learning, and perhaps create opportunities to realize progressive educational goals. Given the longstanding tradition of using philosophy to examine questions surrounding ethics, ontology, technology, and education, the purpose of this critical reflection paper is to draw from prominent philosophers across these disciplines to address the question: how can AI be employed in future educational contexts in a humanizing and ethical manner? Drawing from the work of Gunther Anders, Michel Foucault, Paolo Freire, Benjamin Bloom, and Hannah Arendt, we propose a framework for assessing the use and ethics of AI in modern education contexts regarding human versus AI generated textual and multimodal content, and the broader political, social, and cultural implications. We conclude with applied examples of the framework and implications for future research and practice.

Keywords: generative artificial intelligence (AI), Bloom's taxonomy, Paolo Freire, philosophy of technology, Gunther Anders

Swindell, A., Greeley, L., Farag, A., & Verdone, B. (2024). Against Artificial Education: Towards an Ethical Framework for Generative Artificial Intelligence (AI) Use in Education. *Online Learning*, *Vol 28*(2), (7-28). DOI: 10.24059/olj.v28i2.4438

The arrival of generative[1] artificial intelligence (AI) is fundamentally different from prior technologies used in educational settings. Educators and researchers of online, blended, and in-person learning are still coming to grips with how to employ current AI technologies in the learning experience, let alone understanding the potential consequences that future and unknown developments in AI will produce (Bozkurt, 2024; Şenocak et al., 2024). Despite potential risks, AI may revolutionize previous models of teaching and learning and perhaps create opportunities to realize progressive educational goals. When ChatGPT was released to the general public in November 2022, these dangers and possibilities were immediately made salient as students across the world could instantly use AI to create content for class assignments and educators scrambled to understand if and how AI could fit in their coursework. While some research has explored the ethical implications and imagined futures of AI in education (Akgun & Greenhow, 2022; Nguyen et al., 2023), there is limited consensus or direction for classroom use of AI specifically. Given the longstanding tradition of philosophy to examine questions surrounding ethics, ontology, technology, and education (An & Oliver, 2021), the purpose of this critical reflection paper is to draw from prominent philosophers of these disciplines to address the question: how can AI be employed in future educational contexts in a humanizing and ethical manner? While this is not an empirical study guided by explicit research questions, the overarching problem this paper addresses is how to ethically and practically incorporate generative AI into modern and imagined education systems.

We first review literature from theorists such as Anders and Foucault to bring awareness to the functions of technologies in modern society and their capacity to change the human condition and shape sociopolitical relations. Next, we draw from educational philosophy, where arguments have been made using Paulo Freire that ethical education at its core promotes humanization, conscientization, and radical engagement with the world, while technological adoption in educational practice is not inherently harmful, so long as the technology promotes these humanizing ends (Boyd, 2016; Kahn & Kellner, 2004; Farag et al., 2021). We then synthesize the work of Bloom's (1956) taxonomy and Arendt's (1958) hierarchy of labor, work, and action to construct a lens through which educators and classroom teachers can understand both the types and goals of learning that are necessary given the possible futures of AI in education. With this theoretical grounding, we propose a framework for assessing the use and ethics of AI in modern education contexts regarding human versus AI generated textual and multimodal content, and the broader political, social, and cultural implications. The framework is general in that it is not limited to a specific modality of education delivery, thus it can be applied to online, blended, and in-person settings. We conclude with applied examples of the framework and implications for future research and practice.

The Philosophy of Anders on Technology and Society

[1] While general or generic artificial intelligence are more broadly defined, the subject of this analysis is limited to generative artificial intelligence (AI) systems which are "developed to analyze complex patterns and structures in human language [and] are primarily designed to comprehend and replicate it. Generative AI, when expertly trained, exemplifies a potent tool capable of learning, unlearning, and relearning which makes it a continually adapting [and] evolving entity" (Bozkurt, 2024, p. 2).

After decades of neglect by academics, especially in the English-speaking world, many scholars across disciplines are beginning to study Gunther Anders. Anders, a German-Jewish intellectual, wrote prolifically on “the lasting effect of the industrialism, the psychological and political implications of mass media, the legacy of the Holocaust and the intervention of the atomic bomb for history and memory, the Vietnam War, ecological devastation, and new forms of internationalism and collective political action” (Dawsey, 2014, p. 11). A connecting thread between Anders’s interdisciplinary milieu of interests was how technologies were not just reshaping the social and psychological behaviors of humans, but how technologies were actually modifying what it means to be human, and perhaps moving into a space where humanity is irrelevant. The opening to his deepest work on the subject, *The Obsolescence of Man, Volume II,* begins

> It is not enough to change the world. That is all we have ever done. That happens even without us. We also have to interpret this change. And precisely in order to change it. So that the world will not go on changing without us. And so that it is not changed in the end into a world without us. (Anders, 1980/2015, p. 1)

Anders’s formulation for interpretation and change rests on a process of critical reflection, in order to assess the current place of humans within the interconnected systems of technologies they have developed, and engagement with imagination in the act of exaggeration, in order to reveal the indeterminate and identify spaces for potential freedom.

As a starting place, Anders argues that we must understand “Artificiality is the nature of man and his essence is instability” (Anders, 1936/2009, p. 146). Humans are able, through abstract thinking, to transform the world and “build over it according to a thousand historical variants” creating a paradoxical situation in which “agency” brought to us through technology simultaneously creates a prison of contingency, whereby given technologies shape and direct our means of production, our communication, and our social structures but cannot be escaped. This paradox was specifically escalated at the point in which humans began “Producing machines, or at least parts of machines, by way of machines” (Anders 1980/2015, p. 6) creating entire systems in which seemingly infinite products can be produced with very little input from humans themselves. “Only at the beginning of these chains of production (as inventors or artisans) and at the end (as users) do men have a place” (Anders, 1980/2015, p. 6). As early as the 1950s Anders formulated what he called the “Promethean discrepancy,” which is the gap between what can be produced and what humans can imagine or emotionally grasp in terms of the consequences and implications for society and for the individual being. It is in this space that the method of exaggeration is needed to bring fantasy and anticipation to get a better understanding not of the future potential of technology but its present reality. Catalani (2020, p. 161) makes this point well by summarizing, as an example from Anders’s work, a bomb that in pure sight as an object is “understated” but its true meaning can only be grasped by imaging the terrible potential it contains. Anders’s explicitly says that when we use our imagination in this way, we increase our “Freedom to Fear,” which is a “stirring fear, since it should drive us into the streets instead of under cover” and a “loving fear, not fear of the danger ahead but for the generations to come” (Anders, 1962, p. 498). Anders (1980/2015) argues that humans have adopted as a principle of modernity, “the possible is generally accepted as the compulsory and what can be done as what must be done”; a principle that confuses technological possibility with moral justification (p. 7). The examples of this confusion are manifest in the creation of weapons that can destroy the world, the overproduction of goods that can destroy the environment, and the development of machines that can do our thinking for us. Consider the Promethean discrepancy found in the widespread adoption of "smart" devices and the correlated social media platforms that operate on them. Such technologies have been rapidly adopted, with little consideration for their consequences, and their use thus far seems to have negative societal impacts on domains such as personal privacy, the development of youth, and psychological health, not to mention the resources that are being used to produce them and their impact on the biosphere. In the following section, the concept of Promethean discrepancy is used to illustrate the vast and tremendous unknown that society must confront regarding AI, and to interrogate its already -realized and imagined impact on global education systems.

Foucault, Power, and Generative AI as an Educational Technology

Given the uncertainty surrounding how AI and society will impact each other, we use a Foucauldian analysis to understand technologies as systems of power, and it allows us to deconstruct the role technology plays in modern epistemologies (Giantini, 2023; Swartz & McElroy, 2023; Megahed et. al., 2023). The most striking example of producing machines by way of machines as described by Anders is through modern AI. While artificial intelligence has impacted society in various forms (Rahm, 2023) its new manifestation, generative AI, through its emulation of human interaction, has penetrated through a metaphysical barrier between machine and man. According to Baido and Ansah, "Generative modeling artificial intelligence (AI) is an unsupervised or partially supervised machine learning framework, which generates manmade relics via the use of statistics, probabilities etc." (2023, p. 53). However, the application of this machine learning in the form of GPT, or Generative Pre-trained Transformer, which can "engage customers in human-like conversation" erodes the boundaries between machine and human developed epistemologies (Baido and Ansah, 2023, p. 53). Rather than users searching the internet and AI providing a group of answers associated, AI generates content acting *as* a human. Generating information in a human-like manner centers the machine as the synthesizer and evaluator of knowledge, rather than the human. With vast amounts of data processed at lightning speed to generate human-like interactions, the user gains tremendous advantages in perceived efficiency but is left exposed to ontological risks where meaningful thought, investigation, and creation are "outsourced" to other actors. Uncritical users of AI, without training, adaptation, and awareness, may be left vulnerable to manipulations by corporations, bad actors, or perhaps the AIs themselves. The core of human-driven epistemology is shaken by the powerful effects AI has on our abilities to synthesize knowledge.

French philosopher Michel Foucault provides a helpful vocabulary for analyzing these shifting power dynamics through his concept "regimes of truth." Lorenzini (2015) analyzes Foucault's concept, stating

> Each society has its regime of truth, and by this expression [he] means: (1) "the types of discourse [society] harbors and causes to function as true"; (2) "the mechanisms and instances which enable one to distinguish true from false statements" and (3) "the way in which each is sanctioned"; (4) "the techniques and procedures which are valorised for obtaining truth"; (5) "the status of those who are charged with saying what counts as true" (Foucault 1976, p. 112; 13). Therefore, "truth" is "a system of ordered procedures for the production, regulation, distribution, circulation and functioning of statements"; it is linked "by a circular relation to systems of power

> which produce it and sustain it, and to effects of power which it induces and which redirect it". (p. 2)

Considering the current arms race amongst trillion-dollar corporations such as Microsoft and Google as they develop respective AI technologies following a decade where algorithm-driven platforms such as Facebook, YouTube, Twitter, and TikTok created an ecosystem of anger, misinformation, and conspiracy thinking, it is easy to imagine the outsized role accelerating AI will have on epistemologies and definitions of truth. These for-profit companies, incentivized to increase user platform "engagement," are seeking ways to more effectively and efficiently manipulate human behavior. Through AI, corporations enhance their abilities to establish regimes of truth leaving human users of these platforms struggling to formulate their own truths.

For educators whose core mission is to disseminate knowledge and assist learners in the comprehension of the world, it is worth considering the rapidly changing information and technological landscape and, more specifically, the competing regimes of truth that AI presents. There have been instances in which similar questions have been asked of competing AIs like OpenAI's ChatGPT and Google's Gemini, which have led to different responses reflecting various data sources and methodologies including learned falsehoods (Marr, 2024; Pacchiardi et al., 2023; Wong, 2023). Further complicating these discrepancies is that the engineers and programmers who design AI systems often cannot explain how a specific response or output was reached given the complexity of the data architecture and decision-making processes of the systems (Dobson, 2023). AIs have been shown to "hallucinate," calling into question what these corporations define as truth and exaggerating the influence of errors. In a study that assessed AI's ability to understand culturally nuanced questions, researchers found that "the evaluated models demonstrated varying performance with controversial topics, those lacking clear scientific consensus and the brain teasers proving more susceptible to GPT hallucinations…their identification necessitates human-centric assessments by interrogators who apply their own cultural perspectives and values" (McIntosh et al., 2023, p. 12). Other limitations include AI's replication of human biases such as racism and sexism (Rountree & Condee, 2021).

These inconsistencies, hallucinations, and biases represent varying regimes of truth and without a human-centric ability to assess the conclusions various GPTs come to, educators and learners will be unable to distinguish between these radically different and competing "truths." The various regimes of truth replicated by AI produce errors that can be normalized in ways that can be harmful to humans. If education is to be a liberating force against oppressive constructs, and AI reinforces those constructs, educators will continually be fighting an uphill battle. Given the influence these corporations have already attained in creating learning management systems of educational institutions (Farag et al., 2021; Ofgang, 2023), these regimes of truth can manipulate educators and learners who are relying on AI. As the primary aim of these competing corporations is increasing profitability by developing and marketing more advanced AI valuing efficiency over accuracy, educators cannot fully depend on the "truths" these corporations provide regardless of how accurate and efficient they advertise themselves to be. Without cautious and critical strategies for use, learners become consumers and data providers to corporations building their ever increasingly powerful AIs.

Freire and AI as Humanizing Education

Regardless of how the corporate and regulatory power dynamics surrounding AI unfold, it is clear that the AI used in educational settings cannot be assumed to always be accurate or have students' or educators' best interests at heart. The debate over ethical use of technology in education is certainly not new, and in educational philosophy, arguments have been made using Paulo Freire as a guide that technological adoption in educational practice is not inherently harmful, so long as the technology promotes conscientization and humanizing ends (Boyd, 2016; Kahn & Kellner, 2007). Here Freire's (1968) method of *conscientization* is especially relevant, where communities engage in critical dialogue, investigation, and action as an educative endeavor, in order to develop a better understanding of the world and engage in the "ontological and historical vocation to be more fully human" (Freire, 1968, p. 37) and thereby provide an effective framework to counter machine generated understandings of the world. Freire argued that conscientization through educational processes and activities is realized when learners (and/or educators) understand not just their place in the world, but how to transform both their reality and the world (Freire, 1965, 1997) . Regarding the role of technology in these processes of conscientization and humanization, Farag et al. (2021) noted that:

> The growing integration of technology into educational settings was viewed by Freire as an area of concern and pedagogical possibility…despite Freire's concerns that increasingly advanced technologies would serve cultural and economic interests of those in power, he viewed technologies as tools which, if used critically and carefully, could benefit the oppressed…Freire identifies the primary goal of humanity as the ontological pursuit of being more fully human, which is done through exercising one's capacities, having one's voice heard, and acting with others to transform the world. (p. 3)

These concepts of conscientization and humanizing education have been used in education philosophy for decades, though research on AI using Freire has only just begun. Freirean analysis has been employed to question the neutrality of AI systems in education (Stapleton et al., 2023) and used to examine how AI can assist students in identifying what matters to themselves in an educational setting (Loftus & Madden, 2020). Freire argued that the technique of dialogue in education amongst students, teachers, and all others involved was vital to pedagogy, and specifically a crucial means to help all parties realize conscientization and better understand their agency in the world. While research on how AI and chatbots in particular is limited on how they can facilitate such meaningful dialogue, Lin (2023) specifically found that:

> ChatGPT's conversational capability enables it to not only play an intermediate role but also act as an independent agent to engage in classroom dialogues with learners and teachers. What is more impressive is that the conversation with active users within a certain classroom context further becomes training data for ChatGPT, which allows it to grow accuracy and sensitivity in conversations by gaining a higher level of context-specific knowledge. (p. 3)

Despite the limited research on the application of Freire to AI in education, it is clear that applying Freire's concept of humanizing education and conscientization to examine the political, economic, social, cultural impacts of AI can help inform how teachers, students, and administrators can use AI in education in a way that is both humanizing and advances student learning objectives like critical thinking and creativity. AI, at its best, can act as a fellow member in humanization and conscientization, though significant questions remain on how to accomplish this at the classroom level.

Typologies and Purpose of AI Use in Education

Given this analysis, which demonstrates that educators will need teleological guideposts to employ AI at the classroom level in a humanizing way, we explore how AI fits within Bloom's (1956) taxonomy, a prevalent framework amongst practitioners for thinking about educational activities. We suggest that in the presence of machines, which can perform much of the "labor" of classifying, analyzing, and synthesizing, educators require a new framework that prioritizes the use of technology and adoption of learning toward goals that improve the human condition. For this purpose, we apply Hannah Arendt's (1958) hierarchy of labor, work, and action (terms used by Arendt to classify and value how humans spend their time and energy) to educational contexts to interrogate both the intent and outcomes of education.

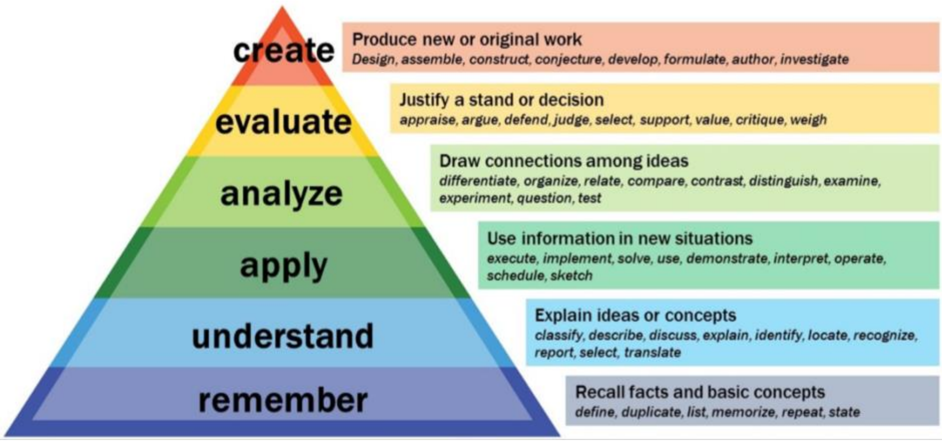
Understanding Teaching and Learning with the Revised Bloom's Taxonomy

Bloom's (1956) *Taxonomy of Educational Objectives* and Anderson and Krathwohl's (2001) subsequent *Revised Bloom's Taxonomy* (RBT) have been a foundation in educational preparation programs and classrooms globally for decades. The application of the RBT in research and practice varies significantly, and is understood narrowly in this analysis as a way to classify teaching and learning in the context of AI that is familiar and clear. The cognitive dimension of RBT (Figure 1) depicts a spectrum of cognitive processes in learning that range from the lower tier of remembering and understanding to the higher levels of evaluating and creating. Each of these tiers represents an ascending order of cognitive complexity and its corresponding "action" words that can be used to create lesson plans, educational activities, and assessments in particular. Anderson and Krathwohl (2001) also argued in their development of RBT that there is a knowledge dimension to learning that includes "metacognitive knowledge is knowledge of [one's own] cognition and about oneself in relation to various subject matters . . ." (p. 44)." Accordingly, the cognitive dimension shown in Figure 1 and the metacognitive element of the knowledge dimension illustrate a clear and distinguishable taxonomy and framework that AI can be understood within.

Figure 1

Bloom's Taxonomy

(Armstrong, 2010)



Given the utility that the RBT provides in examining learning processes, research has already been conducted on AI and the RBT. Research on generative AI Large Language Models (LLM), like ChatGPT, have shown these LLMs can complete activities across the RBT, though they perform significantly better at the lower tiers (remember, understand) than the upper (evaluate, create) (Binh Nguyen Thanh et al., 2023; Lourenco et al., 2023). LLMs have also been shown that using keywords from across the spectrum of RBT can challenge "the AI model's capabilities" (Elsayed, 2023, p. 6). Regarding AI usage in educational contexts, Jin et al. (2023) found that LLMs are useful in "supporting metacognitive, cognitive, and behavioral regulation…but not for regulating motivation" (p. 1). More generally, Damaševičius (2023) argues that "the advanced natural language processing capabilities of ChatGPT have led to a shift away from the linear, hierarchical model of Bloom's taxonomy, towards a more dynamic and fluid approach to knowledge acquisition and application" (p. 115) suggesting that AI may unlock new ways of teaching and learning that can go beyond the tiers of RBT. Despite these potential positive use cases, calls have been made to "prioritize ethical AI usage, cultivate AI literacy, and develop frameworks that empower students and educators to safely harness the full potential of these technologies" (Farrelly & Baker, 2023, p. 11). We argue that as a normative framework, RBT has great utility in understanding AI use in education, but that it is not sufficient to interrogate the ethical quandaries that AI presents, particularly surrounding how AI can work towards or against a humanizing education. In other words, given AIs demonstrated ability to operate, at varying levels of competency, across the RBT in educational settings, a new framework is needed that incorporates the impact of AI not just on these tiers of learning, but also centers the human condition, with its various psychological, social, and physical motivations, and the need to act in the world. Because RBT is not prescriptive in a way that relates to the purposes or motivations to which humans apply their learning, we propose supplementing the framework with the work of political philosopher Hannah Arendt. Arendt is specifically valuable in providing a normative directionality for human action, especially in an era of rapid technological change.

The Philosophy of Arendt and Action-oriented Educational Goals.

Hannah Arendt's *The Human Condition* (1958/2013) is a careful and thought-provoking exercise in the classification and examination of the most fundamental human activities and provides useful insight into a theory of education that seeks to develop capacities for deliberating in, and acting on, the world. Originally published in 1958 during the Cold War era, when human activities seemed to be leading toward self-destruction, Arendt began the work as a call to critically reflect on the significance and purpose of human activity so that we may "think what we are doing" before it is too late (p. 5).[2] Introducing her book shortly after Sputnik had been launched, Arendt presciently describes a new age where the life-giving qualities of Earth are taken for granted, and where scientific advancements, expressed in new technologies, become so ascendent they think *for* us:

> The trouble concerns the fact that the "truths" of the modern scientific worldview, though they can be demonstrated in mathematical formulas and proved technologically, will no longer lend themselves to normal expression in speech and thought…In this case, it would be as though our brain, which constitutes the physical, material condition of our thoughts, were unable to follow what we do, so that from now on we would indeed need artificial machines to do our thinking and speaking. If it should turn out to be true that knowledge (in the modern sense of know-how) and thought have parted company for good, then we would indeed become the helpless slaves…thoughtless creatures at the mercy of every gadget which is technologically possible, no matter how murderous it is. (p. 3)

Arendt's diagnosis aptly characterizes the new AI age, where the creators of LLMs and similar software cannot explain exactly how their programs are working (known as the "black box" problem, see Dobson, 2023), and where at least 68% of the human population is using a smartphone (Laricchia, 2023) without full comprehension of how they work or where their materials are sourced from. Despite this challenging disconnect, her study of human activities that follows, and how society organizes itself, suggests a space for reclaiming agency.

For Arendt, humankind is defined by its most common activities, which she categorizes into a hierarchy of three groups and labels humans according to activities in which they engage. *Animal laborans* is the label she gives to the most basic and essential human activities: labor and consumption. Arendt calls laboring and consuming activities "metabolic" not only because of their close relation to the life process, but also because laboring and consuming, like the functions of the body, require little thought (p. 98–100). The second label Arendt gives is *homo faber*, which means man who "works upon" or who "makes something" (p. 136). *Homo faber* is defined by the activity of "work." Work is the act of creating and constructing material objects of a lasting durability (p. 143). According to Arendt, it is work that allows humans to build a world that extends across generations and improve the conditions under which we labor and consume.

It is the third activity of "action" that is Arendt's highest classification of human endeavor and representative of the title *zoon politikon.* Arendt says that humans are imbued with the unique freedom to "set into motion," through deeds and speech, actions that have

[2] It is perhaps not coincidental Arendt's foundational concerns pertaining to technology share similarities to Anders: they were married from 1929–937 and maintained a lifelong correspondence.

never been taken before and whose influence is impossible to predict (p. 189). Essential to action is the presence of others—a public sphere, where humans debate, discuss, plan, create, perform, and engage in activities with the purpose of changing the perspective of others and influencing their future behaviors. Arendt states that action "corresponds with the human condition of plurality" and action itself is what constitutes "*the* condition…of all political life" (p. 7). Action is not drawn from the necessity of *animal laborans* or the desire for mastery of *homo faber*, which each seem to follow observable patterns of "standard" human behavior. Arendt says that genuine action possesses a "miraculous" quality because it is immersed in the diversity of interests and values of human life and brings into being new thoughts and relationships amongst the public that had never before existed (p. 178). As such, action is very much an "event," not a process or idea, which takes place at a particular time and place when a human attempts to influence others (p. 259).

Arendt carefully delineates how, over the course of human history, labor, defined as the repetitive and painful activities required to sustain one's life, has ascended from the domestic sphere of life to dominate the public sphere. During the industrial revolution the activities of *homo faber* (i.e., the activities of production) were broken into small unskilled movements, so that the coordinated activity of labor became central to economic and social life (p. 123–124). When the system of production requires any indistinguishable person to constitute its basic movements, humans become defined by their "labor power" and not by their skills or actions, and person labors so that they might "earn a living" (p. 125–128). Of significance to Arendt is that the purpose of the machine, organization, or society is not primarily to build something of lasting significance or value to humanity, but instead to increase consumption that *by definition* cannot have lasting value (p. 145–149). Arendt clearly identifies the negative consequences of laboring for its own sake: destructive tendencies go unquestioned and those caught in the never-ending labor and consumption cycle face existential unhappiness. As a consequence of consumption's ascendency in the public sphere, the activity Arendt labels as the greatest form of human activity, "action," has been subsumed, and its place in the public sphere (and the public sphere itself) has diminished.

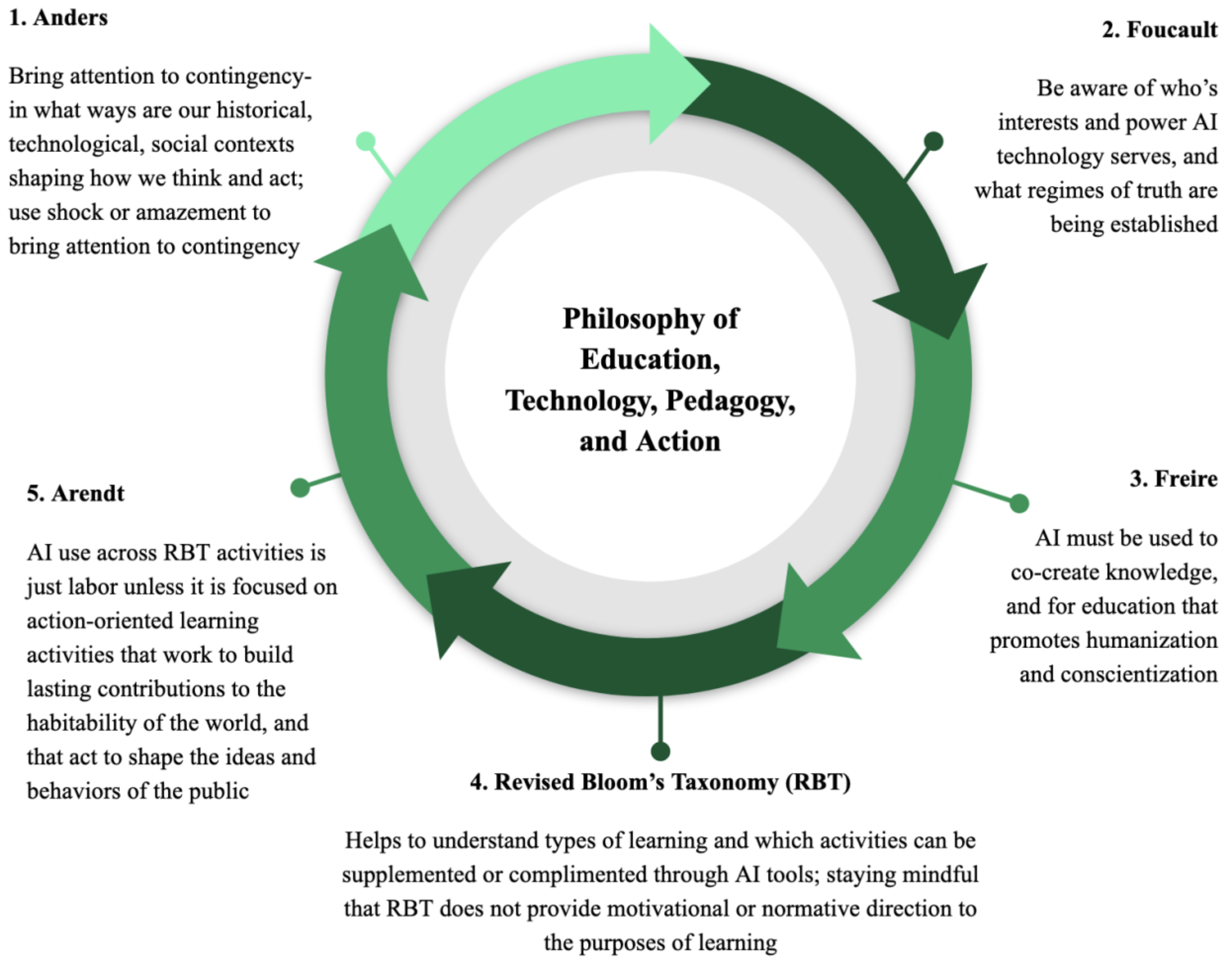
Applying Arendt's framework to the question of AI and its use in educational spaces, it moves the question of technological use from a scientific or pedagogical one (as in the RBT) to an ethical or political one. Let's consider an example of how AI might be used with current GPT technology in a classroom. A journalist, under pressure to produce more consumable content for its struggling publication, uses a GPT to write a story about the benefits and costs of electrical vehicle production and use. A teacher, excited by the labor-saving allure of an AI teaching assistant product called Brisk, uses the software extension to read the news story about electric vehicles and design a 60-minute lesson plan for their students, complete with learning goals, discussion prompts, a presentation activity, and summary quiz about the reading. The students, given carte blanche to use their school-provided Chromebooks, "read" the story using an AI platform like Perplexity, which provides summary analysis and key takeaways for them to use in their discussion and respond to the quiz. Simultaneously, they use Microsoft's AI image generator to create a slide deck for the class to graphically represent their group's ideas. The teacher completes the assessment cycle by having their AI assistant grade the quizzes, provide feedback to the students, and input their scores into a learning management system.

In this scenario, the AI engages in activities of labor and consumption, while all of the parties involved advance nothing of lasting significance, and if debate or critical reflection arise amongst students it is an incidental, rather than planned, outcome of the AI-prescribed lesson. Indeed, the Brisk teaching assistant might be well programmed to incorporate into the lesson features of the RBT such as understanding, evaluating, and creating activities; but unless a human being in this process is attuned to helping learners act in the world and make it a place, using Arendt's (1963/2006) words, "fit for human habitation" (p. 233), the most common educational experience might become, ironically, ones in which humans are unnecessary. As will be discussed in the next section, educational activities guided toward higher-order Arendtian work and action would focus on the tangible outcomes produced through the activity and opportunities provided to learners to critically think, reflect, and influence with peers and the broader community.

Framework for Ethical AI Use in Education

The work of Anders, Foucault, Freire, Bloom, and Arendt serve as the philosophical foundation for understanding how AI ought to be used in education. To summarize, Figure 2 illustrates the various philosophical threads that are discussed above, highlighting the core ideas from each philosopher, and how they relate to both AI use in education and each other. It is important to note the relationship between RBT and Arendt specifically, given that Arendt's concept of action is used to supplement RBT as a way to understand motivation and purpose more fully in the context of AI.

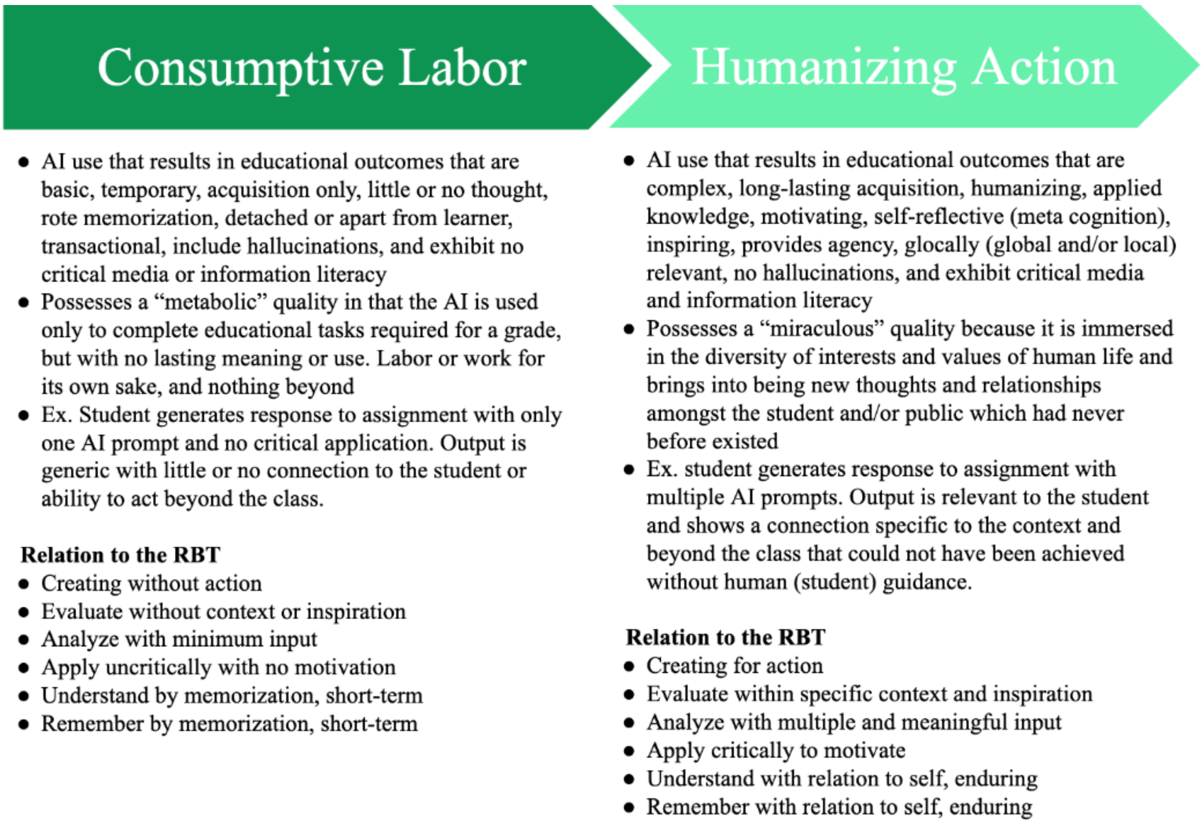
Figure 2
Philosophical Foundation for Ethical AI use in Education



Conceptualizing and imagining the philosophical underpinnings of AI use in education, however, is necessary but not sufficient for educators to confidently and proactively make decisions in the classroom. Recognizing that we easily feel compelled to adopt and use new technologies as they arise, Anders argues that we adopt a spirit of "shame," where we feel that we cannot stop our behaviors and practices "even if we can conceive of it" (Anders, 1936/2009, p. 152). The key for overcoming this shame, and the deterministic qualities of technology, according to Anders, is to use philosophical exaggeration and reflection to reveal the specific contingencies of our historical moment and contrast them with the particular indeterminacy of our individual selves, so we might begin to understand where we are capable of acting (p. 150). Stated another way, to find "the point of specific indetermination that the general determinability of man is possible" (p. 151). Coupled with Freire's concepts of humanization and conscientization, and Arendt's theory of action, and applied to educational practice, a goal for educators is to create public spaces for reflection, dialogue, and critical questioning; where responding to works of art, storytelling, politics, and science specifically designed to elicit a "shocking" space between the given technological immersion and the indeterminant experience of being a unique human, the learning community attempts to develop and interpret personal meaning and advocate for social purpose. Arendt reminds us that in such a public space, where authentic speech and deeds may have unforeseen outcomes, we develop important interpersonal capacities such as promise-making, forgiveness, and an appreciation for plurality.

Accordingly, the central finding of this philosophical analysis is to propose a framework for quickly and practically assessing AI use in educational settings. The framework, illustrated in Figure 3, is centered on student AI use and displays a spectrum from consumptive labor to

Figure 3
Framework for Ethical AI Use that Promotes Humanizing Action



humanizing action that draws from the work of Freire and Arendt specifically. The illustration is directional (from left to right), which exhibits how action-oriented and humanizing use of AI is ethically more appropriate in education than just using AI for labor and consumptive purposes alone. The purpose of this spectrum-based orientation is to allow educators to visualize where certain educational activities or AI-assisted student created content fits, from an ethical perspective. For example, if a student hands in an assignment that uses AI generated textual or multimodal content, it might fall towards the consumptive labor end of the spectrum if it clearly does not relate to that student's specific situation, has errors from potential hallucinations, or exhibits a generally uninspired position towards that activity. Conversely, student work on the humanizing action end will clearly show critical use of AI, relation to that student's perspective, or a demonstrated use for that student to act in the world.

It is important to note that brief examples of RBT are included in Figure 3 for each level of the RBT hierarchy. While early studies have shown that AI is perhaps more capable of performing tasks at the lower end of the RBT (i.e., understanding, applying), each type of these cognitive tasks are important to learning (Binh Nguyen Thanh et al., 2023; Lourenco et al., 2023). Moreover, the purpose of this framework and spectrum is to show how and where

AI can function ethically across the RBT. Indeed, AI may eventually enable students to complete tasks at all levels of the RBT. However, a student creating (the highest order of RBT) content with little thought or lasting impact on themselves or the world means less than if it pushes a student towards action. The framework and spectrum orientation in this case is specifically intended to serve as a guidepost or compass of sorts that educators can aim towards when assessing if a specific AI use case is appropriate and ethical. To clarify the use of this framework with RBT explicitly included, examples are provided below to illustrate both its intended use and function in educational settings.

Applications

While the framework for student use of AI is certainly a large part of the ethical equation, these actions do not happen in a vacuum. The learning objectives, design, activities, and assessments must also be considered in real-world teaching scenarios. Given the fact that AI in education is here to stay, our roles as educators must undergo a paradigm shift. This change necessitates a kaleidoscopic approach, one that adapts to the ever-shifting capabilities and structures of AI, especially in imagining that the primarily text-based functionality will soon (perhaps by the time of publication!) be multimodal. Here we provide a few imagined use examples of applying the framework to educational contexts allowing for the educator to be both adaptive and kaleidoscopic in reimagining their pedagogy. The examples below are provided to operationalize the framework of AI use that promotes humanizing action in imagined classroom contexts. We start with guiding questions, that can ideally serve as guideposts for educators to formulate curricula, unit, and lesson plans that use the capabilities of AI:

1. In what ways are our historical, technological, social contexts shaping how we think and act; what activity or experience can shock learners into appreciating their contingency?
2. Will the technologies we are going to use advance humanizing ends? In what ways can the technology enhance or harm the co-creation of knowledge?
3. How can we design learning activities that have benefits beyond their own sake; how are the learning activities helping students to act in the world?
4. In what ways can AI reduce the burdens of teaching and learning labor while increasing the capacity to act in the world?

In the following, we provide examples of activities educators across all modalities (i.e., online, blended, and in-person) might implement in order to effectively use the powerful AI “regimes of truth” by centering humanization and moving towards action-oriented pedagogies. A modified lesson plan format is used given its familiarity with educators generally and to help make the application clear for classroom use. Accordingly, each example begins with the overarching purpose, followed by a summary of the learning activity, learning objectives, ethical use cases for AI, and possible assessments. Actionable learning objective words are borrowed from the RBT throughout, and all activities are designed to be adapted for students aged 10 and above.

Community-Based Political Action

Purpose

Allow students to see themselves as civic actors and participants with agency in their local communities.

Summary

This activity will help students identify and evaluate local political activities, apply their understanding to their own lives, and create a plan to become involved in a meaningful and individualized way. Student learning is focused partially on knowledge acquisition but, more importantly, on civic engagement and community participation. In the classroom exercise, students engage in a metacognitive exercise through collaboration with AI to learn about their local political landscape. Educators have students identify local political issues within their communities and allow the use of AI to facilitate researching related and applicable political platforms and candidates and evaluate platforms and candidates from their own unique student perspective. In this example, skillfully and critically using AI allows students to more deeply understand their own social, economic, and political contexts. Leveraging AI, students undertake the task of identifying local political representatives (town council, board members, etc.) and evaluate their respective platforms centering their own life experience and agency. A multifaceted activity like this serves as a catalyst for the development of critical thinking skills, as students navigate the complexities of evaluating platforms, juxtaposing their evaluations of said platforms within their own educational experiences, and articulating personal assessments of their effectiveness.

By encouraging students to assess the efficacy of platforms, the assignment transcends the realm of automated tasks, labor, compelling students to engage in a wholly human endeavor—conducting a nuanced and uniquely individual logical sequence. The ultimate outcome of this practice is a manifestation of contextual critical thinking, where students craft their own evaluations grounded in personal opinions regarding the effectiveness of identified platforms, thereby fostering a deeper understanding of their own educational experiences and their place within the broader context of community-driven educational paradigms.

Students will be able to

1. Identify and understand local political issues.
2. Understands themselves as part of a larger collective by reading and understanding local political discourse issues.
3. Evaluate political candidates and platforms.
4. Articulate students' interpretation and preference of political platforms and candidates.
5. Create an individual plan of action to become politically involved.

Humanizing Action-Oriented AI Use

1. AI streamlines research activities and allows students to focus their mental faculties around evaluating representatives and identifying biases, all while positioning themselves within their respective contexts, rather than simply learning about them and recalling that information.
2. Students use AI to identify what political dialogue exists in their local community (i.e., community-based discussion forum)
3. Students choose a specific political issue/debate that exists in their local community.
4. Students use AI to understand what political candidates or policies are involved in said issue.

5. Students evaluate candidates and policies according to their own perspective as a student/community member who is directly involved.

Assessment

1. Students write a position paper on their issue of choice using their evaluations and personal perspective as resources. Students are permitted to use and cite AI for information gathering while their positions are wholly their own. Evaluations of platforms are assessed based on foundational understanding and articulation of argument.
2. Students discuss and debate positions of similar topics. Students engage with one another, modify and amend their positions through collaborative thought and consensus.

Socratic Dialogue for Individualized Research

Purpose

Help students conceptualize what is important to them, ask exploratory and critical questions about the topic, and apply their self-directed research toward a meaningful outcome.

Summary

A central component of being human is to understand what matters to oneself, direct these interests toward knowledge acquisition, and discover ways to act in a meaningful and impactful way. In this example, students are tasked with researching a topic of their choosing both to learn about it and apply this knowledge to their own context. To facilitate this endeavor, AI acts as an agent of Socratic dialogue and questioning for the student, helping students generate research idea topics that will be specifically catered towards student interests. AI will be equipped to ask students questions regarding their level of interests and commitment, suggest other topics of potential interest based on specific student response in addition to refine students' thinking regarding logical sequencing of topic selection and eventually argument. This personalized approach allows them to analyze how these topics manifest in their own lives and communities, gaining valuable insights.

Equipped with these findings, students use AI to curate a comprehensive list of research questions and potential projects. By actively creating engagement plans for community outreach related to their chosen research topics, students' learning therefore transcends the classroom and students themselves become proactive contributors. This distinctive approach positions students as researchers and educators. They can share their findings with community members, fostering dialogue and promoting knowledge exchange. By using AI as a research tool and not just an information aggregator, students emerge as catalysts for community-based action and learning. In this example, the humanity of activity rests in an action-oriented interaction with a mentor whereas the labor of developing a research topic can be facilitated by AI. Within the ecosystem of AI-student-mentor, AI serves not as a replacement but as an enabler, enhancing the efficacy of human interaction by streamlining the initial stages of research ideation. This symbiotic collaboration between students and AI epitomizes the thoughtful integration of technology into the learning process, nurturing a pedagogical environment where exploration and experimentation harmonize with the guidance and expertise provided by human mentors; thus, promoting more human ends and metacognition.

This multifaceted process exemplifies action-oriented, community-driven research, where students actively shape their learning journey while contributing to their communities.

Students will be able to

1. Identify a topic of interest to them.
2. Engage in dialogue discussing their own interests.
3. Develop a research topic and questions.
4. Conduct research to address questions.
5. Synthesize information and communicate their findings.
6. Create a community outreach plan based on findings.

Humanizing Action-Oriented AI Use

1. Student uses AI as a Socratic questioner to help students identify a research topic of interest.
2. Student identifies a specific research topic idea and uses AI to help guide research process.
3. Student uses AI to generate community outreach ideas regarding said research.

Assessment

1. Student presents research findings to the class.
2. Student engages in community-based outreach based on research findings.

Conclusion

Pandora's box is open and AI will forever be a part of our society and education systems. Educators must adapt strategies that continuously address and reconsider the Promethean discrepancy surrounding how AI is used, and toward what ends. In this critical analysis, we contend that the philosophical traditions on technology, education, and society can help guide how AI is used, similar to other technologies of the past. Anders and Foucault bring awareness of the relationships between technology and power, while Freire and Arendt ground education as a humanizing force that must build towards action. Taken together, we argue that a framework for ethical AI use in education across all online, blended, and in-person modalities, must not just a means to complete the temporary and metabolic purposes of previous educative goals, but rather a new way to help students and teachers alike realize their full humanity and agency to act in relevant and meaningful ways in the world.

While this framework is designed around student use of AI, we argue that teachers and instructional designers must also use similar guideposts for using AI to create and implement teaching activities. That is, AI use in education demands not just a rethinking of what is appropriate given our current educative goals, but also a reimagining and redesigning of our pedagogy more generally. To this end, we provide imagined use examples, and argue that the framework itself is useful to be applied across varied educational contexts. Educators will need continuous creativity to reframe and rethink teaching, learning, and assessment as AI continues to develop. As is often the case with any ethical debates, the real tests will come in the gray areas of AI use, and we call for future research to be conducted in these spaces. While the functionality of AI might be outdated by the time this is published, we argue these ethical guideposts will not. Humanizing education that helps foster agency in the world is a timeless goal—it grounds humanity in an ever-changing world.

Conflict of Interests Statement

The authors declare that they have no competing interests.

References

An, T., & Oliver, M. (2021). What in the world is educational technology? Rethinking the field from the perspective of the philosophy of technology. *Learning, Media and Technology*, *46*(1), 6–19.

Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K–12 settings. *AI and Ethics*, *2*(3), 431–440. https://doi.org/10.1007/s43681-021-00096-7

Anders, G. (1956/2002*). Die Antiquiertheit des Menschen: Über die Seele im Zeitalter der zweiten industriellen Revolution*. C.H. Beck.

Anders, G. (1962). Theses for the Atomic Age. *The Massachusetts Review*, *3*(3), 493–505. http://www.jstor.org/stable/25086864

Anders, G. (2015). *The obsolescence of man, volume II: On the destruction of life in the epoch of the third industrial revolution.* (Recluse, A., Trans.) Libcom.org. (Original work published 1980). Accessed October 30, 2023, at: https://libcom.org/book/export/html/51647

Anders, G. (2009). The pathology of freedom. (Wolfe, K., Trans). In Bischof, G., Dawsey, J., & Fetz, B. (Eds.) (2014). *The life and work of Günther Anders: émigré, iconoclast, philosopher, man of letters*. Studien Verlag, Austria. (Original work published in 1936).

Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Longman.

Arendt, H. (1958/2013). *The human condition* (2nd ed.) University of Chicago Press.

Arendt, H. (1963/2006). *Eichmann in Jerusalem*. Penguin Publishing Group.

Armstrong, P. (2010). *Bloom's Taxonomy.* Vanderbilt University Center for Teaching. https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Baidoo-Anu, D., & Ansah, L. O. (2023). Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. *Journal of AI*, *7*(1), 52–62.

Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain*. Longmans.

Boyd, D. (2016). What would Paulo Freire think of Blackboard. *International Journal of Critical Pedagogy*, *7*(1), 22.

Bozkurt, A. (2024). GenAI et al.: Cocreation, authorship, ownership, academic ethics and integrity in a time of generative AI. *Open Praxis*, *16*(1), 1–10. https://doi.org/10.55982/openpraxis.16.1.654

Catalani, F. (2020). Anticipation as critique: Objective phantasy from Ernst Bloch to Günther Anders. *Praktyka teoretyczna*, *35*, 149–166.

Celik, I., Dindar, M., Muukkonen, H., & Järvelä, S. (2022). The promises and challenges of artificial intelligence for teachers: A systematic review of research. *TechTrends, 66*(4), 616-630.

Crawford, J., Cowling, M., & Allen, K. A. (2023). Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI). *Journal of University Teaching & Learning Practice*, *20*(3), 02.

Crompton, H., Burke, D., & Lin, Y.-C. (2019). Mobile learning and student cognition: A systematic review of PK-12 research using Bloom's Taxonomy. *British Journal of Educational Technology*, *50*(2), 684–701. https://doi.org/10.1111/bjet.12674

Damaševičius, R. (2023). The rise of ChatGPT and the demise of Bloom's Taxonomy of Learning Stages. In *Creative AI Tools and Ethical Implications in Teaching and Learning* (pp. 115–134). IGI Global. https://doi.org/10.4018/979-8-3693-0205-7.ch006

Dawsey, J. (2013). *The limits of the human in the age of technological revolution: Günther Anders, post-Marxism, and the emergence of technology critique*. (Publication No. 3568370) [Doctoral dissertation, University of Chicago]. ProQuest Dissertations & Theses Global. https://www.proquest.com/openview/97326c30c7b44c5e6e7684e17262cbe2/1?pq-origsite=gscholar&cbl=18750

Dobson, J. E. (2023). On reading and interpreting black box deep neural networks. *International Journal of Digital Humanities*, *5*(2), 431–449.

Elsayed, S. (2023). *Towards mitigating ChatGPT's negative impact on education: Optimizing question design through Bloom's Taxonomy* (arXiv:2304.08176). arXiv. http://arxiv.org/abs/2304.08176

Farag, A., Greeley, L., & Swindell, A. (2021). Freire 2.0: Pedagogy of the digitally oppressed. *Educational Philosophy and Theory*, 1–14. https://doi.org/10.1080/00131857.2021.2010541

Farrelly, T., & Baker, N. (2023). Generative Artificial Intelligence: Implications and considerations for higher education practice. *Education Sciences*, *13*(11), 1109. https://doi.org/10.3390/educsci13111109

Freire, P. (1965). *Education for critical consciousness*. Bloomsbury Academic.

Freire, P. (1968). *Pedagogy of the Oppressed: 30th Anniversary Edition*. Bloomsbury Publishing USA.

Freire, P. (1997). *Politics and education*. UCLA Latin American Center.

Freire, P. (2005). *Education for critical consciousness*. Continuum.

Fuchs, C. (2017). Günther Anders' undiscovered critical theory of technology in the age of big data capitalism. *tripleC: Communication, Capitalism & Critique. Open Access Journal for a Global Sustainable Information Society*, *15*(2), 582–611.

Giantini, G. (2023). The sophistry of the neutral tool: Weaponizing artificial intelligence and big data into threats toward social exclusion. *AI and Ethics*, *3*(4), 1049–1061. https://doi.org/10.1007/s43681-023-00311-7

Jin, S.-H., Im, K., Yoo, M., Roll, I., & Seo, K. (2023). Supporting students' self-regulated learning in online learning using artificial intelligence applications. *International Journal of Educational Technology in Higher Education*, *20*(1), 1–21. https://doi.org/10.1186/s41239-023-00406-5

Kahn, R., & Kellner, D. (2004). New media and internet activism: From the "Battle of Seattle" to blogging. *New Media & Society*, *6*(1), 87–95. https://doi.org/10.1177/1461444804039908

Laricchia, F. (2023) *Smartphone penetration worldwide as share of global population 2016–2022*. Statista. Retrieved January, 6 2024, from https://www-statista-com.proxy.libraries.rutgers.edu/statistics/203734/global-smartphone-penetration-per-capita-since-2005/

Lin, Jingjing, ChatGPT and Moodle Walk into a Bar: A Demonstration of AI's Mind-blowing Impact on E-Learning (March 20, 2023). Available at SSRN: https://ssrn.com/abstract=4393445 or http://dx.doi.org/10.2139/ssrn.4393445

Loftus, M., & Madden, M. G. (2020). A pedagogy of data and artificial intelligence for student subjectification. *Teaching in Higher Education*, *25*(4), 456–475. https://doi.org/10.1080/13562517.2020.1748593

Lourenco, A. P., Slanetz, P. J., & Baird, G. L. (2023). Rise of ChatGPT: It may be time to reassess how we teach and test radiology residents. *Radiology*, *307*(5), e231053. https://doi.org/10.1148/radiol.231053

Lorenzini, D. (2015). What is a "Regime of Truth"? *Le foucaldien*. *1*(1). doi:10.16995/lefou.2

Markauskaite, L., Marrone, R., Poquet, O., Knight, S., Martinez-Maldonado, R., Howard, S., ... & Siemens, G. (2022). Rethinking the entwinement between artificial intelligence and human learning: What capabilities do learners need for a world with AI? *Computers and Education: Artificial Intelligence*, *3*, 100056.

Marr, B. (2024, February 13). AI Showdown: ChatGPT vs. Google's Gemini—Which reigns

supreme? *Forbes*. https://www.forbes.com/sites/bernardmarr/2024/02/13/ai-showdown-chatgpt-vs-googles-gemini-which-reigns-supreme/?sh=518ed7746072

Masapanta-Carrión, S., & Velázquez-Iturbide, J. Á. (2018). A systematic review of the use of Bloom's Taxonomy in computer science education. *Proceedings of the 49th ACM Technical Symposium on Computer Science Education*, 441–446. https://doi.org/10.1145/3159450.3159491

McIntosh, T. R., Liu, T., Susnjak, T., Watters, P., Ng, A., & Halgamuge, M. N. (2023). A culturally sensitive test to evaluate nuanced GPT hallucination. *IEEE Transactions on Artificial Intelligence*, 1–13. https://doi.org/10.1109/TAI.2023.3332837

Megahed, F. M., Chen, Y.-J., Ferris, J. A., Knoth, S., & Jones-Farmer, L. A. (2023). How generative AI models such as ChatGPT can be (mis)used in SPC practice, education, and research? An exploratory study. Quality Engineering, *36*(2), 1–29. https://doi.org/10.1080/08982112.2023.2206479

Müller, C. J. (2016). *Prometheanism: Technology, digital culture and human obsolescence*. Rowman & Littlefield.

Müller, C. J. (2019). From radioactivity to data mining: Günther Anders in the Anthropocene. *Thesis Eleven*, *153*(1), 9–23.

Nguyen, A., Ngo, H. N., Hong, Y., Dang, B., & Nguyen, B.-P. T. (2023). Ethical principles for artificial intelligence in education. *Education and Information Technologies, 28*(4), 4221–4241. https://doi.org/10.1007/s10639-022-11316-w

Ofgang, E. (2023, December 20). Gemini: Teaching with Google's latest AI. *TechLearningMagazine*. https://www.techlearning.com/news/gemini-teaching-with-googles-latest-ai

Schraube, E. (2005). "Torturing things until they confess": Günther Anders' critique of technology. *Science as Culture*, *14*(1), 77–85.

Şenocak, D., Bozkurt, A., & Koçdar, S. (2024). Exploring the ethical principles for the implementation of artificial intelligence in education: Towards a future agenda. In R. Sharma & A. Bozkurt (Eds.), *Transforming education with generative AI: Prompt engineering and synthetic content creation* (pp. 200–213). IGI Global. https://doi.org/10.4018/979-8-3693-1351-0.ch010

Stapleton, L., Taylor, J., Fox, S., Wu, T., & Zhu, H. (2023). *Seeing seeds beyond weeds: Green teaming generative AI for beneficial uses* (arXiv:2306.03097). arXiv. http://arxiv.org/abs/2306.03097

Swartz, M., & McElroy, K. (2023). The "Academicon": AI and surveillance in higher education. *Surveillance & Society, 21*(3), 276–281. https://doi.org/10.24908/ss.v21i3.16105

Thanh, B. N., Vo, D. T. H., Nhat, M. N., Pham, T. T. T., Trung, H. T., & Xuan, S. H. (2023). Race with the machines: Assessing the capability of generative AI in solving authentic assessments. *Australasian Journal of Educational Technology*, *39*(5), 59–81. https://doi.org/10.14742/ajet.8902

Rahm, L. (2023). Education, automation and AI: A genealogy of alternative futures. *Learning, Media and Technology*, *48*(1), 6–24.

Rountree, B., & Condee, W. (2021). The nonmaterial mirror: Performing vibrant abstractions in AI networks. *Theatre Journal*, *73*(3), 299–318.

Wong, M. (2023, June 23). The chatbots may poison themselves. *The Atlantic*. https://www.theatlantic.com/technology/archive/2023/06/generative-ai-future-training-models/674478/

AI Literacy Across Curriculum Design: Investigating College Instructors' Perspectives

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Abstract
Artificial Intelligence (AI) is increasingly prevalent, permeating various aspects of and spreading across education. However, a comprehensive understanding of AI applications and how to define AI literacy is under-investigated. On this note, teaching and evaluating AI literacy necessitates educators to integrate it into course content. The implementation and use of AI are reshaping college students' learning experiences. Limited efforts have been made to promote AI literacy for individuals at academic institutions. This study aims to investigate college instructors' perspectives on AI integration in curriculum design at a higher education institution, Palestine Technical University Kadoorie (PTUK). A mixed study approach is used with a pre-existing questionnaire containing 14 items in this study and 17 semi-structured interviews. The data were collected from nine different departments at PTUK. The target population consisted of 176 college instructors. The results revealed that college instructors perceive AI literacy as a weak element in the curriculum. Two themes merged from qualitative data: accomplishing educational goals, and lack of AI guidelines and concepts. Recommendations include the necessity to incorporate AI literacy curriculum design in higher education contexts in different disciplines.

Keywords: artificial intelligence, curriculum content, AI literacy, higher education, curriculum design

Salhab, R. (2024). AI literacy across curriculum design: Investigating college instructors' perspectives. *Online Learning, Vol 28*(2), (29-49). DOI: 10.24059/olj.v28i2.4426

Artificial intelligence (AI) is a technology designed to emulate human intelligence in performing cognitive tasks, such as learning and problem-solving, through the application of rules and environmental cues (Wang, 2019). As AI revolutionizes our methods of communication, work, and coexistence with both humans and machines, possessing AI literacy becomes increasingly vital for future endeavors (Long & Magerko, 2020). Educational frameworks for AI literacy have been crafted for primary, secondary, and higher education levels to enhance understanding in this field (Kong et al., 2023; Su & Yang, 2022).

Since higher education plays a crucial role in reshaping societies, the structure and arrangement of higher education curricula can be seen as the framework that guides societal progress (Leal Filho et al., 2018). As the world evolves due to technological and communicative advancements, societal characteristics and functions will inevitably transform.

This is a natural progression that occurs over time. In response to evolving individuals and societies, it becomes imperative to consider reforming higher education curricula to meet contemporary demands to equip pre-service teachers in higher education institutions (Varghese & Mustafa, 2022).

However, it is crucial to recognize that merely incorporating AI literacy into the curriculum will not suffice. Instead, a cultural shift towards digital and technological proficiency among students is necessary. College students need to be well-equipped with AI literacy skills and fostered through their development of technological intelligence. A well-rounded curriculum should encompass fundamental elements that promote a harmonious integration of these two aspects: AI literacy skills and technological intelligence (Varghese & Mustafa, 2022). To tackle this issue, this study seeks to bridge this knowledge gap and contribute to the advancement of social equity and sustainable development objectives by enhancing AI curricula tailored for higher education. This study focuses on AI literacy as it is part of the curriculum, where it is recognized as a vital competency for twenty-first-century individuals.

The novelty of this study lies in investigating AI literacy across the curriculum, which was an under-researched topic. To date, the integration of AI into educational curricula has primarily been limited to specific subjects, such as data science, computer science, and engineering (Cantú-Ortiz et al., 2020). This study investigates the integration of AI literacy in other subjects in higher education settings since there is a growing recognition of the necessity for a more comprehensive AI education across the entire campus (Ng et al., 2021). Moreover, factors like gender, technical skills, and academic rank that might influence the perspectives of college instructors on AI literacy integration across the curriculum were never investigated previously.

This study is significant since integrating AI literacy into college classrooms effectively forces educators to occupy a crucial role in determining which learning components (such as curriculum, instruction, and assessment) influence teaching effectively. This study is unique in this aspect. Moreover, rarely have studies explored demographic influence on the perspectives of college instructors, which affects AI literacy in curriculum infusion to some extent. Nonetheless, educators might lack familiarity with emerging technologies. Therefore, it is essential to explore the perspectives to assist educators in creating suitable learning activities that align with teaching objectives and learning outcomes. Consequently, this study will offer universities, and professional organizations, the opportunity to provide guidelines and standards for the development of AI literacy in curriculum integration materials and tools.

Additionally, this study will contribute to the limited literature in this area, showing college teachers and policymakers the importance of AI literacy infusion across the curriculum.

Problem Statement

Curricula need to be formulated to fit this digital era, as shifts in society and technology persist in shaping our lifestyles and professions. The curriculum must evolve to guarantee that students possess the digital competencies needed in the AI era. The incorporation of skills related to AI literacy into the curriculum framework holds significant importance since it should reflect the current requisites of society and the job market, it is a fundamental necessity for success across diverse occupations and daily affairs, and it fosters the capacity for innovative thinking among students, enabling them to devise creative solutions for intricate issues.

At PTUK as a technical university with diverse disciplines like: Engineering, Information Technology, Applied Science, Arts and Social Sciences, Agriculture Sciences and Technology, Business and Economics, and Physical Education and Sport Sciences, integration of AI literacy skills within the curriculum is crucial to equip and empower students with effective AI usage, ethical use, and responsibly utilization of AI. As a result, students should gain knowledge about AI. There still an ongoing debate regarding its precise integration into education at PTUK. Some propose the concept of AI literacy as a means to delineate the skills students need to develop to navigate a future imbued with AI in both their daily lives and careers.

Literature Review

AI Literacy in Higher Education

In higher education AI literacy is a fundamental pillar that encompasses the proficiencies and knowledge necessary to effectively carry out practical tasks expected of both instructors and students within an educational context while using AI (Su and Yang, 2024). AI literacy refers to the capacity to comprehend, apply, assess, and responsibly maneuver through AI technologies (Long & Megerko, 2020; Laupichler et al., 2022). There are four primary dimensions to AI literacy. Firstly, comprehension entails grasping the fundamental concepts of AI, encompassing its workings, machine learning algorithms, training data, and recognizing potential limitations and biases within AI systems. Secondly, utilization involves employing AI tools and platforms proficiently to tackle problems and achieve objectives, potentially necessitating coding skills and proficiency in handling extensive datasets. Thirdly, assessment and creation entail appraising the reliability and quality of AI systems, along with the capability to devise and construct ethically sound AI systems, requiring both technical expertise and an awareness of the societal and ethical ramifications of AI. Fourthly, AI ethics involves comprehending the ethical and moral considerations associated with AI and making well-informed decisions regarding its utilization across different contexts, encompassing aspects like fairness, transparency, accountability, and the broader societal impacts of AI.

Fostering related competencies and skill sets, such as programming and statistics, will enable AI to encompass academics courses. Even though AI literacy has advantages for students, studies, such as Stople & Hallstrom (2024), examining AI's implementation in education have highlighted numerous challenges for future educational endeavors. One such challenge is the significant risk of students encountering misinformation because of the variable quality of online data. Also, Bozkurt & Sharma (2023) reported several challenges while using generative AI, including potential algorithmic bias, the necessity for dependable knowledge sources and quality control, issues of inequality and inequity in access, limitations in fostering creativity and critical thinking, the potential for teacher displacement, concerns regarding privacy and ethics, complexities in technical implementation, and an increased reliance on technology. AI literacy necessitates a blend of technical acumen and an understanding of the ethical and social implications of AI (Yi, 2021).

Reviewing current AI literacy in curriculum infusion, it is evident that there is a demand for broadening the scope of AI literacy in the curriculum beyond specific subjects like computer science and engineering (Cantú-Ortiz et al., 2020). Few studies were found that explore the perspectives of college instructors towards AI literacy across the curriculum. For example, the perspectives of instructors were examined regarding AI and reported negative results, such as thinking that relying too much on AI systems might minimize the student's ability to learn independently, solve problems creatively, and think critically (Seo et al., 2021). It is important to examine how students' and instructors' perceptions about AI integration in the curriculum was investigated by researchers. For example, Picciano (2019) reported the necessity of AI applications for instructors to assess the progress of both individual students and the entire class. Additionally, they received recommendations for enhancing instructional methods, including insights into AI and its impact on the educational landscape. Moreover, Bozkurt et al. (2023) noted that AI now has the potential to assume a broader range of educational responsibilities that were previously exclusive to human educators. Additionally, Schroeder et al. (2022) conducted a study with two professors from the University of Central Florida who employed AI-generated course materials as the main educational tool for their students. They personalized the selection and refinement of these materials to suit the specific context of each course. They identified qualitative changes in the impact on student engagement, preparedness, satisfaction, and exam performance.

AI Literacy Across the Curriculum

AI has become pervasive in society, serving as a widely adopted concept and tool that significantly influences everyday life. Therefore, ensuring that students possess a fundamental understanding and familiarity with AI is essential for nurturing competent global citizens.

The ongoing development of AI across the curriculum in higher education institutions aims to establish AI education as a pivotal component accessible to all students. It is an overarching objective to cultivate a workforce equipped with the necessary twenty-first-century skills, as recognized by the global workforce and governmental requirements. Adequately skilled human resources are imperative for addressing the complexities of the modern era (Southworth et al., 2023). Few studies suggested an AI literacy framework for curriculum integration like Wong et al. (2020), who presented a comprehensive AI literacy framework with three dimensions: understanding AI concepts (such as machine learning, deep learning, and neural networks), recognizing AI applications (like speech recognition, robotics, and smart assistants), and addressing AI ethics. Based on a systematic review that Ng et al. (2021) conducted, these AI education initiatives can bolster students' AI literacy across four key areas: (1) understanding AI fundamentals and applications, (2) applying AI in various contexts, (3) assessing and creating AI solutions, and (4) considering ethical implications of

AI. Despite the potential benefits of AI, it's essential to acknowledge its adverse effects on students. For instance, exposure to biased AI algorithms can result in students internalizing and perpetuating biases (Melsión et al., 2021). Additionally, AI literacy raises ethical concerns, such as privacy and security issues, which may be challenging for students to comprehend and navigate (Ali et al., 2019). When designing an AI literacy curriculum, it is crucial to consider these potential negative impacts on students.

Li (2021) addressed the absence of clear definitions for AI literacy. Hence, this study explores college instructors’ perspectives on the AI literacy infusion in curriculum content, materials, and teaching strategies to nurture students’ skills. Also, this study investigates the influence of gender, technical skills, and academic ranks on college instructors' perspectives toward AI literacy integration into the curriculum, which was not investigated previously. Southworth et al. (2024) investigated possible paths to address potential gaps in AI literacy across the curriculum at a traditional research university, the University of Florida. Their results revealed that infusing AI across the curriculum will make AI education a cornerstone opportunity for all students and will create an AI-ready workforce who possess essential twenty-first-century competencies.

Moreover, Bozkurt (2023) argues that generative AI presents a range of opportunities, such as enabling personalized learning, fostering inclusive curriculum, facilitating collaboration in educational settings, automating assessment tasks, enhancing accessibility, streamlining efficiency in time and effort, honing language skills, and ensuring round-the-clock availability of such technologies. Wolf and Wolf (2022) conducted a quasi-experiment to investigate the automated essay-scoring systems employing AI to assess writing skills for nursing students. It found that AI offers new opportunities for efficient, reliable, and valid assessments of writing skills. On the other hand, Laupichler et al. (2022) highlighted in their review that the exploration of AI literacy is in its infancy, resulting in a scarcity of literature on this subject.

After reviewing the literature, it seems that incorporating AI literacy into the curriculum can transform the dynamics of teaching and learning. Despite recent discussions on different facets of AI in education, educators often do not integrate AI skills effectively into their classrooms. The willingness of teachers to embrace AI literacy is shaped by their perspectives and other relevant factors. Thus, it is imperative to explore their perspectives and some demographic factors to leverage the potential of AI literacy integration effectively.

Navigating the literature related to AI literacy across the curriculum shows that there is a scarce amount of research addressing AI literacy in the context of curriculum development (Su and Yang, 2024). The literature review revealed a need for more studies measuring AI literacy inclusion in the curriculum and the factors that might influence these perspectives. There is a need to explore curriculum content in terms of AI competencies, and to define the current needs and establish a clear road map to enhance AI competencies in curriculum content. This study will seek to answer the following questions:

Research Questions

1. What are college instructors' perspectives towards AI literacy's infusion into curriculum content?
2. What is the influence of gender, technical skills, and academic ranks on the perspectives of college instructors toward AI literacy across the curriculum?

Methodology

To answer the study's questions, a mixed approach was used. For the quantitative part, a questionnaire was designed to target the college instructors' perspectives in different disciplines and the influence of gender, technical skills, and academic ranks on college instructors' perspectives. For the qualitative part, semi-structured interviews were conducted with participants to answer the first question, which is related to college instructors' perspectives towards AI literacy inclusion. Research designs of phenomenology and descriptive research were considered and adopted as they align well with the study objectives. The rationale for adopting a mixed-method design lies in the recognition that relying solely on either quantitative or qualitative approaches fails to comprehensively address the research issue. Morse (2016) advocates for the integration of qualitative data to validate quantitative findings, justifying this methodological choice.

Research Design

To investigate the perspectives of college instructors on AI literacy across the curriculum, a mixed-method explanatory sequential design was used. Mixed-method design employs different types of inquiry to gain a better understanding of a phenomenon by combining more than one data collection tool (Creswell & Clark, 2017). The sequential approach is used, with the quantitative phase being followed by the qualitative phase (Creswell, 2013); thus, the qualitative findings are used to contextualize the quantitative data to assess perspectives. A descriptive approach with initial quantitative steps was used in this study, with a questionnaire for college instructors. Because the researcher wants to describe the AI across curriculum experience, a phenomenological approach was used for the qualitative step.

Research Context and Participants

This study included 176 instructors from different colleges at PTUK a publicly funded university in Palestine, as participants. This university is one of eight institutions offering undergraduate and postgraduate programs across a wide range of disciplines, taught in English and Arabic languages. The participants had master's or doctoral degrees. They had some experience with AI tools in their personal lives and had previously integrated AI into their classes. PTUK is a technical-based university that focuses on technical programs. Faculty at PTUK use AI for research capacity and to prepare thousands of students annually to enter society equipped for success.

Study's Instrument

A questionnaire was adapted from a pre-existing scale for data collection in this study (Ng et al., 2023). The questionnaire consisted of 14 items. The responses, using a 5-point Likert scale, are provided. There are four dimensions of the scale: know and understand, use and apply, evaluate and create, and AI ethics. Information was gathered from faculty who were enrolled in different programs at PTUK. Ethical clearance was sought from the ethics committee at PTUK before data collection. Questionnaire responses were collected via Google Forms. Respondents' demographic characteristics are presented in Table 1.

Table 1

Respondents' Demographic Characteristics

Variable	Category	Frequencies	Percentage
	6–10	38	21.5%
Years of experience	More than 10	38	21.5%
	Less than 10	100	57%
	Engineering	14	7.6%
	Applied Sciences	25	14.2%
	Business and Economics	21	11.9%
	Agricultural Science and Technology	18	10.2%
	Arts and Educational Sciences	90	51.1%
College/Faculty	Physical Education and Sport Sciences	8	5%
	Male	120	68.2%
Gender	Female	56	31.8%
	Prefer not to mention	3	1%
	Professor	8	4.5%
Academic Rank	Associate professor	28	15.9%
	Assistant professor	84	47.7%
	Lecturer	56	31.8%
Digital literacy	Excellent	46	26.1%
	Very good	102	58%
	Good	28	15.9%
Overall		**176**	**100%**

Table 1 presents the sample demographic. Digital literacy is defined as the ability to locate, assess, employ, disseminate, and generate content using information technologies and the internet. It was classified into three levels: excellent, very good, and good.

Validity and Reliability of the Study Tool

The scale was validated by assessing face validity and construct validity by administering the pre-existing scale to professors from various universities with specialties in educational psychology, educational technology, and information technology. To assess the construct validity of a scale, a principal component analysis with the Varimax rotation test was conducted (Wang et al., 2022). The exploratory factor analysis test was used to assess how well the 14 measured AI literacy items of this scale represented the number of constructs, with a pilot study consisting of 60 college instructors. The Kaiser Meyer-Olkin measure of sample adequacy was 0.908, which was higher than the usually advised value of 0.6, and Bartlett's test of sphericity was significant (χ^2 = 1015.55, p = 0 .000), showing very strong validity of research data (Cheng & Shao, 2022).

Table 2

Principal Component Analysis

Items	**Component**			
	1	**2**	**3**	**4**
1. Part of the curriculum gives limited space for AI.	.860	.350	.275	.125
2. Part of the assessment process uses AI tools.	.782	.350	.298	.145
3. The curriculum emphasizes AI application usage (e.g., Siri, chatbot).	.762	.417	.276	.135
4. The curriculum explains the limitations and biases that can be present in AI systems.	.625	.159	.312	.248
5. The curriculum covers AI-related knowledge concepts.	.141	.802	.251	.414
6. The curriculum helps students to apply AI applications in their learning process.	.441	.765	.215	.310
7. The curriculum develops AI employability skills needed for educators.	.304	.709	.231	.365
8. The curriculum supports evaluating AI applications and concepts for different situations.	.196	.380	.814	.130
9. The curriculum is enriched AI-driven solutions (e.g., chatbots, robotics) to solve problems.	.484	.329	.691	.231

10. The curriculum emphasizes AI application integration.	.380	.174	.827	.421
11. Part of the assessment process uses AI tools.	.548	.391	.633	.122
12. The curriculum emphasizes AI ethics.	.094	.487	.256	.786
13. AI systems should benefit everyone, regardless of physical abilities and gender.	.141	.588	.567	.671
14. The curriculum explains how misuse of AI could result in substantial risk to humans.	.417	.263	.622	.762

To ascertain the reliability of the scale, Cronbach's alpha was computed for each of the four dimensions of the scale, as shown in Table 3. The calculation of reliability for AI literacy perceptions involves assessing internal consistency. Specifically, Cronbach's alpha value for the total scores of perspectives was .723. These findings indicate a high level of internal consistency for the overall scale, demonstrating strong reliability, as presented in Alnahdi (2020).

Table 3

Cronbach's Alpha Ability Values for the Questionnaire Items

Items	**Number of Items**	**Cronbach's alpha values**
Total	14	0.723

The interview participants were interviewed personally, and they were informed about the purpose and significance of the study, with an assurance that their input would be kept confidential and used solely for research purposes. The interview time ranges from 25 to 35 minutes. The interviews were conducted in a conducive environment with a respectful, grateful, and comfortable interaction between the researcher and participants. Participants were notified that their responses would be accurately recorded for thorough documentation and direct quotations.

Interview responses were transcribed objectively and without bias, with clarifications provided when participants faced difficulties understanding questions. After the interviews, participants were allowed to review and amend their responses. Table 4 presents the participant's characteristics for the semi-structured interviews.

Table 4

Semi-structured Interviews Participants' Characteristics

Instructor Department	**Gender**	**Years of Experience**	
Instructor1	Male	10	Chemistry
Instructor2	Female	7	Education
Instructor3	Female	23	Education
Instructor4	Female	11	Math
Instructor5	Male	5	Engineering
Instructor6	Female	9	English
Instructor7	Male	7	Math
Instructor8	Female	13	Education
Instructor9	Female	17	Engineering
Instructor10	Female	15	English
Instructor11	Male	6	Engineering
Instructor12	Female	3	Math
Instructor13	Female	7	Biology
Instructor14	Female	9	Physics
Instructor15	Male	8	Education
Instructor16	Male	11	Engineering
Instructor17	Female	10	Engineering

Data Analysis

To analyze the results of the first question ("What are instructors' perspectives towards AI literacy` infusion in the curriculum content?") both a questionnaire and a thematic analysis were conducted.

A qualitative approach was employed for thematic data analysis, aiming to identify themes that reveal trends and connections within the qualitative data and address the research questions, following the methodology outlined by Creswell & Clarke (2017). The analysis comprises multiple steps, starting with a thorough reading of transcribed interviews by the researcher to gain a deep understanding of the content. Thematic analysis is a method to identify and report patterns of meaning in qualitative data. This analysis method is a process for interpreting textual data and converting scattered data into rich and detailed data (Creswell and Clarke, 2017).

Trustworthiness of Qualitative Data

Four validation criteria were employed to ensure study reliability and validity. These included cross-referencing responses in semi-structured interviews with additional field experts in the coding process, achieving an 82% agreement rate, surpassing the acceptable threshold of 80%.

To ensure qualitative data credibility and dependability, four validation criteria were implemented. These included cross-referencing responses through semi-structured interviews with additional experts in the field, achieving an 82% agreement rate in coding, a percentage considered acceptable. The credibility of results was ensured through cross-checking codes and outcomes, verifying original data, and confirming the absence of discrepancies in the coding system. Triangulation, involving various research tools such as interviews and focus group discussions, was employed to enhance credibility.

Dependability was addressed through a code-recode strategy, where the same dataset was independently coded twice, with a two-week interval between coding instances. A comparison between the outcomes of these two coding rounds assessed their similarity or disparity.

For the second question, a questionnaire was used with SPSS 23. Mean and SD were calculated. One sample t-test was used to assess the perspectives toward AI literacy across the curriculum. Data was checked for normality and no significant outliers were found.

For the second question, a multiple regression analysis was conducted. Assumptions were checked, as there is a linear relationship between the dependent variable and independent variables and no significant outliers were presented**.**

Results

Perspectives Toward AI Literacy Across the Curriculum

To answer the first question, subscale means and one sample t-test are calculated as shown in Tables 4 and 5. Mean scores of perspectives were computed for each dimension. These resultant mean scores were compared to a scale formulated by Daher (2019). Per this scale, scores falling within the range of 0.8 to 1.8 were classified as "very weak," scores ranging from 1.8 to 2.6 were categorized as "weak attitudes," scores falling between 2.6 to 3.4 were considered "moderate attitudes," and scores between 3.4 to 4.2 were considered "strong attitudes" on this continuum. Finally, scores ranging from 4.2 to 5 were denoted as "very strong attitudes." A statistical evaluation, specifically a one-sample t-test, was conducted to compare the mean scores to the predetermined Daher's referenced scale as shown in Figure 1.

Figure 1

Interpretation Scale of Mean Scores (Daher, 2019, p. 5)

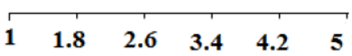

Table 5

Perspectives of College Instructors on AI Literacy in Curriculum Means and SD

Dimensions	Items	Mean	SD	Degree
Know and understand	Part of the curriculum gives limited space for AI.	3.750	.7892	Strong
	Part of the assessment process uses AI tools.	3.728	.7961	Strong
	The curriculum emphasizes AI application usage (e.g., Siri, chatbot).	3.727	.9162	Strong
	The curriculum explains the limitations and biases that can be present in AI systems.	3.943	.6821	Strong
Use and apply	The curriculum covers AI-related knowledge concepts.	4.18	.702	Very strong
	The curriculum helps students to apply AI applications in their learning process.	4.330	.7815	Very strong
	The curriculum develops AI employability skills needed for educators.	4.261	.7170	Very strong
Evaluate and create	The curriculum supports evaluating AI applications and concepts for different situations.	1.739	.8392	Very weak
	The curriculum is enriched AI-driven solutions (e.g., chatbots, robotics) to solve problems.	4.125	.6757	Medium
	The curriculum emphasizes AI application integration.	1.523	.7558	Medium
	Part of the assessment process uses AI tools.	4.489	1.3841	Medium
AI Ethics	The curriculum emphasizes AI ethics.	1.511	.7892	Very weak
	AI systems should benefit everyone, regardless of physical abilities and gender.	1.773	.7961	Very weak
	The curriculum explains how misuse of AI could result in substantial risk to humans.	1.807	.9162	Very weak
Total		**3.190**	**.197**	**Weak**

Table 5 indicates that the responses of the study sample towards AI literacy in the curriculum are weak, and dimensions, like know and understand, are strong. Use and apply was also very strong. AI ethics dimension was weak. One sample was conducted to find if there is a significant difference between this mean and the population mean.

Table 6

One Sample t-test of the Total Score of Perspectives

	Test Value = 2.60					
Category	T	Df	Sig.	MD	95% CID	
					Lower	Upper
Total	12.781	175	.000	.34729	.2937	.4009

Table 6 shows that total perspectives mean = 3.190. To find the statistically significant difference between the sample-estimated population mean and the comparison population mean (2.60), one sample t-test was conducted, and the results indicate that there are statistically significant differences at the level of significance (0.05) between the average score of 3.19 and a test value of 2.6, a weak value.

To assess the influence of gender, technical skills, and academic qualifications on the perspectives toward ai literacy, multiple linear regression was calculated as shown in Table 7.

Table 7

Linear Regression

Variable	**B**	**Beta**	**T**	**Sig.**	**R**	**R^2**	**F**
(Constant)	1.758		8.468	.000	.653	.427	42.703
Gender	.364	.472	7.358	.000			
Academic qualification	.092	.265	4.177	.000			
Technical skills	.246	.438	7.277	.000			

Linear regression analysis was used to test if gender, academic qualification, and technical skills influenced AI literacy perceptions. The results of the regression indicated the three predictors explained 42.7% of the variation in college instructors' AI literacy perceptions [F(3,172) = 42.703, p = .000]. These results were significant at the $p < .001$ level.

The results state that gender differences (more specifically, female college instructors) tend to have higher perceptions of AI literacy in curriculum development. The regression coefficient is positive (.364) and the relationship is statistically significant ($p < .001$). The regression coefficient is also positive for college qualification (.092), indicating that the higher academic degree influences the perceptions of AI literacy in curriculum development;

the relationship is statistically significant ($p < .001$). The regression coefficient is positive (.264), indicating strong technical skills influence college instructor perceptions towards AI literacy in curriculum content. The relationship is statistically significant ($p < .001$).

Semi-structured interviews were conducted after the questionnaire to gather data on the perspectives regarding the infusion of AI literacy in the curriculum. College instructors were asked to appraise the positive and adverse perspectives of the curriculum that relate to AI literacy.

By conducting content analysis, the collected qualitative data underwent assessment using the seven stages outlined in Kuckartz (2012) The initial phase of the process involves analyzing, organizing, and summarizing the text. Subsequently, the principal categories are identified and the initial coding phase begins for these categories. If necessary, subcategories can be established, leading to the implementation of the second coding phase. After this, diverse analyses can be carried out, culminating in the final step that involves documenting the procedure and outcomes. Importantly, the spiral process can be restarted as needed.

The initial step in the evaluation process was transcribing the text. Modifications were made to existing dialects for enhanced compatibility. The second stage encompassed rephrasing the text and pinpointing crucial details. The statements were then organized based on various categories, even though a single statement might relate to multiple subjects. Three primary themes were categorized, as Table 8 illustrates, based on the results from the transcription.

Table 8

Theme	**Code**	**f (%)**
Accomplishing *educational goals*	AI literacy skills are crucial to achieving educational goals.	8 (47)
	AI literacy is needed to search for and evaluate information.	4 (23)
	AI literacy enhances the curriculum.	5 (30)
Lack of AI ethical guidelines and concepts	Concerns about AI literacy ethics guidelines in the curriculum.	10 (58.8)
	AI literacy concepts are not covered in the curriculum.	7 (41.2)

Themes and Codes

Based on the thematic analysis of the data, two themes were found: accomplishing educational goals and lack of AI ethical guidelines and concepts.

(1) Accomplishing educational goals

Most participants showed positive perspectives toward implementing AI literacy across the curriculum. Three subthemes emerged.

AI literacy skills are crucial to achieving educational goals**.** Most of the participants mentioned that AI literacy in curriculum design is necessary for students to know. A participant commented "AI literacy across courses is necessary for Z-generation students since it facilitates their learning process."

AI literacy is needed to search for and evaluate information**.** Many college instructors explained the importance of AI literacy infusion in the designed curriculum. Instructor 7 said "It was very easy for me to enhance my research productivity with AI literacy. Infusion of AI literacy across the curriculum is vital for students to communicate and search for information, they are useful to be integrated in the course."

A participant supported the previous instructor: "I used to let my students use their mobile phones to search and evaluate information, I provide my students with links to AI applications to access text tutorials."

AI literacy enhances the curriculum. Many participants encouraged integrating AI literacy across their curriculum. Instructor 13 added, "Yes, AI literacy across the curriculum is crucial as it offers all undergraduate students the chance to explore and understand AI, not only within their specific field of study but also in a cross-disciplinary context that mirrors real-world work environments."

(2) Lack of AI ethical guidelines and concepts

Most college instructors showed negative perspectives toward AI literacy ethics guidelines in the curriculum. A college instructor said "The curriculum that I teach is traditional and needed a reform in terms of AI literacy." Another instructor added "It is imperative to augment curriculum with AI literacy at the college level, students are still dependent on the lecturer."

Overall, most of the college instructors are unsatisfied with the curriculum they teach in terms of AI literacy. On the other hand, they are generally welcoming to AI literacy integration. Despite these negative responses, college instructors highlighted some positive perspectives on AI literacy integration into their curriculum.

Discussion

To answer the first question of the study, "What are college instructors' perspectives towards AI literacy infusion into curriculum content?" one sample t-test was performed and revealed weak statistical significance of college instructors' perspectives of AI literacy across the curriculum. In the know and use and use and apply dimensions are at a very strong degree. This finding is in line with (Seo et al., 2023) who reported that AI tools minimize the skills of students to learn independently, solve problems creatively, and think critically. Qualitative results complement these findings that show AI literacy is needed in the curriculum to search and evaluate information and to help students achieve educational goals. This finding is in line with Southworth et al. (2024), who investigated possible paths to address potential gaps in AI literacy across the curriculum and revealed that infusing AI across the curriculum is necessary for all students, which will create an AI-ready workforce for the twenty-first century. This study contrasts with a previous study (Kerneza, 2023), which stated that college students understand the content produced by chatbots at a more advanced level. Moreover, a study by Ng et al. (2023) has shown that adopting basic AI literacy across the curriculum, like knowing and using AI, will allow the students to cultivate advanced cognitive abilities, transforming them into discerning analysts, cooperative innovators, and adept problem-solvers capable of leveraging AI applications to address real-world challenges. Additionally, Bozkurt & Sharma (2023) have also mentioned some challenges while using generative AI such as algorithmic bias, lack of creativity and critical thinking.

It seems that AI literacy in curriculum development is at its starting point at PTUK. The curriculum at this point highlights how students comprehend, use, and apply AI concepts.

The AI ethics dimension was found to a weak degree. Qualitative results support this finding. Most college instructors report a lack of AI ethics inclusion in the designed curriculum. AI ethics integration in the curriculum is necessary. Broadening participation in AI literacy for all is necessary to ensure that the design and use of AI technologies are inclusive to address the under-representation of equity and quality. Many previous studies are in line with this finding. Bozkurt & Sharma (2023) also reported other concerns relating to using generative AI like inequality and inequity in access and concerns regarding privacy and ethics. Another study (Borenstein & Howard, 2020) stated that AI ethics education has not yet been fully integrated into the computing curriculum. This underscores the importance of education in cultivating a professional outlook among future generations of AI developers. If ethics is already part of the engineering or computing curriculum, there is a need to assess and possibly revise the approach, as it may not be sufficiently effective or widespread to influence a shift in mindset.

For the second research question, it appears that gender accounts for the perspectives of college instructors on AI literacy across the curriculum. Gender stereotypes may account for the fact that female participants feel happy by the necessity of implementing AI literacy across the curriculum.

Academic ranks also influence the perspectives of college instructors on integrating AI literacy across the curriculum. This could be due to the relationship between academic usage of AI literacy among different ranks to improve their academic productivity and enhance students' performance levels. Moreover, as academic rank increases, keeping pace with technological advancement is necessary. As one ascends in academic rank, there is a growing necessity to incorporate technology into both teaching methodologies and research endeavors. This is in line with Darawsheh et al. (2023) who stated that full professors are required to focus on teaching students to develop research and projects.

Digital literacy also influences the perspectives of AI literacy across the curriculum. It seems that digital skills necessitate the acquisition of new skills, which have the potential to facilitate the delivery of more efficient solutions like AI literacy. This study is in line with Lim (2023), which showed that there is a relationship with a positive correlation between digital literacy and the perspectives of AI education for students.

According to the received feedback, the curricula at the university level must be reformed such that more AI literacy must be employed. College instructors and students must be trained on the latest technologies, teaching methods, and AI concepts that can innovatively support their learning.

The scope of AI in teaching and learning is enormous. The obvious benefits include access and research from the internet and the use of interactive tools that can assist students in better understanding the subject matter, removing the need to spend long hours reading traditionally.

Conclusions

Due to the growing interest in AI in the academic field, it is essential to bridge the gap between the market needs and the skills and competencies delivered by the university programs. For example, students should be upskilled with varying degrees of AI literacy due to the increasing presence of AI usage around them. AI literacy across the curriculum infusion is vital to equip students with essential real-world skills and expertise in AI technology. Understanding AI is crucial for students in the twenty-first century, as emphasized by various researchers (Cantú-Ortiz et al., 2020; Ng et al., 2021; St Louis et al., 2021), but it is equally vital for all subjects, not solely confined to technology and computer disciplines.

AI can cultivate society to be full of "competent digital citizens" and "collaborators on a global scale." The outcomes of this initiative will yield a pioneering educational approach that can serve as a blueprint for others, with a framework that can be tailored to various campus-wide endeavors beyond just AI.

Recommendations and Limitations

Based on the results of this study, the implementation of AI literacy should emphasize the following aspects of curriculum development. More attempts are needed to incorporate ethics into the curriculum that involves a focus on increasing students' familiarity with professional codes of ethics. Integrating core principles from the field of data science alongside ethical considerations regarding data acquisition, using actual datasets that necessitate students to confront matters of privacy, equity, and legality as they construct AI solutions. Additionally, providing ethical instruction through various formats and on multiple occasions is necessary.

This study has certain limitations. Initially, the sample was limited to individuals from a single university. Despite encompassing participants teaching various majors and academic levels, this sample does not accurately represent the broader population of Palestine, let alone participants from other nations or regions. Subsequent research endeavors could involve participants from multiple universities in Palestine and from diverse countries and regions, aiming to explore the impacts of integrating AI literacy across courses on more diverse and representative samples.

Declarations

The authors declare no conflicts of interest associated with this study. The authors declare no funding associated with this study. Permission to conduct research with human subjects was granted by the ethics board of Palestine Technical University Kadoorie (PTUK).

Acknowledgment

Thanks to Palestine Technical University Kadoorie (PTUK) for supporting this study. PTUK's support for scientific research is appreciated.

References

Ahmad, H., Naser, S. S. A., El Talla, S. A., & Al Shobaki, T. (2018). Information technology role in determining communication style prevalent among Al-Azhar Universityadministrative staff. *International Journal of Information Technology and Electrical Engineering*, *7*(4), 21–43.

Ali, S., Payne, B. H., Williams, R., Park, H. & Breazeal, C. (2019). Constructionism, ethics, and creativity: Developing primary and middle school artificial intelligence education. *International Workshop on Education in Artificial Intelligence K–12* (Vol. 2, pp. 1–4).

Alnahdi, G. H. (2020). The construct validity of the Arabic version of the Chedoke-McMaster attitudes towards children with handicaps scale. *Cogent Education*, *7*(1), 1745540. https://doi.org/10.1080/2331186X.2020.1745540

Borenstein, J., & Howard, A. (2021). Emerging challenges in AI and the need for AI ethics education. *AI and Ethics*, *1*, 61–65. https://doi.org/10.1007/s43681-020-00002-7

Bozkurt, A. (2023). Generative artificial intelligence (AI) powered conversational educational agents: The inevitable paradigm shift. *Asian Journal of Distance Education*, *18*(1), 198–204. https://doi.org/10.5281/zenodo.7716416

Bozkurt, A., & Sharma, R. C. (2023). Challenging the status quo and exploring the new boundaries in the age of algorithms: Reimagining the role of generative AI in distance education and online learning. *Asian Journal of Distance Education*, *18*(21), i–viii. https://doi.org/10.5281/zenodo.7755273

Cantú-Ortiz, F. J., Galeano Sánchez, N., Garrido, L. Terashima-Marin, H., & Brena, R. F. (2020). An artificial intelligence educational strategy for digital transformation. *International Journal on Interactive Design and Manufacturing*, *14*, 1195–1209. https://doi.org/10.1007/s12008-020-00702-8

Chae, H.-C., Koh, C., & Park, E. (2018). Information technology capability and firm performance: Role of industry. *Information & Management*, *55*(5), 525–546. https://doi.org/10.1016/j.im.2017.10.001

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Pearson Education.

Creswell, J. W., & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. Sage.

Daher, W. (2019, February). Assessing students' perceptions of democratic practices in the mathematics classroom. In *Eleventh Congress of the European Society for Research in Mathematics Education* (No. 6). Freudenthal Group, Freudenthal Institute. ERME.

Darawsheh, N. A. H., Alkailanee, K. K., Alrashdan, H., Alquran, N. M. A., Tamara, A. L., Alradi, M. N., & Al-Shamali, S. I. (2023). The degree of using artificial intelligence among academic leaders in Jordanian universities and its relationship to teaching competencies of faculty members. *Journal of Namibian Studies: History Politics Culture*, *34*, 4904–4926.

Kuckartz, U. (2012). *Qualitative inhaltsanalyse: methoden, praxis, computerunterstützung*. Beltz Juventa.

Leal Filho, W., Raath, S., Lazzarini, B., Vargas, V. R., de Souza, L., Anholon, R., . . . Orlovic, V. L. (2018). The role of transformation in learning and education for sustainability. *Journal of Cleaner Production, 199*, 286–295. 10.1016/j.jclepro.2018.07.017

Laupichler, M. C., Aster, A., Schirch, J., & Raupach, T. (2022). Artificial intelligence literacy in higher and adult education: A scoping literature review. *Computers and Education: Artificial Intelligence*, 100101. 10.1016/j.caeai.2022.100101

Lim, E. M. (2023). The effects of pre-service early childhood teachers' digital literacy and self-efficacy on their perception of AI education for young children. *Education and Information Technologies*, 1–27. 10.1007/s10639-023-11724-6

Melsión, G. I., Torre, I., Vidal, E., & Leite, I. (2021). Using Explainability to help children understand gender bias in AI. In *Interaction design and children* (pp. 87–99). https://doi.org/10.1145/3459990.3460719

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence*, *2*, 100041. 10.1016/j.caeai.2021.100041

Picciano, A. G. (2019). Artificial intelligence and the academy's loss of purpose. *Online Learning*, *23*(3), 270–284. https://doi.org/10.24059/olj.v23i3.2023

Schroeder, K., Hubertz, M., Van Campenhout, R., & Johnson, B. G. (2022). Teaching and learning with AI-generated courseware: Lessons from the classroom. *Online Learning*, *26*(3), 73–87. https://doi.org/10.24059/olj.v26i3.3370

Seo, K., Tang, J., Roll, I., Fels, S., & Yoon, D. (2021). The impact of artificial intelligence on learner– instructor interaction in online learning. *International Journal of Educational Technology in Higher Education*, *18*(1), 1–23. https://doi.org/10.1186/ s41239-021-00292-9

Southworth, J., Migliaccio, K., Glover, J., Reed, D., McCarty, C., Brendemuhl, J., & Thomas, A. (2023). Developing a model for AI Across the curriculum: Transforming the higher education landscape via innovation in AI literacy. *Computers and Education: Artificial Intelligence*, *4*, 100127. https://doi.org/10.1016/j.caeai.2023.100127

St Louis, A. T., Thompson, P., Sulak, T. N., Harvill, M. L., & Moore, M. E. (2021). Infusing 21st century skill development into the undergraduate curriculum: The formation of the iBEARS network. *Journal of Microbiology & Biology Education*, *22*(2).. https://doi.org/10.1128/jmbe.00180-21

Su, J., & Yang, W. (2024). AI literacy curriculum and its relation to children's perceptions of robots and attitudes towards engineering and science: An intervention study in early childhood education. *Journal of Computer Assisted Learning*, *40*(1), 241–253. https://doi.org/10.1111/jcal.12867

Su, J., & Zhong, Y. (2022). Artificial intelligence (AI) in early childhood education: Curriculum design and future directions. *Computers and Education: Artificial Intelligence*, 3. https://doi.org/10.1016/j.caeai.2022.100072

Urquijo, I., & Natalio, E. (2017). Academic satisfaction at university: The relationship between emotional intelligence and academic engagement. *Electronic Journal of Research in Educational Psychology*, *15*(3), 553–573. http://dx.doi.org/10.14204/ejrep.43.16064

Varghese, J., & Musthafa D. (2022). Integrating digital literacy skills and technological intelligence in the higher education curriculum of India: A new paradigm. *10*(1), 31–38. https://doi.org/10.15415/iie.2022.1010

Wang, P. (2019). On defining artificial intelligence. *Journal of Artificial General Intelligence*, *10*(2), 1–37. https://doi.org/10.2478/jagi-2019-0002

Wang, X., Lin, W., Liu, L., Wu, Z., Wu, Y., & Yao, Y. (2022). Validation of the translated version of the EVAN-G scale in a Chinese-speaking population. *BMC Anesthesiology*, *22*(1), 1–8. 10.1186/s12871-022-01909-w

Wolf, R. R., & Wolf, A. B. (2023). Using AI to evaluate a competency-based online writing course in nursing. *Online Learning*, *27*(3), 41–69. https://orcid.org/0000-0002-2588-9673

Yi, Y. (2021). Establishing the concept of AI literacy. *Jahr–European Journal of Bioethics*, *12*(2), 353–368. https://doi.org/10.21860/j.12.2.8

Examining Students' Self-Regulation Skills, Confidence to Learn Online, and Perception of Satisfaction and Usefulness of Online Classes in Three Suggested Online Learning Environments that Integrate ChatGPT

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Abstract

This study investigates students' self-regulation skills, confidence to learn online, and perception of satisfaction and usefulness of online classes in three online learning environments that integrate ChatGPT. The participants were 100 undergraduate students from Palestine Technical University Kadoorie registered in the first semester of 2023–2024 academic year within the Faculty of Arts and Educational Sciences. A quasi-experimental design was used to compare three online learning environments that integrate ChatGPT (independent, peer, and group) and students were randomly assigned to these three groups. Three questionnaires were used for data collection. The results showed that the self-regulation levels were high among the participants in these three online ChatGPT groups. However, learning in peer and group environments were more effective in developing self-regulation skills than learning independently. This research also found that the participants in the peer and group learning environments had high levels of confidence to learn online compared to the participants in the independent group. The results also showed that the participants in the peer learning group had the highest scores in perception of satisfaction and usefulness of online classes compared to the participants in the independent and group learning environments. The findings of this study support the notion that integrating ChatGPT within peer groups can enhance students' perception of satisfaction and usefulness of online classes. Therefore, integrating ChatGPT in online peer group settings can bring about a transformative educational experience marked by customized interactions, adaptable content delivery, and enhanced engagement levels.

Keywords: online learning, ChatGPT, self-regulation skills, confidence to learn online, perception of satisfaction

Younis, B. K. (2024). Examining students' self-regulation skills, confidence to learn online, and perception of satisfaction and usefulness of online classes in three suggested online learning environments that integrates ChatGPT. *Online Learning, Volume 28*(2), (50-74). DOI: 10.24059/olj.v28i2.4397

ChatGPT is a new interface that facilitates human-computer interaction in a user-friendly method. Created by OpenAI, ChatGPT is an artificial intelligence language model that uses the GPT architecture. It generates human-like responses to user inquiries and commands by integrating deep learning and machine learning algorithms to simulate natural conversations. Its efficacy in mimicking human responses and adapting to user input within certain constraints has been demonstrated (Terwiesch, 2023). In education, initial researchers suggest that ChatGPT holds promise for enriching knowledge acquisition and refining writing and problem-solving competencies (Chatterjee & Dethlefs, 2023; Terwiesch, 2023). Despite the extensive use of artificial intelligence (AI) and GPT in various industrial sectors (Ahuja, 2019; Veloso et al., 2021), Bozkurt (2024) argued for innovative AI-inclusive strategies, emphasizing the urgent need for academia to adapt and evolve in response to the transformative impact of generative AI across various information-processing domains. Nevertheless, research that integrates chatbots in classroom settings and online learning environments is still in the early stages (Hwang & Chang, 2021).

The global expansion of online education has been rapid, with a growing number of platforms supporting distance learning. However, several challenges persist in enhancing the learning experience of online students. For instance, research has revealed significant differences in the outcomes of online math courses at the community college level compared to traditional face-to-face classes. These differences include lower grades, decreased pass rates, and a higher probability of withdrawal among students in online courses (Francis, Wormington, & Hulleman, 2019). Faculty feedback has also emphasized the importance of students' self-regulation for success in online classes (Gaytan, 2015; Levy, 2007; Nistor & Neubauer, 2010). If students do not possess self-regulated learning (SRL) skills while engaging in online education, they might encounter challenges in fulfilling the assigned learning tasks within their online courses (Barnard et al., 2009). However, online students hardly engage in interaction activities or receive direct guidance and supervision from their instructors (Broadbent & Poon, 2015; Su & Wu, 2021), which might make them struggle to regulate their learning (Jansen et al., 2019). Furthermore, students who dropped out of online classes reported lower satisfaction levels and displayed lower engagement, particularly in the early stages of the course, compared to those who completed it. Students with better ability to self-regulate their online learning were found to have significantly higher levels of perceived effectiveness than those with less ability in this area (Charo, Maite, & Guillermo, 2020).

The perception of self-regulation skills, confidence to learn online, and satisfaction and usefulness of online classes are crucial factors in the success of online learning. Landrum (2020) found that students' confidence in their ability to learn online was the strongest predictor of satisfaction, emphasizing the importance of students' confidence in online learning. Another study by Dai, Li, & Jia (2022) revealed that self-regulated learning was positively associated with perceived academic control and online mathematics learning engagement, highlighting the significance of self-regulation in online learning success. Additionally, students' satisfaction with online learning is influenced by their perception of the usefulness of online courses, their confidence in learning online, and their level of familiarity with the course content. Moreover, the level of students' satisfaction with online learning tends to increase with their accumulated experience in online education (Landrum et al., 2020). These findings highlight the need to address self-regulation skills, confidence to learn online, and perception of satisfaction and usefulness of online classes to improve the effectiveness of students learning in online environments.

One possible direction to improve online learning is integrating AI chatbots. For example, ChatGPT has the ability to help learners overcome language and geographical barriers. Integrating ChatGPT into the online learning platform enables learners to access knowledge and information from anywhere with an internet connection. This expands the diversity of learning opportunities and provides equal learning opportunities for everyone. While large language models like ChatGPT can provide valuable assistance in online learning, it is crucial to acknowledge the potential risk of unreliable responses stemming from limitations in their training data and algorithms (Saeidi et al., 2021). Therefore, one must be aware of ChatGPT's current limitations, particularly its potential for providing inaccurate responses, when incorporating it into educational settings.

The potential and challenges of integrating ChatGPT into online learning platforms need to be further researched. To our knowledge, there have been no studies addressing this issue. Therefore, this research focuses on examining the opportunities of integrating ChatGPT into online learning systems. This study investigates students' self-regulation skills, confidence in online learning, and perceptions of satisfaction and usefulness within three distinct learning environments employing ChatGPT. Using a quasi-experimental design, our objective is to comprehensively compare the integration of ChatGPT in independent, peer-assisted, and group-based online learning settings. The findings from this research offer potential for enriching online learning experiences through the use of AI technologies like ChatGPT. By interpreting the possible advantages and obstacles linked to these integrations, our results contribute to the continuous improvement of educational practices in digital environments.

Literature Review

ChatGPT to Support Online Learning Groups

The use of ChatGPT in higher education has generated interest for its ability to improve students' learning experiences. Through delivering personalized and prompt responses, ChatGPT can address students' needs, provide instant feedback, and help students understand complex concepts. This makes it a promising tool that supports active student engagement and cognitive progress by adapting to individual learning speeds and offering continuous assistance in knowledge acquisition (Dempere et al., 2023).

ChatGPT potential to support group interactions in an online learning context is significant. Firstly, ChatGPT can help facilitate group discussions and provide explanations on complex topics, serving as a virtual tutor for students seeking additional support or clarification (Javaid et al., 2023). Secondly, ChatGPT's continuous availability allows for on-demand support, enabling students to engage in group interactions and seek assistance at any time, which can be particularly beneficial for collaborative projects or study groups (de Winter, Dodou, & Stienen, 2023). Thirdly, the chatbot can personalize group interaction and support students with varying learning needs (Labadze, Grigolia, & Machaidze, 2023). Fourthly, ChatGPT can handle interactions with multiple users simultaneously, making it suitable for supporting group discussions and collaborative activities in online learning environments, even with large numbers of participants (Montenegro-Rueda et al., 2023). Finally, in the realm of online learning, ChatGPT can serve a supportive role by facilitating group interactions, guiding discussions, and providing insights into complex subjects. However, ethical considerations, such as finding a balance between automation and human interaction and ensuring transparency and accountability in its development and use, must be carefully considered (Lo, 2023). Additionally, one must be aware of ChatGPT's current limitations, particularly its potential for providing inaccurate responses, when incorporating it into educational settings.

Self-regulation

Self-regulation skills refer to the ability to monitor one's thoughts, feelings, and behaviors, compare them against personal goals, and decide whether to adjust or maintain them. These skills are essential for managing emotions and maintaining focus on tasks (Boekaerts & Corno, 2005; Zimmerman, 2000). Students develop self-regulation by establishing goals, choosing and employing strategies, keeping track of their performance, and regularly reflecting on their learning outcomes over an extended period (Zimmerman, 2008). Online learning literature highlights the importance of self-regulated learning (SRL) for student success in digital educational environments. For example, students who receive self-regulation support, such as metacognitive questioning, outperform their peers in math procedural tasks, transfer tasks, and self-monitoring strategies (Artino, 2007). This literature also highlighted the role of interventions and tools like online virtual tutors in improving the performance of students with learning difficulties or unstable SRL skills (Pérez-Álvarez et al., 2018). Moreover, self-regulated learning in online environments includes various dimensions such as motivational, social, behavioral, and cognitive factors, all of which contribute to improved self-regulation and learning outcomes (Bylieva et al., 2021). If integrated properly, ChatGPT could have a positive impact on self-regulated learning. Some key aspects of this relation include cultivating metacognitive awareness by offering features that support self-regulation and promote metacognitive awareness (Bai, Liu,

& Su, 2023). ChatGPT was found to be effective in promoting self-regulation progress and knowledge construction in a large mathematics blended class using a flipped learning approach (Li et al., 2023). Lee et al. (2024) found that integrating ChatGPT with a guidance mechanism in blended learning environment was effective in improving students' SRL, higher-order thinking skills (HOTS), and knowledge construction compared to traditional ChatGPT use.

Confidence to Learn Online

Confidence to learn online refers to the individuals' belief in their ability to effectively engage with and succeed in the process of online learning. It involves having the self-assurance and positive mindset necessary to navigate digital learning platforms, comprehend online course materials, and participate in virtual learning activities (Landrum, 2020). Confidence to learn online is related to self-efficacy, which is a student's belief in his ability to perform a specific task (Greener & Wakefield, 2015; Bandura, 1977). It serves as a foundational influence on human behavior and involves perceptual beliefs specific to users' activities, making it relevant for assessing particular situations or tasks (Bandura, 2010). In the context of online learning, self-efficacy relates to a student's confidence or capacity to learn using an online learning technology system (Cai et al., 2018). Individuals with enhanced self-efficacy levels experience reduced anxiety when using technology and demonstrate increased confidence in carrying out tasks related to technology (Downey & Kher, 2015). ChatGPT integration in face-to-face problem solving at university levels was found to have positive effects on self-efficacy for task resolution and enhanced the quality of deliberation and originality of solutions (Urban et al., 2023). Urban et al. (2023) found that the participants who received ChatGPT assistance perceived the task as easier requiring less mental effort. However, their study showed that the perceived usefulness of ChatGPT appeared to inform self-evaluation judgments, resulting in higher inaccuracy.

Perception of Satisfaction and Usefulness of Online Classes

Literature review indicates that students' perception of satisfaction and usefulness of online classes can be influenced by various factors like course design, quality of instructor, and students' expectations (Martin & Bolliger, 2022; Gopal, Singh, & Aggarwal, 2021). Technology integration can enhance students' satisfaction and usefulness of online classes through creating an engaging and collaborative learning environment and can improve the quality of the online learning system (Butt et al., 2021; Alqahtani et al., 2022). ChatGPT, as a language model, can potentially be used to enhance online learning experiences by providing personalized and interactive support to students, facilitating discussions, and answering queries.

Relationship Between Self-Regulation Skills, Confidence to Learn Online, and Perception of Satisfaction

The relationship between self-regulation skills, confidence to learn online, and perception of satisfaction and usefulness of online classes is interconnected. Research indicates that students' confidence in their ability to learn online is a significant predictor of their satisfaction and perceived usefulness of online classes (Landrum, 2020). Additionally, self-regulation strategies, time-management skills, and past online learning experience play crucial roles in enhancing students' satisfaction and perceived usefulness of online classes (Artino, 2008). Therefore, students with strong self-regulation skills are likely to feel more confident in their ability to learn online, which in turn can positively influence their perception of satisfaction and usefulness of online classes. Inversely, students who lack confidence in their ability to learn online may struggle to regulate their learning effectively and may perceive online classes as less satisfactory or useful. Therefore, interventions aimed at improving self-regulation skills and fostering confidence in online learning can have positive implications for learners' overall satisfaction and success.

Group Size

Group size in online learning can significantly impact students' performance, motivation, cognitive load, and collaborative problem-solving quality (Afify, 2019; Zhan et al., 2022). The relation between group size and self-regulation in online learning is noteworthy. Group size can influence students' self-regulation, which is essential for successful online learning outcomes (Lin, Szu, & Lai, 2016). Smaller groups tend to enhance student self-regulation by creating a more personalized and interactive learning environment, reducing the negative aspects of online learning, such as social loitering and low levels of group structure, and promoting a sense of community and cohesion (Akcaoglu & Lee, 2016). Research shows that group awareness and self-regulation levels substantially affect student outcomes in online learning (Lin, Szu, & Lai, 2016). Thus, smaller group sizes can positively influence students' self-regulation skills and overall success in online learning environments. Furthermore, the relationship between group size and the perception of satisfaction and usefulness of online classes is significant in online learning. Studies indicate that students' satisfaction with online classes is influenced by factors like group size and composition in online discussions (Murdoch & Lin, 2023). Additionally, students' perceptions of satisfaction and usefulness in online classes can be affected by the level of engagement, collaboration, and support facilitated by different group sizes (Gopal, Singh, & Aggarwal, 2021). Therefore, group size plays an important role in shaping students' perceptions of satisfaction and usefulness in online classes, emphasizing the importance of considering group dynamics when designing online learning environments. Furthermore, research suggests that students' confidence in their ability to learn online significantly predicts their satisfaction and perceived usefulness of online classes (Landrum, 2020). Thus, a combination of confidence in online learning and group size can impact students' self-regulation skills and overall success.

Some studies suggest that group sizes of four to five are best for small group learning, while others report that the ceiling on group size should be four (Correge & Michinov, 2021). Literature review present mixed findings of group size effects on self-regulation in online learning. For example, larger groups are associated with decreased performance of individual students and less diverse social interactions (Saqr, Nouri, & Jormanainen, 2019). The impact of group size on self-regulation may be influenced by factors such as the design of collaborative activities, the use of technology to support group interactions, and the facilitation of group processes by instructors. Additionally, the literature suggests that the quality of group interactions, the establishment of group norms, and the distribution of roles within the group can all play a role in shaping self-regulatory processes (Thürmer, Wieber, & Gollwitzer, 2020; Doebel & Munakata, 2017). The size of online groups can also have an impact on students' confidence in learning online. Research has shown that students may believe that online instruction could lead to decreased social presence and a lack of ability to self-regulate, which can affect their confidence in learning online (Garner, Kuborn, & Chisum, 2022). Additionally, a study on motivation in massive open online courses (MOOCs) found that the size of online groups can influence the participants' motivation to learn online (Barak, Watted, & Haick, 2016). Furthermore, the size of the group can influence students' perception of usefulness in online learning. Research has shown that varying group sizes can impact students' perception of social presence, personal identity, and group cohesiveness (Luo et al., 2023). It has been found that small group discussions can lead to a higher level of social presence, which can contribute to increased perceived usefulness in online learning (Akcaoglu & Lee, 2016). Therefore, the impact of group size on students' perception of usefulness in online learning is a complex and multifaceted issue that may depend on the specific learning context and activities.

Theoretical Framework

This research is guided by two theoretical frameworks: connectivism and the Community of Inquiry (CoI) model. George Siemens and Stephen Downes (2005) introduced connectivism as a contemporary learning theory (Herlo, 2017). This theory underscores the significance of technology in education and the interconnected nature of knowledge acquisition. The theory advocates for students to gather diverse ideas and knowledge from various sources, combining them effectively to create meaningful understanding. Several key principles characterize connectivism. Firstly, learning is a social process where students take control of their learning while teachers serve as facilitators. Secondly, learning occurs across a network where knowledge is derived from diverse opinions, viewpoints, and experiences, treating individuals and resources as "nodes." Thirdly, learning is a process of connecting and emphasizing the importance of building relationships with colleagues to access new skills and ideas. Finally, learning may reside in non-human devices, allowing learners to store information digitally (Harasim, 2017; Herlo, 2017; Sa'adi, 2016). Connectivism promotes group interaction, fostering diverse perspectives in decision-making, problem-solving, and information comprehension. It encourages learning through online communities, blogs, and public spaces, aligning with the changing educational landscape influenced by technology (Harasim, 2017).

The CoI model emphasizes the significance of interactions among teaching, social, and cognitive aspects in forming collaborative and positive learning communities. It comprises three fundamental components: teaching presence, cognitive presence, and social presence. Teaching presence involves guiding cognitive and social processes to achieve personally meaningful learning outcomes. Cognitive presence gauges learners' ability to construct and validate meaning through reflection and discourse. Social presence entails participants connecting with the community, using purposeful communication in a trusting environment, and building interpersonal relationships by expressing their individual personalities. Widely employed in online education, the CoI model is adaptable to blended and in-person courses. It advocates for active engagement and shared meaning-making, promoting a profound and significant learning experience while fostering a positive, community-focused learning atmosphere (Garrison, Anderson, & Archer, 1999; Vaughan, 2013).

Despite the growing use of ChatGPT in educational settings to improve engagement and meaning-making, there is a need to understand its specific impact on undergraduate students' online learning experiences. The aim of the study is to investigate the impact of integrating ChatGPT within three suggested online learning environments (independent, peer, and group) on undergraduate students' self-regulation skills, confidence to learn online, and perception of satisfaction and usefulness of online learning.

Problem Statement and Research Question

The previous literature review shows that while there is extensive literature on the potential of ChatGPT to support group interactions and enhance learning experiences, there is a lack of empirical evidence regarding its actual impact on self-regulation, confidence, and perception of satisfaction and usefulness in the context of online learning. Additionally, the existing research primarily focuses on the benefits and challenges of ChatGPT implementation, as well as the perspectives of key stakeholders in higher education, rather than on the direct impact on students' learning experiences and outcomes. Therefore, there is a need for empirical studies that specifically investigate the influence of ChatGPT integration within different online learning environments on students' self-regulation, confidence, and perception of satisfaction and usefulness, in order to provide a more comprehensive understanding of its effects on undergraduate students' online learning experiences. Therefore, the presented study aims to investigate the impact of integrating ChatGPT within three suggested online learning environments (independent, peer, and group) on undergraduate students' self-regulation skills, confidence to learn online, and perceptions of satisfaction and usefulness of online classes.

It seeks to answer the main question: what is the impact of integrating ChatGPT within independent, peer, and group online learning environments on undergraduate students' self-regulation skills, confidence to learn online, and perceptions of satisfaction and usefulness of online classes? How do these effects vary across the three suggested online learning environments? Three sub-research questions were derived from this main question:

Q1: Is there a significant difference in the self-regulation levels among the students who participated in the three online ChatGPT groups: individual learning, peer learning, and group learning?

Q2: Is there a significant difference in the confidence to learn online mong the students who participated in the three online ChatGPT groups: individual learning, peer learning, and group learning?

Q3: Is there a significant difference in the perception of satisfaction and usefulness of online classes levelsmong the students who participated in the three online ChatGPT groups: individual learning, peer learning, and group learning?

Methods

Research Design and Context

This study aimed to investigate the impact of integrating ChatGPT within three suggested online learning environments (independent, peer, and group) on undergraduate students' self-regulation skills, confidence to learn online, and perception of satisfaction and usefulness of online courses. Pre-test and post-test experimental design was used to collect data from three experimental learning groups. These groups were: individual learning with ChatGPT, peer learning with ChatGPT, and group learning with ChatGPT. The participants were 100 undergraduate students from Palestine Technical University Kadoorie registered in a problem-solving and decision-making course during the first semester of the 2023–2024 academic year. These participants were at various stages of their bachelor's degree programs within the Faculty of Arts and Educational Sciences. Their specialties were Media Technology, Educational Technology, and Decoration and Interior Design. During this online course on the Moodle platform, the participants were required to integrate ChatGPT to analyze and discuss cases on online worksheets that present problem-solving and brainstorming activities.

A training session was given to the participants in the first week of the course to introduce ChatGPT and explain how it can be used to enhance problem-solving and decision-making. Table 1 presents the learning activities of the ChatGPT training.

Table 1

The Outline of the ChatGPT Training

Session	Activities
Introduction to Chatbots and ChatGPT:	• Explain what chatbots are and how they work. • Introduce ChatGPT and its capabilities, including text generation, language understanding, and context handling. • Discuss the potential benefits of integrating ChatGPT in problem solving and decision making.

Hands-On Experience:	• Provide students with access to ChatGPT in Moodle environment. • Let them experiment with the tool, ask questions, and observe how the chatbot responds. • Encourage them to identify potential use cases for problem solving and decision making.
Identify Use Cases in Problem Solving:	• Brainstorm with students to identify specific use cases where ChatGPT can enhance problem-solving. • Examples might include Creative Problem Solving (CPS) which involves breaking down a problem to understand it, generating ideas to solve the problem and evaluating those ideas to find the most effective solutions.
Promote Student Engagement:	• Explore strategies to engage students actively in interactions with ChatGPT. • Discuss how ChatGPT can be used as a tool to spark discussions, encourage creativity, and problem-solving.
Address ChatGPT Challenges and Limitations:	• Discuss the limitations of ChatGPT, such as generating incorrect or biased responses. • Teach students how to verify information provided by ChatGPT and supplement it with reliable sources. • Encourage critical thinking and evaluation when using AI-generated content.
Understand Responsible AI Usage:	• Address the ethical considerations of using AI and chatbots in the online setting. • Discuss the importance of responsible AI usage, data privacy, and avoiding biases in the training data. • Provide guidelines on using ChatGPT appropriately and avoiding harmful or inappropriate content during this course.

The participant students were randomly assigned in the three experimental groups. Table 2 presents the demographic information of the participants in each group.

Table 2

Demographic Information of the Participants

	Gender		**Level**			
Learning Group	Male	Female	First year	Second year	Third year	Fourth year
Individual	17	17	6	8	10	10
Peer	16	17	7	9	8	9
Group	16	17	9	7	9	8

Instruments

Three different questionaries were applied to assess students' self-regulation skills, confidence to learn online, and perception of satisfaction and usefulness of online classes during the implementation phase of this study. Firstly, the Online Self-Regulated Learning Questionnaire (OSLQ) was adopted by the researcher to assess the participants' self-regulation skills (Barnard et al., 2009). This questionnaire consisted of 24-items in a 5-point Likert response format. Higher scores on this scale indicate better self-regulation in online learning by students. Secondly, to assess confidence to learn online, a questionnaire was developed based on the learning management system self-efficacy scale (Bradley, Browne, & Kelley, 2017), and self-efficacy for learning online scale (Zimmerman & Kulikowich, 2016). This questionnaire consisted of 10 items in a 5-point Likert response format. Finally, to assess students' perception of satisfaction and usefulness of online classes, the student satisfaction survey developed by Strachota (2006) was adapted. The applied draft consisted of 10-items in a 5-point Likert scale format.

Validity and Reliability of the Instrument

To assess the validity of the instruments, the questionnaires were presented to eight experts with graduate degrees and vast experience in instructional design and online learning. The experts evaluated the questionaries' accuracy, clarity, and appropriateness. A final version of the scales was developed based on the experts' feedback. Cronbach's Alpha was used to determine the internal consistency reliability of the three scales. The results are accepted values of Cronbach's Alpha scores (Taber, 2008), as presented in Table 3.

Table 3

Cronbach's Alpha Scores

Scale	Self-Regulation Skills	Confidence to Learn Online	Perceptions of Satisfaction and Usefulness
Cronbach's Alpha	.95	.93	.84

Students' Results Prior to the Study

A one-way analysis of variance was conducted to assess whether a significant difference in confidence to learn online, self-regulation skills, and perception of satisfaction and usefulness of online courses exist between the three learning groups (independent, peer, and group) on the pre-test scores. The results are presented in Table 1.

Table 4

ANOVA Test Results Comparing the Three Experimental Groups Prior to the Study

		Sum of Squares	df	Mean Square	F	Sig.
Self-Regulation Skills	Between Groups	.015	2	.008	.037	.963
	Within Groups	19.865	97	.205		
	Total	19.880	99			
Perceptions of Satisfaction and Usefulness	Between Groups	.050	2	.025	.106	.900
	Within Groups	22.831	97	.235		
	Total	22.881	99			
Confidence to Learn Online	Between Groups	.084	2	.042	.248	.781
	Within Groups	16.467	97	.170		
	Total	16.552	99			

ANOVA results showed that there are no significant differences in students' self-regulation skills, confidence to learn online, and perception of satisfaction and usefulness of online classes before participating in this study, F = .037, $p > 0.05$ for self-regulation skills, were F = .248, $p > 0.05$ for confidence to learn online, and F = .106, $p > 0.05$ for perceptions of satisfaction and usefulness of online courses. The results reveal that the three online ChatGPT groups (independent learning, peer learning, and group learning) were at the same level before participating in the study.

Results

Q1 Results

Is there a significant difference in the self-regulation levels among the students who participated in the three online ChatGPT groups: individual learning, peer learning, and group learning?

One-way analysis of variance was conducted to assess whether a significant difference in self-regulation scores exist between the three online ChatGPT groups (individual learning, peer learning, and group learning) after participating in online course. The results are presented in Table 5.

Table 5

ANOVA Results of Self-Regulation Skills by Learning Group After Participating in the Study

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.684	2	.342	5.823	.004
Within Groups	5.696	97	.059		
Total	6.380	99			

Table 6

Descriptive Results of the Self-Regulation by Learning Group After Participating in the Study

	N	Mean	Std. Deviation

Independent learning	34	3.545	.2659
Peer learning	33	3.733	.1717
Group learning	33	3.702	.2748
Total	100	3.659	.2538

Table 6 shows that a significant difference exists in the self-regulation scores between the three online ChatGPT groups. A LSD test was applied to figure out the direction of these differences.

Table 7

LSD Test Results

	Independent learning	Peer learning	Group learning
Independent learning	-	*	*
Peer learning	*	-	-
Group learning	*	-	-

Table 7 shows that the participants in the peer learning and group learning had high levels of self-regulation scores (3.733 and 3.702, respectively). Otherwise, the participants in the independent group had the lowest scores (3.545). However, the self-regulation levels were high among the participants in these three online ChatGPT groups.

Q2 Results

Is there a significant difference in the confidence to learn online levels among the students who participated in the three online ChatGPT groups: individual learning, peer learning, and group learning?

ANOVA test was conducted to assess whether significant differences in confidence to learn online scores exist between the three online ChatGPT groups (individual learning, peer learning, and group learning) after participating in the online course. The results are presented in Table 8.

Table 8

ANOVA Results of Confidence to Learn Online by Learning Group After Participating in the Study

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.553	2	2.277	18.155	.000
Within Groups	12.164	97	.125		
Total	16.718	99			

Table 9

Descriptive Results of the Confidence to Learn Online by Learning Group After Participating in the Study

	N	Mean	Std. Deviation
Independent learning	34	3.841	.5081
Peer learning	33	4.336	.2678
Group learning	33	4.227	.2050
Total	100	4.132	.4109

Table 8 shows that a significant difference in the confidence to learn online scores exists between the three online ChatGPT groups. A LSD test was applied to figure out the direction of these differences.

Table 10

LSD Test Results

	Independent learning	Peer learning	Group learning
Independent learning	-	*	*
Peer learning	*	-	-
Group learning	*	-	-

Table 10 shows that the participants in peer learning and group learning had very high levels of confidence to learn online scores (4.336 and 4.227, respectively). Otherwise, the participants in the independent learning group had the lowest score (3.841). However, the level was high in these three groups.

Q3 Results

Is there a significant difference in the perceptions of satisfaction and usefulness of online classes levels among the students who participated in the three online ChatGPT groups: individual learning, peer learning, and group learning?

ANOVA test was conducted to assess whether a significant difference exist in the perception of satisfaction and usefulness of online classes scores between the three online ChatGPT groups (individual learning, peer learning, and group learning) after participating in the online course. The results are presented in Table 11.

Table 11

ANOVA Results of Satisfaction and Usefulness of Online Classes by Learning Group After Participating in the Study

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.359	2	1.679	11.496	.000
Within Groups	14.171	97	.146		
Total	17.530	99			

Table 12

Descriptive Results of Satisfaction and Usefulness of Online Classes by Learning Group after Participating in the Study

	N	Mean	Std. Deviation
Independent learning	34	3.785	.5070
Peer learning	33	4.230	.3996
Group learning	33	3.960	.1344
Total	100	3.990	.4208

Table 11 shows that a significant difference exists in the perceptions of satisfaction and usefulness of online classes scores between the three online ChatGPT groups. A LSD test was applied to figure out the direction of these differences.

Table 13

LSD Test Results

	Independent learning	**Peer learning**	**Group learning**
Independent learning	-	*	-
Peer learning	*	-	*
Group learning	-	*	-

Table 13 shows that the participants in the peer learning group had the highest scores of perceptions of satisfaction and usefulness of online classes (4.230). Otherwise, the participants in the independent learning and group learning had the lowest scores (3.785 and 3.960, respectively).

Discussion

This study aimed to investigate the impact of integrating ChatGPT within three suggested online learning environments (independent, peer, and group) on undergraduate students' self-regulation skills, confidence to learn online, and perceptions of satisfaction and usefulness of online classes. The participants were 100 undergraduate students from Palestine Technical University Kadoorie registered in a problem-solving and decision-making course during the first semester of 2023–2024 academic year. The results showed that the self-regulation levels were high among the participants in these three online ChatGPT groups. However, learning in peer or group was more effective in developing self-regulation skills than learning independently. This research found that participants in peer and group learning environments were more confident in learning online compared to those in the independent learning environment. The results also showed that the participants in the peer learning group had the highest scores of perception of satisfaction and usefulness of online classes compared to the participants in the independent and group environments.

The findings of this research highlighted the importance of interactive learning experiences in online education and aligned with existing literature on online interaction and engagement. Interaction and engagement have emerged as pivotal factors influencing self-regulation, confidence, and satisfaction in online learning environments (Miao & Ma, 2022). Previous researchers had established a positive correlation between social presence, self-regulation, and online interaction with students' engagement in online courses (Landrum, 2020; Wu et al., 2023). Moreover, the theory of transactional distance emphasizes the significance of interaction in fostering effective online learning experiences (Moore, 1993; Benson & Samarawickrema, 2009). The integration of ChatGPT within the online course facilitated enhanced interaction among the participants, provided them access to a diverse range of information and resources, thereby fostering collaboration, problem-solving, and engagement. The use of a language model (LLM) such as ChatGPT in learning settings brings about a transformative educational experience marked by customized interactions, adaptable content delivery, and enhanced engagement levels. ChatGPT, when integrated properly into educational settings, tailors its responses to match individual learning styles, provides instantaneous feedback, and cultivates critical thinking skills through open-ended chats. Acting as a virtual tutor, study mate, and content creator in the online learning setting, ChatGPT improves the quality of the learning experience (Mai, Da, & Hanh, 2024). In contrast, the absence of AI-driven support, content creation, and feedback mechanisms could restrict the extent of engagement and personalization achievable during the learning journey. Hence, while interactive learning experiences without ChatGPT remain valuable, the distinctive capabilities of ChatGPT in enhancing personalization, engagement, and inclusivity distinguish it as a pivotal tool in revolutionizing educational learning experiences. Notably, interaction within peer groups leveraging ChatGPT appeared particularly effective, likely due to its facilitation of peer projects and collaborative activities.

While prior studies on group size's impact on learning tasks in online discussions have yielded mixed results (Corrégé & Michinov, 2021). This study observed that integrating ChatGPT within peer and group online environments enhanced self-regulation compared to independent learning settings. These results align with previous findings suggesting that collaborative group projects can bolster students' self-regulation skills, fostering independence in online learning environments (Khurshid, 2020).

The perception of satisfaction and usefulness of online classes was significantly higher in the online environment that integrates ChatGPT in peer learning environment compared to those integrating it in larger groups or independently. Large group sizes may impede effective communication and information exchange, potentially leading to reduced satisfaction and engagement (Saqr, Nouri, & Jormanainen, 2019). However, the impact of group size on learning outcomes and satisfaction may vary across disciplines (Zhan et al., 2022), highlighting the need for further research and contextual understanding.

Implications

The findings of the study suggest several implications for online education practitioners and educators aiming to enhance the effectiveness of online learning environments. Firstly, educators and course designers should consider integrating ChatGPT into assignments within peer and group settings to foster collaborative learning experiences. The study highlights the effectiveness of ChatGPT in facilitating group projects, brainstorming sessions, and problem-solving activities, which can enhance student engagement and interaction. Secondly, institutions should focus on promoting self-regulated learning skills among students by encouraging collaborative group projects and activities. By leveraging technologies like ChatGPT, educators can provide students with the tools and resources necessary to develop and enhance their self-regulation skills, thereby fostering independence and autonomy in online learning environments. Thirdly, educators should pay attention to the dynamics of group size when designing collaborative learning activities. While smaller group sizes may facilitate effective communication and information exchange, larger groups may lead to less cohesive interactions and reduced satisfaction. Understanding the optimal group size for different disciplines and learning contexts can help educators design more effective collaborative learning experiences. Fourthly, integrating ChatGPT within peer groups can enhance students' perception of satisfaction and usefulness of online classes. Educators should explore ways to leverage ChatGPT to facilitate meaningful interactions and collaboration among students, thereby increasing their satisfaction and engagement with online learning materials and activities. Finally, given the evolving nature of online education and technology, continuous research and adaptation are essential. Educators and researchers should conduct further studies to explore the long-term effects of integrating ChatGPT in online learning environments and to identify best practices for optimizing its use to enhance student learning outcomes and satisfaction.

ChatGPT shows potential as a helpful tool for educators and a virtual mentor for students in online learning; however, it poses specific challenges. These challenges include generating incorrect or false information and being able to bypass plagiarism detection. It is crucial to address these issues promptly by revising assessment methods and institutional policies in educational institutions. For example, Trust (2023) proposed several strategies aimed at mitigating the adverse effects of ChatGPT on academic integrity. These strategies include, firstly, encouraging activities and assignments that emphasize genuine understanding and application of knowledge, rather than relying solely on automated responses from ChatGPT. Secondly, fostering an environment where students are encouraged to question, analyze, and evaluate information provided by ChatGPT, rather than passively accepting it as definitive. Finally, designing assignments that require creativity, originality, and personal input from students, thereby reducing reliance on ChatGPT-generated content and enhancing the value of human thought and effort in academic work. Therefore, providing training for instructors and educating students on effectively managing the impact of ChatGPT in the educational landscape is equally vital.

Declarations

Ethical Approval

Approval to conduct this study was received from the Human Subjects Committee at Palestine Technical University Kadoorie. All research activities were reviewed and approved by the Human Subjects Committee. The researcher also followed the Code of Ethics by the American Educational Research Association.

Informed Consent of Participation

Informed consent of participation was obtained from each participant.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this work the author(s) used Open AI's ChatGPT (Version as of April 2024) in order to develop literature review. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Declaration of Interest

The author has no conflicts of interest to declare. The authors certify that the submission is original work and is not under review at any other publication.

Data availability

All data generated or analyzed during this study are included in this published article (and its supplementary information files).

Acknowledgments

This work was supported by Palestine Technical University Kadoorie, Palestine. This university has no role in the design and implementation of this study. The author is also grateful for the insightful comments suggested by the editor and the anonymous reviewers.

References

Afify, M. K. (2019). The Influence of group size in the asynchronous online discussions on the development of critical thinking skills, and on improving students' performance in online discussion forum. *International Journal of Emerging Technologies in Learning*, *14*(5), 132–152. https://doi.org/10.3991/ijet.v14i05.9351

Ahuja, A. (2019). The impact of artificial intelligence in medicine on the future role of the physician. *PeerJ, 7*, no. 7702. https://doi.org/10.7717/peerj.7702

Akcaoglu, M., & Lee, E. (2016). Increasing social presence in online learning through small group discussions. *The International Review of Research in Open and Distributed Learning, 17*(3). https://doi.org/10.19173/irrodl.v17i3.2293

Alqahtani, M. A., Alamri, M. M., Sayaf, A. M., & Al-Rahmi, W. M. (2022). Investigating students' perceptions of online learning use as a digital tool for educational sustainability during the COVID-19 pandemic. *Frontiers in Psychology*, 13. https://doi.org/10.3389/fpsyg.2022.886272

Artino, A. R. (2007). Self-regulated learning in online education: A review of the empirical literature. *International Journal of Instructional Technology and Distance Learning, 4*(6), 3–18. http://itdl.org/Journal/Jun_07/article01.htm

Artino, A. R. (2008). Online military training: Using a social cognitive view of motivation and self-regulation to understand students' satisfaction, perceived learning, and choice. *Quarterly Review of Distance Education*, *9*(3), 207–223.

Bai, L., Liu, X., & Su, J. (2023). ChatGPT: The cognitive effects on learning and memory. *Brain-X, 1*(3). https://doi.org/10.1002/brx2.30

Bandura, A. (2010). Self-efficacy. *The Corsini Encyclopedia of Psychology*, 1–3.

https://doi.org/10.1002/9780470479216.corpsy0836

Barak, M., Watted, A., & Haick, H. (2016). Motivation to learn in massive open online courses: Examining aspects of language and social engagement. *Computers & Education, 94*, 49–60. https://doi.org/10.1016/j.compedu.2015.11.010

Barnard, L., Lan, W. Y., To, Y. M., Paton, V. O., & Lai, S. L. (2009). Measuring self-regulation in online and blended learning environments. *Internet and Higher Education*, *12*, 1–6. https://doi.org/10.1016/j.iheduc.2008.10.005

Benson, R., & Samarawickrema, G. (2009). Addressing the context of e-learning: Using transactional distance theory to inform design. *Distance Education, 30*, 5–21. Doi.org: 10.1080/01587910902845972

Boekaerts, M., & Corno, L. (2005). Self-regulation in the classroom: A perspective on assessment and intervention. *Applied Psychology, 54*(2), 199–231. https://doi.org/10.1111/j.1464-0597.2005.00205.x

Bozkurt, A. (2024). GenAI et al.: Cocreation, authorship, ownership, academic ethics and integrity in a time of generative AI. *Open Praxis*, *16*(1), 1–10. https://doi.org/10.55982/openpraxis.16.1.654

Bradley, R. L., Browne, B. L., & Kelley, H. M. (2017). Examining the influence of self-efficacy and self-regulation in online learning. *College Student Journal, 51*(4), 518–530.

Dai, W., Li, Z., & Jia, N. (2022). Self-regulated learning, online mathematics learning engagement, and perceived academic control among Chinese junior high school students during the COVID-19 pandemic: A latent profile analysis and mediation analysis. *Frontiers in Psychology, 13*. https://doi.org/10.3389/fpsyg.2022.1042843

de Winter, J. C. F., Dodou, D., & Stienen, A. H. A. (2023). ChatGPT in education: Empowering educators through methods for recognition and assessment. *Informatics, 10*(4), 87. https://doi.org/10.3390/informatics10040087

Dempere, J., Modugu, K., Hesham, A., & Ramasamy, L. K. (2023). The impact of ChatGPT on higher education. *Frontiers in Education, 8*. https://doi.org/10.3389/feduc.2023.1206936

Harasim, L. (2017). Connectivism as an online learning theory. *Learning Theory and Online Technologies*, 80–104. https://doi.org/10.4324/9781315716831-6

Herlo, D. (2017). Connectivism, A new learning theory? *The European Proceedings of Social and Behavioral Sciences*. https://doi.org/10.15405/epsbs.2017.05.02.41

Hwang, G. J., & Chang, C. Y. (2021). A review of opportunities and challenges of chatbots in education. *Interactive Learning Environments*, *31*(7), 4099–4112. https://doi.org/10.1080/10494820.2021.1952615 Jansen, R. S., van Leeuwen, A.,

Janssen, J., Jak, S., & Kester, L. (2019). Self-regulated learning partially mediates the effect of self-regulated learning interventions on achievement in higher education: A meta-analysis. *Educational Research Review*, *28*, 100292. https://doi.org/10.1016/j.edurev.2019.100292

Javaid, M., Haleem, A., Singh, R. P., Khan, S., & Khan, I. H. (2023). Unlocking the opportunities through ChatGPT Tool towards ameliorating the education system. *BenchCouncil Transactions on Benchmarks, Standards and Evaluations*, *3*(2), 100115. https://doi.org/10.1016/j.tbench.2023.100115

Khurshid, F. (2020). Online collaboration and self-regulated learning in online learning environment. *Pakistan Journal of Distance and Online Learning*, *6*(1), 177–193.

Labadze, L., Grigolia, M., & Machaidze, L. (2023). Role of AI chatbots in education: Systematic literature review. *International Journal of Educational Technology in Higher Education*, *20*(1). https://doi.org/10.1186/s41239-023-00426-1

Landrum, B. (2020). Examining students' confidence to learn online, self-regulation skills and perceptions of satisfaction and usefulness of online classes. *Online Learning*, *24*(3). https://doi.org/10.24059/olj.v24i3.2066

Lo, C. K. (2023). What is the impact of ChatGPT on education? A rapid review of the literature. *Education Sciences*, *13*(4), 410. https://doi.org/10.3390/educsci13040410

Luo, H., Chen, Y., Chen, T., Koszalka, T. A., & Feng, Q. (2023). Impact of role assignment and group size on asynchronous online discussion: An experimental study. Computers & Education, 192, 104658. https://doi.org/10.1016/j.compedu.2022.104658

Mai, D. T. T., Da, C. V., & Hanh, N. V. (2024). The use of ChatGPT in teaching and learning: a systematic review through SWOT analysis approach. *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1328769

Martin, F., & Bolliger, D. U. (2022). Developing an online learner satisfaction framework in higher education through a systematic review of research. *International Journal of Educational Technology in Higher Education*, *19*(1). https://doi.org/10.1186/s41239-022-00355-5

Miao, J., & Ma, L. (2022). Students' online interaction, self-regulation, and learning engagement in higher education: The importance of social presence to online learning. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.815220

Montenegro-Rueda, M., Fernández-Cerero, J., Fernández-Batanero, J. M., & López-Meneses, E. (2023). Impact of the implementation of ChatGPT in education: A systematic review. *Computers*, *12*(8), 153. https://doi.org/10.3390/computers12080153

Moore, M. G. (1993). Theory of transactional distance. In D. Keegan (ed.), *Theoretical principles of distance education* (pp. 84–103). Routledge.

Murdoch, Y. D., & Lin, Y.-H. (2023). Factors mediating the link between engagement and satisfaction among online English-mediated instruction learners during COVID-19. *Electronic Journal of E-Learning*, *21*(3), 158–174. https://doi.org/10.34190/ejel.21.3.3031

Nistor, N., & Neubauer, K. (2010). From participation to dropout: Quantitative participation patterns in online university courses. *Computers & Education*, *55*(2), 663–672. https://doi.org/10.1016/j.compedu.2010.02.026

Pérez-Álvarez, R., Maldonado-Mahauad, J., & Pérez-Sanagustín, M. (2018). Tools to support self-regulated learning in online environments: Literature review. *Lecture Notes in Computer Science*, 16–30. https://doi.org/10.1007/978-3-319-98572-5_2

Sa'adi, S. (2016). Introduction to views of connectivism theory of learning. *Register Journal*, *3*(2), 201. https://doi.org/10.18326/rgt.v3i2.201-214

Saeidi, M., Sun, S., Shakeri, S., & Eskandani, F. (2021). Challenges in deploying large language models: A review. *IEEE Access*, *9*, 16160–16175. doi:10.1109/ACCESS.2021.3056369

Saqr, M., Nouri, J., & Jormanainen, I. (2019). A learning analytics study of the effect of group size on social dynamics and performance in online collaborative learning. *Transforming Learning with Meaningful Technologies*, 466–479. https://doi.org/10.1007/978-3-030-29736-7_35

Strachota, E., (2006, October 4-6). *The use of survey research to measure student satisfaction in online courses* [Conference presentation]. Midwest Research to Practice Conference in Adult Continuing and Community Education. University of Missouri-St. Louis, MO, United States.

https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=4ca117aea5a58c5426420e4989d974134de38b1d

Evaluating Cami AI Across SAMR Stage: Students' Achievement and Perceptions in EFL Writing Instruction

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Abstract

This research evaluates the impact of Cami, an AI-powered tool, integration across SAMR (Substitution, Augmentation, Modification, and Redefinition) stages (Cami AI-SAMR) in EFL (English as a Foreign Language) writing instruction. By examining student achievement and perceptions, it explores how AI technology redefines language learning and teaching in diverse educational settings. Through a mixed-method approach with an explanatory sequential research design, this study investigates the quantitative effects of Cami AI-SAMR implementation on student performance and gauges the qualitative responses of 126 EFL university students to its effectiveness and perceptions. The findings show that Cami AI-SAMR implementation significantly impacted EFL students' writing achievement. Then, the majority of students also had positive perceptions due to the Cami AI's efficacy in supporting EFL writing learning. These findings provide valuable insights into the transformative potential of Cami AI technology in enhancing EFL pedagogy through the SAMR framework, addressing the diverse needs of students, and reshaping the language education landscape. This research contributes to the ongoing discourse on AI integration in education and offers recommendations for optimizing AI-powered EFL instruction for better learning outcomes and experiences.

Keywords: artificial intelligence, Cami, EFL instruction, SAMR, writing

Muslimin, A. I., Mukminatien, N., & Ivone, F. M. (2024). Evaluating Cami AI across SAMR stages: Students' achievement and perceptions in EFL writing instruction. *Online Learning, 28*(2), (75-95). DOI: 10.24059/olj.v28i2.4246

The rapid growth of technology has shifted the era of traditional teaching into digital teaching where huge numbers of innovative technologies appear, including the emergence of artificial intelligence (AI) (Imamyartha et al., 2023; Haleem et al., 2022). AI is a branch of computer science and engineering that focuses on developing systems and machines that can do activities that would normally need human intelligence (Bozkurt & Sharma, 2023; Tai, 2020). These tasks may include reasoning, learning, problem-solving, perception, natural language interpretation, and decision-making. Algorithms and data are used by AI systems to replicate human cognitive functions. AI is a wide field with numerous subfields and AI kinds. Generative AI is one of these types that focuses on creating content that is not explicitly replicated from previous instances, generally in the form of text, photos, audio, or other data (Yu & Guo, 2023). It entails creating fresh data that is similar to what a human would create. One of the newly introduced is Cami AI.

Cami, an AI-powered tool, was introduced in the middle of 2023 with a wide range of capabilities. This AI amalgamates several leading AI technologies, including ChatGPT, Whisper, and Stable Diffusion, resulting in remarkable functions such as grammar correction, writing criticism, image generation, and personalized conversation companionship (Cami, n.d.). These flexible functions are adaptable to support education, particularly in teaching and learning English as a Foreign Language (EFL), where Cami's capabilities align with the required skills. For instance, Cami's image generation feature acts as a visual stimulus, enhancing students' descriptive writing by offering concrete references, fostering creativity, and aiding in the development of detailed descriptions. Furthermore, Cami's dynamic capabilities resonate with the ongoing trend of AI technologies seeking to augment and refine teaching and learning experiences (Zang & Aslan, 2021).

One of the Cami AI features is the ability to provide personalized grammar correction and writing feedback. In addition, it can give suggestions for developing writing ideas and images based on the user's command. These features are relevant for supporting the teaching of EFL writing skills, which are characterized by improvements in vocabulary, grammar, and text structure (Ataizi & Aksak-Komür, 2021). Moreover, based on some current studies discussing EFL writing, many students need more personalized writing feedback to reduce their learning anxiety (Koenka & Anderman, 2019), quick feedback responses from teachers (Irwin, 2017) since some teachers hardly provide more details responses due to many students need their attention, and dialogic feedback to fulfill any students' curiosities (Mamoon-Al-Bashir et al., 2016). One study stated that EFL students had difficulties in writing descriptive text since they did not have images or were able to imagine the model of writing (Ismayanti & Kholiq, 2020; Rizqullah et al., 2023). Hence, Cami AI with its features may scaffold the aforementioned needs and challenges.

The benefits promoted by Cami AI attract EFL teachers to integrate it into their teaching and learning pedagogy in the classroom. However, numerous technology integration models have been introduced by scholars with each of their strengths and weaknesses. Cherner and Mitchell's (2020) study promoted the SAMR (Substitution, Augmentation, Modification, and

Redefinition) technology integration model developed by Puentedura (2014) as the most practical framework for mediating EFL teachers' obstacles to integrating technology into teaching. This framework provides stages from the easiest way to insert technology to support EFL teaching, which is substituting the teaching material into more technology-based material (i.e., substituting paper-based material into an e-book), until the most sophisticated way of technology integration into teaching that is redefining the function of a technology (i.e., using Google Maps to help students narrating a story and share it publicly through YouTube or social media). Due to its practicality, SAMR has provided a scaffold for educators to reimagine and reconfigure their teaching methodologies. Hence, SAMR can be employed to mediate Cami AI integration to support EFL teaching for better outcomes (Muslimin et al., 2023).

While there is a growing body of research on AI applications in education, particularly those focused on EFL instruction, the potential of Cami, a generative AI tool, within the SAMR framework for EFL writing remains unexplored. Alamar and Amin (2023) demonstrated the effectiveness of AI-powered paraphrasing tools (APTs) for EFL students' achievement. Mohamed (2023) highlighted the positive response of instructors towards ChatGPT but cautioned against its potential drawbacks for critical thinking and research skills, as well as creating biased information. Aladini (2023) found AI dictionary applications to be beneficial for writing skills and logical thinking. However, a comprehensive search using Harzing's Publish or Perish revealed a gap in research on integrating Cami specifically within the SAMR framework for EFL writing instruction. This lack of exploration underscores the importance of the present study, which investigates how Cami redefines the EFL writing landscape and informs pedagogical adaptations for the digital age. Henceforth, this study reveals discussion by answering the following research problems:

1. How does the integration of Cami's AI capabilities through the SAMR stages in EFL instruction affect the students' writing achievement?
2. How do students perceive the usability, effectiveness, and challenges of integrating Cami within the SAMR framework in EFL writing instruction?

Literature Review

In the digital age, the field of education has witnessed a transformative wave led by the integration of AI and technology. The realm of English as a Foreign Language (EFL) instruction, an arena deeply rooted in linguistic acquisition, is no exception to this paradigm shift. This literature review explores the multifaceted dimensions of AI integration in EFL education, focusing on the pivotal role of Cami and the guiding framework of SAMR (Substitution, Augmentation, Modification, Redefinition) in reshaping student achievement and perceptions.

AI Integration in EFL Instruction

The integration of AI technology into language learning has emerged as a powerful force in modern education. AI-driven platforms, such as chatbots and virtual language teachers, have rapidly evolved to offer personalized, interactive, and efficient language learning experiences (Imamyartha et al., 2023; Kohnke et al., 2023). Such integration not only automates repetitive language tasks but also adapts to individual learner needs, enhancing the overall quality of language instruction (Tapalova & Zhiyenbayeva, 2022). These AI tools use natural language processing and machine learning capabilities to provide real-time feedback, language correction, and even dynamic, context-aware conversations (Wang et al., 2023). EFL teaching AI-based benefited students to leverage their EFL learning outcome, including the attempts to increase their writing ability (Aladini, 2023; Alamar & Amin, 2023).

Cami AI: A Versatile AI in EFL Writing Skills Learning

Cami, a dynamic and versatile AI platform designed to function as an adaptable language partner, is at the forefront of this AI-driven language instruction. Cami allows users to customize AI responses, allowing for a variety of interactions ranging from peer-like conversations to mentorship (Sharma et al., 2022). Cami's distinct feature set includes the incorporation of multiple AI engines, including GPT-4, GPT-3.5, Stable Diffusion, and Whisper, allowing it to generate text, images, and even voice-based interactions. Its incorporation into EFL instruction has the potential to tailor language learning experiences to learners' diverse linguistic and emotional needs. Each student in the writing class can operate Cami as a personal writing mentor who can give writing feedback, explain grammar to support writing a composition, provide direct answers through chatting, and develop images to guide ideas for writing. Navidinia's (2019) study showed that the group that wrote the descriptive text with the help of images could write with fewer errors and more vocabulary than those who did not. Hence, the present study aimed to investigate the use of Cami AI, which can generate images and provide language feedback to aid EFL students' writing production as well as understanding the students' perceptions toward it.

The SAMR Framework in Education

The SAMR framework, introduced by Puentedura (2014), provides a structured model for understanding the role of technology role in education. It hierarchically divides the technology integration into four layers: Substitution, Augmentation, Modification, and Redefinition. Substitution is understood as the simplest stage of technology integration by substituting traditional teaching with more tech-based teaching. The augmentation stage shows how the teacher maximizes the function of technology. The modification layer is reached when the teacher can modify the original function of technology to restructure a task or process. Lastly, the redefinition stage is indicated by the teacher's ability to completely transform the task or process in ways that were previously unthinkable. SAMR is recognized for its capacity to guide educators in the meaningful and progressive incorporation of technology into pedagogy (Hamilton et al., 2016; Muslimin et al., 2023). In the context of EFL writing instruction, the SAMR model helps EFL writing teachers navigate the integration of AI, ensuring that it enhances traditional teaching methods rather than merely substituting them.

Relevance of SAMR and Cami AI in EFL Writing Learning

The synergy between the SAMR framework and Cami's AI capabilities is particularly relevant to EFL writing learning. The framework facilitates the gradual and systematic integration of technology, offering a structured approach to adapting teaching methods (Cherner & Mitchell, 2020; Puentedura, 2014). This aligns seamlessly with the adaptability of Cami, as it traverses the SAMR stages, offering a range of AI-based EFL writing activities, from basic substitution to redefinition. The integration of Cami within the SAMR framework empowers EFL teachers to progressively explore the potential of Cami AI, ensuring that it enhances students' writing skills at any SAMR stage (Canbay, 2020). Then, in the present study, the details of Cami AI integration into EFL writing teaching through the SAMR framework (Cami AI-SAMR) are presented in the methodology section.

Methodology

This research aimed to investigate the impact of Cami AI integration in EFL instruction guided by the SAMR (Substitution, Augmentation, Modification, Redefinition) framework on the students' EFL writing achievement and perceptions. To meet the goal of the study, it employed a mixed-method approach with an explanatory sequential research design. It brought the discussion of the topic by combining both quantitative and qualitative data (Dawadi et al., 2021).

According to Creswell (2016), qualitative research focuses on examining and understanding complex social phenomena using methods such as interviews and content analysis. On the other hand, quantitative research includes activities such as collecting and interpreting numerical data through structured surveys and statistical analysis. Therefore, combining qualitative and quantitative data allows researchers to better understand the research problem and enables data triangulation, enhancing the validity and depth of the research findings (Youngs & Piggot-Irvine, 2012). While quantitative data reveals the prevalence of attitudes, qualitative data reveals these feelings' underlying reasons and complexities (Creswell & Plano Clark, 2017). Then, the qualitative data were used to explain the quantitative data and it reflected the essence of the explanatory sequential research approach (Othman et al., 2020).

The selection of SAMR as an AI integration framework, compared to other technological frameworks such as PICRAT, TPACK, RAT, etc., was based on the research conducted by Cherner and Mitchell (2020). Their study revealed that SAMR surpasses other frameworks for several reasons, including its aesthetic appeal, practical integration into teaching pedagogy resulting in teachers' preference for its use, popularity among researchers leading to its validation, and theoretical functionality for evaluating teachers' digital literacy competence. Hence, the present study employed the SAMR framework as a medium for Cami AI to empower EFL teaching pedagogy.

Participants

The participants of this research were 126 students who studied EFL in a Writing Class in an English education department at a public university in West Nusa Tenggara, Indonesia. They were selected purposively due to feasibility and willingness to participate factors. From this total number, ten participants joined the qualitative research by participating in the interview voluntarily without any incentive. Before joining the research, all participants claimed their consent by clicking the agreement option to join this research, and their responses were used for the scientific work of this research.

Research Procedure

To reach the objectives of this study to investigate both the perception and the impact of Cami AI-based EFL writing instruction within SAMR framework implementation, the researcher went through the research procedure as shown in Table 1.

Table 1

The Research Procedure

Steps	Activities		
1	EFL writing pre-test		
2	Treatment	Cami AI-based EFL writing instruction within the SAMR framework	
		Substitution	Students learned the function/features of Cami AI from the website and installed it into their gadgets as a WhatsApp add-on application. Students received the EFL writing prompt on WhatsApp and transmitted it to Cami AI (substituting paper-based prompt for e-prompt through Cami AI). Students substitute the printed dictionary into an AI-based dictionary by giving a prompt (/language [the target language for translation]) or directly typing the prompt (please translate "….") .
		Augmentation	Students developed descriptive writing outlines in Cami AI and asked for idea suggestions and feedback for the vocabulary and grammar used. Students practice creating images using Cami AI by giving prompts (/imagine [the character/image wants to be generated]).
		Modification	Students ask for a guide to write good descriptive text by chatting with Cami AI as a personal teacher. Then, students requested feedback and grammar checking by giving prompts (please check the grammar and give feedback on the following text "…."). Students also can ask for feedback by recording the voice command. Students shared their experience of using Cami AI with classmates and learned from others how to operate efficiently Cami AI to support descriptive text writing.
		Redefinition	Students created images as their basis to compose new descriptive writing text.

		Students composed their descriptive text based on new images generated by Cami AI. Students asked for feedback for both image and descriptive text they developed from Cami AI. Cami AI checked the appropriateness between both. Students transmitted their composition to Class WhatsApp.
3	EFL writing post-test	
4	Cami's AI – SAMR questionnaire administration	
5	Conducting interview	
6	Data analysis, data presentation, and data discussion	

Instruments

The instruments applied to gather the data were the Cami's AI-SAMR questionnaire that comprised the participants' demographic data and questions related to Cami AI-SAMR implementation, documentation of the participants' writing course scores (pre- and post-treatment test scores), and interview guidelines containing reflective questions of Cami's AI-SAMR implementation. Toward the end of the Cami AI-SAMR questionnaire, participants were asked for their agreement to participate in the interview. This form helped the researcher identify participants who were willing to join the interview.

The pre- and post-tests were conducted to evaluate the EFL students' writing achievement before and after the implementation of the Cami AI-SAMR activities. The pre-test assessed the students' baseline writing skills, while the post-test measured the impact of the Cami AI-SAMR intervention on their writing proficiency. Specifically, the pre-test included prompts for descriptive writing tasks, vocabulary usage, grammar, and overall writing coherence. The criteria for comparison between the pre-test and post-test scores were based on the student's performance in these specific writing tasks, with a focus on improvements in content quality, language accuracy, and overall writing effectiveness. These details were considered essential in assessing the effectiveness of the Cami AI-SAMR intervention in enhancing the EFL students' writing outcomes.

Data Collection and Analysis

The quantitative data were obtained by administering Cami's AI-SAMR questionnaire online developed by Google Forms through link-sharing and the documentation of the participants' writing scores in the pre-test and post-test. Both of the quantitative data were analyzed statistically using the SPSS 24 version to comprehend the significance of Cami's AI-SAMR treatment toward the participants' EFL learning achievement. Then, the qualitative data were gathered by interviewing the participants who already stated their willingness to join the interview. From the submitted agreement form, it was known that ten participants were willing to voluntarily join the interview. So, the interview participants' selection was based on the willingness that was stated in the survey (Knapik, 2006). These qualitative data were analyzed thematically following inductive theme development steps proposed by Naeem et al. (2023). The themes were derived through an inductive process, allowing patterns and insights to emerge directly from the data collected during the interviews with the participants. The themes were not predetermined based on existing literature but were identified through a systematic and iterative process of coding the data. This approach ensured that the themes were grounded in the participants' responses and experiences. Based on the coding process from the interview transcription, the developed themes were the participants' perceptions of Cami's AI efficacy, Cami's AI operation challenges, Cami's AI learning experience along with the SAMR framework, and Cami's AI usability. Finally, the qualitative data were used to explain the obtained quantitative data for maintaining the validity of this research.

Ethical Considerations

The research adhered to ethical considerations by following research ethics guidelines proposed by Yaw et al. (2023). These considerations included providing informed consent, which participants filled out during data collection; maintaining participant confidentiality by assigning pseudonyms for anonymity; promoting voluntary participation; ensuring no harm to participants, as approved by the ethics committee at the university where the research was conducted; and ensuring transparency in the presentation of research results. These steps were taken to prevent any coercion, even perceived, in their involvement in the study.

Findings

The purpose of this study was to look into the impact of Cami's AI integration in EFL instruction, as guided by the SAMR framework, on students' EFL writing (achievement) and perceptions. Hence, the presentation of the findings is based on the data to meet this research objective.

The Impact of Cami's AI Integration in EFL Instruction, as Guided by the SAMR Framework, on Students' EFL Writing Achievement

The EFL students joined two tests during the research implementation, pre-test and post-test. The pre-test was conducted before the treatment, implementation of Cami's AI-SAMR activities, in EFL writing class, and the post-test was done after the treatment. Those tests resulted in test scores, which were then analyzed statistically using the SPSS 24 version with the results shown in Tables 2 and 3.

Table 2
Descriptive Analysis of Students' Pre-test and Post-test Scores

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	70.7063	126	10.92671	.97343
	Post-test	77.1825	126	8.21355	.73172

Table 2 shows that there was an increasing average test score of 6.472. This result indicates that there was an impact of Cami's AI-SAMR activities to leverage EFL students' writing achievement.

Table 3
T-Test Analysis of Students' Pre-test and Post-test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre-test – Post-test	-6.47619	13.50065	1.20273	-8.85655	-4.09583	-5.385	125	.000

Then, Table 3 supports the findings explained in Table 2. The statistical calculation of the tests showed that there was a significant influence on the implementation of Cami's AI-SAMR on EFL students' writing achievement. It was seen from the Sig. a score of 0.000, meaning that there was a significant influence of the treatment on the dependent variable (EFL students' writing achievement), and there was a difference in scores between the Pre-Test and Post-Test.

The EFL Students' Perception of Cami's AI-SAMR Integration in EFL Writing Instruction

The EFL students' perceptions on the implementation of Cami AI-SAMR activity to support EFL writing learning were depicted from EFL students' responses in both questionnaire administration and the interview. The quantitative result of the questionnaire administration is prescribed in Figure 1.

Figure 1
The EFL Students' Perception of Cami AI-SAMR Implementation to Support EFL Writing Learning

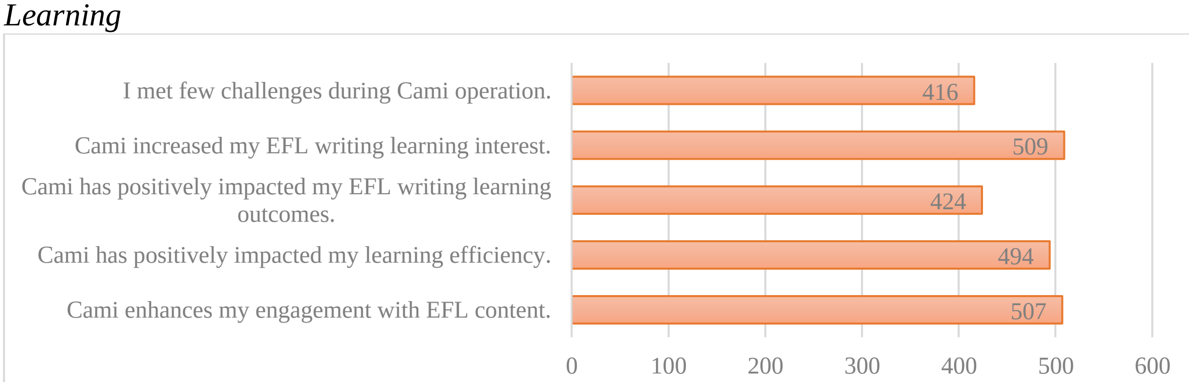

Figure 1 contains information on the questionnaire items asked of the EFL students and the total scores from each questionnaire item. From the prompt, the highest total score of a questionnaire item is 630. Hence, this figure depicts data that the majority of participants admitted Cami AI-SAMR implementation successfully leveraged their writing learning engagement and improved their writing learning efficiency. However, some scores lower than those positive perceptions appear to the ability of Cami AI-SAMR implementation to impact the writing outcome. This fact may be correlated to some challenges that the participants met during the writing practice using Cami AI. Furthermore, through responding to the open-ended question in the Cami AI-SAMR questionnaire, some participants stated some challenges they met during the Cami AI-SAMR implementation.

> I think writing in a small space like in a handphone is quite demanding. The screen is too small and I prefer writing my descriptive on paper. P17
>
> Since Cami's operation is separated from WAG [WhatsApp Group], it requires me to go from one site to another site in WA [WhatsApp]. It was a little bit confusing. P38
>
> Without the internet, Cami will not be helpful. P63
>
> The free Cami version only generates five images a day. However, I redesigned it many times. P101

So, from those excerpts, participants found that conformity of writing medium, internet access, connectivity between Cami and WhatsApp, and the limited feature of Cami AI free version were the issues to challenge the participants during the implementation.

To compare the participants' responses to the questionnaire, some participants who joined the interview stated that Cami AI's inability to generate precise images following the simple prompt meeting the participants' wants became one of the challenges. Also, some students said that Cami AI could not keep up with prompts that were previously stated by the participant. These challenges appear in the following excerpts.

> I found that Cami AI was sometimes not able to generate images that were as realistic or detailed as I would have liked. This made it difficult to write a descriptive text that was as vivid and accurate as I wanted it to be. P2
>
> I also found that Cami AI was sometimes not able to understand my instructions perfectly. This led to Cami AI generating images that were not quite what I was expecting. I had to spend some time adjusting my instructions and trying different things to get Cami AI to generate the image that I wanted. P7
>
> I also found that Cami AI was sometimes not able to keep up with my train of thought when I was writing. I would often have to repeat myself or rephrase my sentences to get Cami AI to understand what I was trying to say. P10

Similar to the quantitative results shown in Figure 1, the majority of the interview results showed that Cami AI-SAMR implementation boosted the participants' writing skills especially to get direct and more personalized feedback related to sentence structure and grammar, as well as for diction selection. Participants admitted that learning writing through Cami AI made them happy since it could be conducted 24/7 at any place and meet each participant's learning needs, especially in developing a desirable image as a writing guide.

> It was one of the most engaging and effective writing activities that I have participated in. Cami AI helped me to improve my writing skills in several ways, including helping me visualize my topic. The image guide helped me to think more carefully about my topic and to come up with more specific and descriptive language. Also, I found that Cami AI provided immediate feedback, which helped me improve my writing skills. Moreover, Cami AI encouraged me to experiment with different writing styles and techniques. Lastly, Cami AI created a safe and supportive environment where I felt comfortable experimenting with different writing styles and techniques." P4

> The activity helped me to develop my critical thinking skills. I now think more carefully about the words that I choose and the way that I structure my sentences. In addition, the activity helped me develop my creativity and come up with more engaging ways to express myself. I am now able to come up with more interesting and engaging ways to express myself. P5

> I like that Cami is available 24/7 for me to practice my writing. P8

> Cami provides personalized feedback based on my writing. P10

Some participants also retell their experiences on how Cami AI helped them compose descriptive text through the SAMR framework.

> When tasked with describing a mountain range, I turned to Cami AI for assistance. The AI recommended beginning with a powerful image of the mountains, like 'The snow-capped peaks piercing the azure sky.' It also advised me to include details on the colors, textures, and the awe-inspiring feeling of being surrounded by such magnificence. With Cami AI's guidance, my descriptive text became both informative and engaging. P1

> I recently had to write about a city street and sought help from Cami AI. It suggested starting with an overall impression of the street, such as 'The bustling city street alive with activity.' Cami AI also guided me to focus on specific elements like people, buildings, and sounds. Thanks to Cami AI's support, my descriptive text turned out vivid and informative. P4

Those excerpts showed that Cami AI helped them to substitute writing medium from paper into a technology-based writing medium. They also augmented the function of Cami AI to respond as a chatbot to talk about writing ideas. Then, Cami AI developed dialogic feedback for collaborative composition development with participants as they worked together to provide details in descriptive text. Lastly, two excerpts (P7 and P8) below showed the manipulation of Cami AI's function to reach the redefinition level in SAMR.

> I collaborated with a classmate on a blog post using Cami AI. We found Cami AI to be a great tool for helping us to write a well-organized and informative blog post. We used Cami AI to generate images and videos to support our blog post. We also used Cami AI to get feedback on our writing and to help us to optimize our blog post for search engines. P7
> I collaborated with a group of classmates on a social media campaign using Cami AI. We found Cami AI to be a very helpful tool for creating engaging and visually appealing social media posts. We used Cami AI to generate images and videos for our social media posts. We also used Cami AI to get feedback on our social media posts and to help us track our results. P8

Instead of creating a pace of autonomy in learning EFL writing, participants admitted that Cami AI-SAMR implementation directed them to collaborate with classmates.

> Yes, I have collaborated with classmates when using Cami AI for EFL writing. We found it to be a helpful way to get feedback on our work and to learn from each other. For example, we would often share our Cami-generated images and give each other feedback on the feedback that Cami AI provided. We also found it helpful to brainstorm ideas for descriptive text together. P1

From the overall participants' responses through the questionnaire and interview, the majority believed that Cami AI-SAMR positively impacted their EFL writing learning outcome, the enactment of a more personalized EFL writing learning experience, the improvement of learning motivation and interest, the creation of creative skills to use technology, and the growth of collaborative writing activities. On the other hand, a few participants admitted that Cami AI-SAMR had limitations that challenged participants during the writing class.

Discussion

Cami AI is an example of generative AI that enables users to generate information and images through typing prompts in the chat feature (Yu & Guo, 2023). This AI can serve as a personal chatbot to assist with any questions delivered to it. For academic purposes, Cami AI can be used as a personal teacher who gives direct feedback on the EFL student's text. Hence, EFL teachers can use it to support teaching with the goal of students' EFL learning achievement enhancement, including EFL writing learning, which becomes the raised issue in this research.

This research focused on how Cami AI-SAMR implementation affected the EFL students' EFL writing learning achievement and their perceptions. The findings showed that EFL students' writing achievement improved after the implementation of Cami AI-SAMR, which was characterized by the test score improvement (see Table 3) and the students' responses in the questionnaire (see Figure 1) and the interview. The sig. score was 0.000 or lower than 0.05, meaning that there was a significant difference between EFL students' writing pre-test and post-test. Table 2 showed that the students' post-test scores were higher than pre-test scores with a 6.472 points difference. The questionnaire and the interview results also reveal the potential of Cami AI-SAMR implementation to aid students in improving their writing achievement. These findings were supported by some previous studies mentioning that AI can enhance the EFL learning outcome (Aladini, 2023; Alamar & Amin, 2023; Ataizi & Aksak-Komür, 2021; Imamyartha et al., 2023; Marzuki et al., 2023; Wolf & Wolf, 2023; Zang & Aslan, 2021). Then, this study's findings counter Mohamed's (2023) study result to show that Cami AI-SAMR could leverage the EFL students' critical thinking skills by being more attentive to diction and sentence structure.

The improvement in EFL students' writing achievement was supported by some factors, which were also mentioned during the data collection. First, Cami AI-SAMR triggered the EFL students' learning interest (Kohnke et al., 2023). The students' interest leverages internal motivation that promotes EFL writing learning resilience for always improving (Muslimin & Cahyono, 2023). Second, the student's learning joys increased due to the flexibility of Cami AI to meet the student's personal needs across time, space, and feedback requests (Irwin, 2017; Schroeder et al., 2022; Wang et al., 2023; Wolf & Wolf, 2023). The students experienced less anxiety since the feedback was given personally to the EFL students without any fear of being judged (Koenka & Anderman, 2019; Tapalova & Zhiyenbayeva, 2022). Third, the students could make their descriptive writing composition coherent with the help of images generated by Cami AI (Ismayanti & Kholiq, 2020; Navidinia, 2019; Rizqullah et al., 2023). Fourth, the integration of technology using the SAMR framework guided the teacher to assist EFL students with the stage-by-stage descriptive writing process (Bhowmik, 2021; Canbay, 2020), which reduced learning complexity. The student learned to develop the composition from the simple step to a more advanced level along with familiarization with technology, Cami AI. Fifth, the EFL students were directed to learn EFL writing collaboratively during the Cami AI-SAMR implementation (Coffin, 2020; Muslimin et al., 2023). The students were delighted to share and ask for suggestions from peers regarding the image they generated and discuss the feedback given by the Cami AI. They also learned from each other about giving more accurate commands or prompts for Cami AI to make it accurately generate the desirable output.

In addition to improving the EFL students' writing achievement, most of the students believed that Cami AI-SAMR implementation also enhanced their learning engagement (Aliyu et al., 2022; Schroeder et al., 2022). The teacher requested them to keep interaction with Cami AI from the lowest stage of SAMR to the highest. The students enjoyed asking Cami AI for suggestions of ideas, experimenting with the images generated in Cami AI, and maintaining communication for descriptive writing improvement by requesting feedback. Furthermore, Cami AI promoted EFL writing efficiency (Mou & Li, 2022; Wolf & Wolf, 2023) since the students sometimes did not need to contact or meet their teacher to gain writing feedback. They could directly ask for instant feedback from Cami AI to efficiently use the time and maintain the flow of ideas for writing descriptive text. Supiani et al. (2023) stated that EFL students' AI-based writing self-assessment using Grammarly enhanced their motivation to write.

Instead of providing positive impacts, since Cami AI was newly introduced in 2023, it also triggered some recommendations due to challenges and limitations that the EFL students encountered. First, Cami AI should extend the limit of the images generated to accommodate the EFL students' needs during the trial-and-error stage (see excerpt of P101). Second, Cami AI can be equipped with a collaborative chatting feature such as a WhatsApp group that enables EFL students to discuss their composition without copying and pasting from a chatbot space (in Cami AI) to another chatbot space (in students' WhatsApp group or a classmate's WhatsApp private chat; see excerpt of P38). This recommendation addresses Barnett-Itzhaki et al.'s (2023) findings to attract EFL teachers' creativity to employ a variety of AI to increase learning efficacy and encourage the AI developer to keep evaluating for feature improvement. Third, Cami AI should be equipped with the ability to connect chat records to give more precise responses when students ask for feedback, which the prompts are still correlated to the previous prompts (see excerpt of P10). Lastly, Cami AI's image-generating ability should be advanced with various types of prompts to increase its accuracy (see excerpt of P7). Bozkurt and Sharma (2023) suggest that prompt engineers and education stakeholders should equip AI with adaptability to any language to respond to the prompts accurately. Hence, educational institutions and educational technology companies should collaborate to advance teaching and learning research, including AI development for education, to support better outcomes (Schroeder et al., 2022). These recommendations reflect that any AI has its strengths and weaknesses. Then, it is the job of EFL teachers to use Cami AI strength to empower their class to leverage the students' learning achievement (Tapalova & Zhiyenbayeva, 2022). It is successfully proven through the findings of this research.

Conclusion

This research aimed to investigate the impact of Cami AI-SAMR implementation on the students' EFL writing achievement and perceptions. The findings show that Cami AI-SAMR had a significant impact on the EFL students' writing achievement enhancement, which was validated by the test scores and students' responses in the questionnaire and interview. Therefore, the majority of the students perceived positively Cami AI integration into EFL writing instruction using the SAMR framework. Then, the students also contributed some recommendations to increase Cami AI operation practicality from the view of students who are learning EFL descriptive writing. This study's findings not only contribute to enhancing EFL students' writing achievement but also offer valuable insights for future researchers exploring the integration of AI technology to improve writing skills across diverse student populations.

In addition, this research serves theoretical and practical implications. Theoretically, it enriches the knowledge of generative AI for EFL teaching and learning. Practically, this research exemplifies the AI integration into EFL writing instruction through the SAMR framework, which opens application adoption for another teaching context. It also guides future researchers to conduct studies with similar interests and methodologies. Nevertheless, it is important to note that due to the limitations of the research setting and context, further investigation is recommended to achieve a more comprehensive understanding of the topic. Additionally, while the mixed methods approach employed in this study was suitable for addressing the research questions and providing comprehensive insights, it is crucial to acknowledge potential biases in data interpretation and the complexities associated with integrating qualitative and quantitative data, which may have influenced the study outcomes.

Declarations

The authors declare no conflicts of interest associated with this study, nor with the software product Cami or the commercial company WhatsApp.

Acknowledgment

The first author would like to extend genuine gratitude to LPDP (Indonesia Endowment Fund for Education), the Ministry of Finance of the Republic of Indonesia, for supporting this research.

References

Aladini, A. (2023). AI applications impact on improving EFL university academic writing skills and their logical thinking. *Educational Sciences Journal, 2*(4), 27–44. https://doi.org/10.21608/ssj.2023.320166

Alammar, A., & Amin, E.A. (2023). EFL students' perception of using AI paraphrasing tools in English language research projects. *Arab World English Journal, 14*(3), 166–181. https://dx.doi.org/10.24093/awej/vol14no3.11

Aliyu, J., Osman, S., Kumar, J. A., Talib, C. A., & Jambari, H. (2022). Students' engagement through technology and cooperative learning: A systematic literature review. *International Journal of Learning and Development, 12*(3), 23–40. http://dx.doi.org/10.5296/ijld.v12i3.20051

Ataizi, M., & Aksak-Komür, İ. (2021). Teaching writing skills in EFL classes with blended learning. *Journal of Educational Technology & Online Learning, 4*(4), 822–834. http://dx.doi.org/10.31681/jetol.932682

Barnett-Itzhaki, Z., Beimel, D., & Tsoury, A. (2023). Using a variety of interactive learning methods to improve learning effectiveness: Insights from AI models based on teaching surveys. *Online Learning, 27*(3), 363–386. http://dx.doi.org/10.24059/olj.v27i3.3575

Bhowmik, S. (2021). Writing instruction in an EFL context: Learning to write or writing to learn language? *BELTA Journal, 5*(1), 30–42. https://doi.org/10.36832/beltaj.2021.0501.03

Bozkurt, A., & Sharma, R. C. (2023). Generative AI and prompt engineering: The art of whispering to let the genie out of the algorithmic world. *Asian Journal of Distance Education, 18*(2), i–vii. https://doi.org/10.5281/zenodo.8174941

Cami. https://www.heycami.ai/

Canbay, F. (2020). EFL teachers' views about technology integration in English language teaching: A case study. *i-manager's Journal on English Language Teaching, 10*(2), 55–63. http://dx.doi.org/10.26634/jelt.10.2.16425

Cherner, T., & Mitchell, C. (2020). Deconstructing EdTech frameworks based on their creators, features, and usefulness. *Learning Media and Technology, 46*(3), 1–26 https://doi.org/10.1080/17439884.2020.1773852

Coffin, P. (2020). Implementing collaborative writing in EFL classrooms: Teachers and students' perspectives. *LEARN Journal: Language Education and Acquisition Research Network, 13*(1), 178–194. https://so04.tci-thaijo.org/index.php/LEARN/article/view/237844

Creswell, J. W. (2016). *Qualitative inquiry and research design*. SAGE.

Creswell, J., & Clark, V. (2017). *Designing and conducting mixed methods research* (3rd ed.). SAGE.

Dawadi, S., Shrestha, S., & Giri, R. A. (2021). Mixed-methods research: A discussion on its types, challenges, and criticisms. *Journal of Practical Studies in Education, 2*(2), 25–36. https://doi.org/10.46809/jpse.v2i2.20

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers, 3*, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. (2016). Examining the substitution augmentation modification redefinition (SAMR) model for technology integration. *TechTrends, 60*, 433–441. http://dx.doi.org/ 10.1007/s11528-016-0091-y

Imamyartha, D., Widiati, U., Anugerahwati, M., & Hamat, A. (2023). Moodle and Telegram to develop students' language performance and knowledge co-construction in technology-enhanced CLIL. *SIELE, 10*(2), 863–883. https://doi.org/10.24815/siele.v10i2.28295

Irwin, B. (2017). Written corrective feedback: Student preferences and teacher feedback practices. *IAFOR Journal of Language Learning, 3*(2), 35–58. https://files.eric.ed.gov/fulltext/EJ1167256.pdf

Ismayanti, E., & Kholiq, A. (2020). An analysis of students' difficulties in writing descriptive text. *E-Link Journal, 7*(1), 10. http://dx.doi.org/10.30736/ej.v7i1.260

Knapik, M. (2006). The qualitative research interview: Participants' responsive participation in knowledge making. *International Journal of Qualitative Methods, 5*(3), 77–93. https://doi.org/10.1177/160940690600500308

Koenka, A., & Anderman, E. M. (2019). Personalized feedback as a strategy for improving motivation and performance among middle school students. *Middle School Journal, 50*(5), 15–22. http://dx.doi.org/10.1080/00940771.2019.1674768

Kohnke, L., Moorhouse, B. L., & Zou, D. (2023). ChatGPT for language teaching and learning. *RELC Journal, 54*(2), 537–550. https://doi.org/10.1177/00336882231162868

Marzuki, Widiati, U., Rusdin, D., Darwin, & Indrawati, I. (2023). The impact of AI writing tools on the content and organization of students' writing: EFL teachers' perspective. *Cogent Education*, *10*, 2, 2236469. https://doi.org/10.1080/2331186X.2023.2236469

Mamoon-Al-Bashir, M., Kabir, R., & Rahman, I. (2016). The value and effectiveness of feedback in improving students' learning and professionalizing teaching in higher education. *Journal of Education and Practice*, *7*(16), 38–41. https://files.eric.ed.gov/fulltext/EJ1105282.pdf

Mohamed, A. M. (2023). Exploring the potential of an AI-based Chatbot (ChatGPT) in enhancing English as a Foreign Language (EFL) teaching: Perceptions of EFL Faculty Members. *Education Information Technology*. https://doi.org/10.1007/s10639-023-11917-z

Mou, X., & Li, R.Y.M. (2022). The impact of artificial intelligence educational robots in the field of education: A PRISMA review. In R. Y. M. Li, K. W. Chau, D. C. W. Ho (Eds.), *Current state of art in artificial intelligence and ubiquitous cities*. Springer. https://doi.org/10.1007/978-981-19-0737-1_4

Muslimin, A. I., & Cahyono, B. Y. (2023). Online learning readiness, motivation, and English learning achievement in higher education. *MEXTESOL*, *4*(3), 1–14. https://www.mextesol.net/journal/index.php?page=journal&id_article=46454

Muslimin, A. I., Mukminatien, N., & Ivone, F. M. (2023). TPACK-SAMR digital literacy competence, technostress, and teaching performance: Correlational study among EFL lecturers. *Contemporary Educational Technology, 15*(2), ep409. https://doi.org/10.30935/cedtech/12921

Naeem, M., Ozuem, W., Howell, K., Ranfagni, S. (2023). A step-by-step process of thematic analysis to develop a conceptual model in qualitative research. *International Journal of Qualitative Research, 22*(1), 1–18. https://doi.org/10.1177/16094069231205789

Navidinia, H., Ozhan, A. R., & Younesi, A. (2018). Using pictures in the English as a foreign language (EFL) classroom: Exploring its potential contribution for developing students' writing skills. *Asia Pacific Journal of Educators and Educations*, *33*, 1–17. https://doi.org/10.21315/apjee2018.33.1

Othman, S. M. E., Steen, M., & Fleet, J. (2020). A sequential explanatory mixed methods study design: An example of how to integrate data in a midwifery research project. *Journal of Nursing Education and Practice*, *11*(2), 75–89. https://doi.org/10.5430/jnep.v11n2p75

Puentedura, R. (2014). *Learning, technology, and the SAMR model: Goals, processes, and practice*. SAGE.

http://www.hippasus.com/rrpweblog/archives/2014/06/29/LearningTechnologySAMRModel.pdf.

Rizqullah, A. M., Sudiro, S., & Abdul Karim, S. (2023). A closer look at the EFL students' grammatical errors in writing descriptive text. *Ethical Lingua: Journal of Language Teaching and Literature, 10*(1), 33–43. https://doi.org/10.30605/25409190.559

Schroeder, K., Hubertz, M., Van Campenhout, R., Johnson, B. G. (2022). Teaching and learning with AI-generated courseware: Lessons from the classroom. *Online Learning, 26*(3), 73–87. https://doi.org/10.24059/olj.v26i3.3370

Sharma, A., Lin, I. W., Miner, A. S., Atkins, D. C., & Althoff, T. (2022). Human–AI collaboration enables more empathic conversations in text-based peer-to-peer mental health support. *Nature Machine Intelligence, 5*, 46–57. https://doi.org/10.1038/s42256-022-00593-2

Supiani, S., Rahmawati, N. M., Ratnawati, Widyaningsih, T. L., Suryati, N., & Mukminatien, N. (2023). EFL students' language accuracy development through self-assessment from online written feedback: How do they experience and perceive it?. *Call-EJ, 24*(2), 260–280. https://callej.org/index.php/journal/article/view/14

Tai, M. C. (2020). The impact of artificial intelligence on human society and bioethics. *Tzu Chi Medical Journal, 32*(4), 339–343. https://doi.org/10.4103/tcmj.tcmj_71_20

Tapalova, O., & Zhiyenbayeva, N. (2022). Artificial intelligence in education: AIEd for personalized learning pathways. *The Electronic Journal of e-Learning, 20*(5), 639–653. http://dx.doi.org/10.34190/ejel.20.5.2597

Wang, J. K., Wang, S. K., Lee, E. B., Chang, R. T. (2023). Natural language processing (NLP) in AI. In K. Yogesan, L. Goldschmidt, J. Cuadros, G. Ricur (Eds.), *Digital eye care and teleophthalmology*. Springer. https://doi.org/10.1007/978-3-031-24052-2_17

Wolf, R. R., & Wolf, A. B. (2023). Using AI to evaluate a competency-based online writing course in nursing. *Online Learning, 27*(3), 41–69. https://doi.org/10.24059/olj.v27i3.3974

Yaw, K., Plonsky, L., Larsson, T., Sterling, S., & Kytö, M. (2023). Research ethics in applied linguistics. *Language Teaching, 56*(4), 478–494. https://doi.org/10.1017/s0261444823000010

Youngs, H., & Piggot-Irvine, E. (2012). The application of a multiphase triangulation approach to mixed methods: The research of an aspiring school principal development program. *Journal of Mixed Methods Research, 6*(3), 184–198. https://doi.org/10.1177/1558689811420696

Yu, H., & Guo, Y. (2023). Generative artificial intelligence empowers educational reform: Current status, issues, and prospects. *Frontiers in Education, 8,* 1183162. https://doi.org/10.3389/feduc.2023.1183162

Zang, K., & Aslan, A. B. (2021). AI technologies for education: Recent research & future directions. *Computers and Education: Artificial Intelligence, 2,* 100025. https://doi.org/10.1016/j.caeai.2021.100025

Appendix 1

Cami AI-Powered EFL Instruction: User Questionnaire

Thank you for participating in our research. Your ideas are valuable in understanding the integration of Cami's AI capabilities into EFL instruction. Your answers will be kept confidential.

<table>
<tr><td>Name (Optional):</td><td colspan="2"></td></tr>
<tr><td>Semester of study:</td><td colspan="2"></td></tr>
<tr><td rowspan="5">Perceptions of Cami:
Please rate your agreement with the following statements about your experience with Cami! (write the score: 1 = strongly disagree, 5 = strongly agree)</td><td>Cami enhances my engagement with EFL content.</td><td></td></tr>
<tr><td>Cami has positively impacted my learning efficiency.</td><td></td></tr>
<tr><td>Cami has positively impacted my EFL writing learning outcomes.</td><td></td></tr>
<tr><td>Cami increased my EFL writing learning interest</td><td></td></tr>
<tr><td>I met a few challenges during Cami AI-SAMR's operation</td><td></td></tr>
<tr><td>Final thought:
(write your responses in the box)</td><td>Is there anything else you would like to share about your experiences with Cami, its integration within EFL instruction, or any suggestions for improvement?</td><td></td></tr>
</table>

Thank you for your participation. Your feedback is invaluable to our research.

Appendix 2

Cami AI-Powered EFL Instruction: Interview Guideline

Thank you for participating in our research. Your ideas are valuable in understanding the integration of Cami's AI capabilities into EFL instruction. Your answers will be kept confidential.

1. How would you describe your experience with Cami AI in EFL writing instruction?
2. Can you share any examples of Cami AI facilitating different SAMR stages in your writing assignments?
3. What benefits have you experienced in your writing tasks due to Cami AI?
4. Have you encountered any challenges or limitations when using Cami AI for writing? Please describe them.

5. Have you collaborated with classmates or peers when using Cami AI for EFL writing? If yes, can you describe those experiences?

Generative AI Generating Buzz: Volume, Engagement, and Content of Initial Reactions to ChatGPT in Discussions Across Education-Related Subreddits

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Abstract

Despite widespread discussions, insights into GenAI's impact on education have been limited because early studies have often been narrow in scope and focused on specific contexts. Therefore, the purpose of this study is to explore and analyze the volume, engagement, and content of initial reactions to one leading GenAI tool, ChatGPT. Specifically, we collected and analyzed public online discussions of ChatGPT in the first four months following the tool's release. We collected 345 posts and 6,463 comments about ChatGPT from 25 education-focused subreddits. We analyzed the volume, engagement, and content of ChatGPT discussions through descriptive statistics and natural language processing techniques. Findings show relatively low *volume* of ChatGPT discussions, unevenly spread across education-related subreddits—with the majority of the discussions occurring in two subreddits, while six subreddits did not have any discussions. Despite this, the level of *engagement* within ChatGPT posts was substantial; for instance, a ChatGPT post hosted a median of 15 comments, and these comments were lengthy, indicating rich engagement rather than superficial. The *content* of ChatGPT discussions across the six largest education-related subreddits differed in the degree of analytical thinking and emotional tone even while sharing a predominant focus on students and AI. Diverse reactions to and perspectives on GenAI—observed from varied levels of volume, engagement, and content of ChatGPT across educational-related subreddits—highlights how diverse educational stakeholders reacted to GenAI differently, offering insights into how to explore, analyze, and comprehend the spread and adoption of technological innovation in education.

Keywords: ChatGPT, GenAI, Reddit, affinity spaces, technology reaction, learning analytics

Staudt Willet, K. B., & Na, H. (2024). Generative AI generating buzz: Volume, engagement, and content of initial reactions to ChatGPT in discussions across education-related subreddits. *Online Learning, Volume 28*(2), (96-123). DOI: 10.24059/olj.v28i2.4434

Incorporating new technologies into educational settings has been widely advocated by the common belief that these tools enhance teaching and learning, and that developing technology-related skills is essential for students to become successful members of society (Davies & West, 2014). These views have led to the perpetual introduction of emerging technologies into education during the past century. For example, Cuban (1986) traced classroom-technology integration from film (1910s) to radio (1920s) to television (1960s). Weller (2020) examined more contemporary applications of technology in education, chronicling the year that 25 technologies became significant in the field of education, starting with digital bulletin board systems (1994) and continuing with the web (1995), wikis (1998), e-learning (1999), learning management systems (2002), virtual worlds (2007), social media (2009), massive open online courses (MOOCs; 2012), and artificial intelligence (AI; 2016).

The reaction to and reception of new technologies in education have often been mixed. Cuban (1986) noted that film, radio, and television were all met with initial resistance. On the opposite end of the reaction spectrum, overhyping technologies has been a persistent reality in education. For instance, Cuban (2003) described how the promise of computers in classrooms was "oversold and underused" in the 1990s, as school districts made large purchases of computers but provided no training or guidance to teachers for how to use them. There has been a long history of promising technology-led changes and transformations to teaching and learning, but these promises not being fully realized (Cuban, 1986, 2003). Even as technologies have come and gone from the educational realm, there has been an overall impact of technology on education—not only on teachers and students, but also on school systems and educational policies (Kalolo, 2019; Tamim et al., 2011).

As technological advances seem to be developed more rapidly than ever, deeper understanding of historic and social context (i.e., a sociohistorical perspective), away from the initial hype, is essential for making real progress (Moore et al., 2024). In 2023, *generative AI* (GenAI) tools—that is, AI-driven technologies capable of creating new content (e.g., written essays, images, music, computer code) based on the patterns learned from large datasets (Stokel-Walker & Van Noorden, 2023)—seemed to be ubiquitous topics of conversation in education circles. This immediate and widespread reaction is reminiscent of the reception to other educational technologies in the past. First launched on November 30, 2022, the ChatGPT GenAI chatbot (OpenAI, 2022) caused a stir in education because of its easy-to-use interface and significantly improved performance over past AI language models (Bozkurt, 2023). In the months following its release, numerous conversations about ChatGPT quickly emerged (Bahroun et al., 2023), including many among educators (Lo, 2023).

Following the heightened interest in ChatGPT, each month of 2023 witnessed the introduction of new GenAI tools or notable improvement in their performance (Martin, 2023). For instance, ChatGPT 4.0, released on March 14, 2023, outperformed earlier versions (OpenAI, 2023) and Google's Gemini, released on December 6, 2023, replaced and improved upon its predecessor, Bard (Pichai & Hassabis, 2023). The potential *benefits* of these increasingly powerful GenAI tools—such as new conversational pedagogies enabled by GenAI dialogue agents (Bozkurt & Sharma, 2023)—are being examined alongside debates about *detriments* such as new avenues for cheating or accidental misallocation of credit (Oravec, 2023). In addition, there are new legal controversies as GenAI push the bounds of copyright and attribution as well as responsibility for online content created with these new tools (Perault, 2023).

Both positive and negative, reactions to GenAI in education have been seemingly frequent in terms of *volume*, active and ongoing in terms of *engagement*, and diverse in terms of *content*. However, understanding the reactions prompted by ChatGPT's release and subsequent GenAI adoption has been more anecdotal than rigorous and systematic. Therefore, the purpose of this study is to explore and analyze the volume, engagement, and content of initial reactions to one leading GenAI tool, ChatGPT in the first four months following the tool's release. To accomplish this purpose, we collected and analyzed discussions about ChatGPT spanning 25 education-related affinity spaces hosted on the social media platform Reddit. This research design supplements the survey and interview approaches of past studies, which have been limited in scope and context.

Literature Review

To begin this investigation of the reactions to ChatGPT in the field of education, we first examine relevant past research. Specifically, we review the literature to understand how past research has explored reactions to new technologies in education generally, as well as applications of AI and GenAI tools in education specifically.

Reactions to New Technologies in Education

Considering the significant impact of new technologies in education, numerous studies have explored how diverse educational stakeholders respond or react to the integration of new technologies. These studies have often drawn upon theoretical frameworks, such as the Technology Acceptance Model (TAM) and Innovation Diffusion Theory (IDT), to analyze these responses (e.g., Frei-Landau et al., 2022; Habibi et al., 2023; Wingo et al., 2017). TAM (Davis, 1989) delineates how individuals accept and use new technology based on two salient factors: perceived usefulness and perceived ease-of-use. In recent research, for instance, Habibi et al. (2023) explored undergraduate students' acceptance of ChatGPT, and Mailizar et al. (2021) investigated teachers' behavioral intention to accept online education through a TAM lens.

Offering a wider perspective than TAM, IDT has been applied to explain how new technologies spread within a community over time (Rogers, 2003). In education, IDT has been used to explore and explain educational stakeholders' technology adoption processes across time (e.g., Frei-Landau et al., 2022). This theory further categorizes people based on when they start using new technology (e.g., early adopters, laggards) and identifies factors influencing an individual's decision to adopt an innovation (e.g., perceived compatibility, how-to knowledge). Although TAM and IDT differ in scope and focus, research has indicated that TAM and IDT converge on certain aspects. For instance, two salient factors of TAM can be seen as a subgroup of factors in IDT (Lee et al., 2011). Put together, these theories emphasize crucial considerations for the new technology adoption process—either *affective* (i.e., attitudes or perceptions toward an innovation) or *intellectual* (i.e., level of understanding about an innovation).

Applications of AI and GenAI Tools in Education

AI encompasses a range of definitions due to its cross-disciplinary nature, but the term broadly refers to machines or computers that perform cognitive tasks, particularly for learning and problem-solving (Chen, Chen, & Lin, 2020). Recognizing the capabilities of AI, applications of AI in education have received considerable attention from educational researchers and practitioners for over 30 years, and this interest has notably intensified in recent years with rapid technological advancements, such as deep learning algorithms (Hwang et al., 2020). Several reviews have highlighted diverse applications of AI in education, including learner profiling, students' performance automatic assessment and prediction, facilitating personalized and adaptive learning experiences, and supporting making an informed decision on educational policies and practices (Chen, Xie, Zou, & Hwang, 2020; Hwang et al., 2020).

Applying AI in education has often faced a variety of challenges, despite its potential as a powerful tool for improving teaching and learning (Hwang et al., 2020; Picciano, 2019). In terms of potential, past studies have underscored that AI can offer intelligent tutoring systems or personalized and adaptive learning guidance (Hwang et al., 2020). AI can also empower educators in various ways; for instance, it can help instructors tailor teaching strategies based on learner profiling data (Huang et al., 2023) and provide timely and individualized feedback (Pokrivcakova, 2019; Wolf & Wolf, 2023). However, in terms of challenges, ethical concerns and data privacy are two significant issues among many others, as illustrated by a recent study assessing 22 AI ethics guidelines (Hagendorff, 2020). Furthermore, there remains a lack of concrete and practical guidance for educators trying to integrate AI into education (Zhang & Aslan, 2021).

The recent rise to prominence of a specific type of AI, generative AI (GenAI) tools, has prompted renewed discussions of pedagogy. Like earlier debates, these more recent discussions have again spanned the full range from potential to challenges. The category of GenAI tools includes technologies that can generate new content based on pre-trained patterns learned from large datasets (Stokel-Walker & Van Noorden, 2023). Producing new content—both in the form of understanding and generating human-like outputs across a broad range of topics (Kelly, 2023)—distinguishes GenAI from other types of AI.

The enhanced accessibility of GenAI—allowing users to interact with the tool in the familiar form of a chatbot—open new possibilities in education while raising familiar and persistent questions and concerns (Chiu, 2023). For instance, recent studies have suggested that GenAI tools can be used as intelligent tutoring systems providing personalized feedback for learners (Lo, 2023) as well as assisting educators with lesson planning and grading (Dai et al., 2023; Topsakal & Topsakal, 2022). However, at the same time, other studies have pointed out concerns about academic dishonesty and an overreliance on these tools that can hinder the development of critical thinking and cognitive skills (e.g., Cotton et al., 2023; Hung & Chen, 2023).

To date, much of the GenAI research base has been narrow in scope and focused on specific contexts—not able to offer a comprehensive understanding of the volume, engagement, and content of such discussions. For instance, numerous studies have employed close-ended surveys to explore educators' perceptions of GenAI tools. Mandal and Mete (2023) surveyed 100 secondary school teachers and students, and Woodruff et al. (2023) surveyed 4,528 K–12 educators. Although Woodruff et al. (2023) had many more participants, their findings were limited due to simple and closed-ended questions. Several studies have employed mixed-method design to explore the content of their discussions. For instance, ElSayary (2023) investigated Dubai secondary teachers' perceptions of using ChatGPT for teaching and learning using an explanatory sequential mixed-methods design. The initial survey consisted closed-ended items, and although the follow-up interviews added a depth of understanding, the small number of interview participants (n = 7) limited the breadth of implications. Similarly, Moura and Cavalho (2024) employed a similar research design, but only nine teachers participated in the study. In a purely qualitative study focusing on higher education, Iqbal et al. (2022) individually interviewed 20 faculty members in a private university—offering deep and nuanced understanding in a specific context, not broad trends. In sum, although these studies have captured specific details of educators' initial reactions to GenAI tools, a more comprehensive investigation regarding the volume, engagement, and content of initial reactions to GenAI in education is still warranted.

Framework

We approach our current investigation with an *affinity space* lens. Gee (2004) defined affinity spaces as environments—whether virtual, physical, or a combination of both—where individuals gather around shared interests or goals. Affinity spaces emphasize open membership and varied levels of participation, ensuring everyone can participate in such spaces without concerning participants' age, gender, race, and expertise level. Affinity spaces are most concerned with what users choose to do with the space, allowing flexibility to examine how much people contribute (i.e., volume), how they interact with each other and the content of the space (i.e., engagement), and how these interactions align with the shared affinity of the spaces (i.e., content). Previous studies have applied the concept of affinity spaces to Reddit, identifying subreddits as distinct affinity spaces that accommodate users with specific interests (e.g., Carpenter et al., 2018; Na & Staudt Willet, 2022; Na et al., 2024; Robinson et al., 2023). This affinity-space lens appeared particularly useful for our investigation, as ChatGPT discussions within various education-related subreddits manifest a wide range of perspectives from diverse participants who are interested in its impact on education.

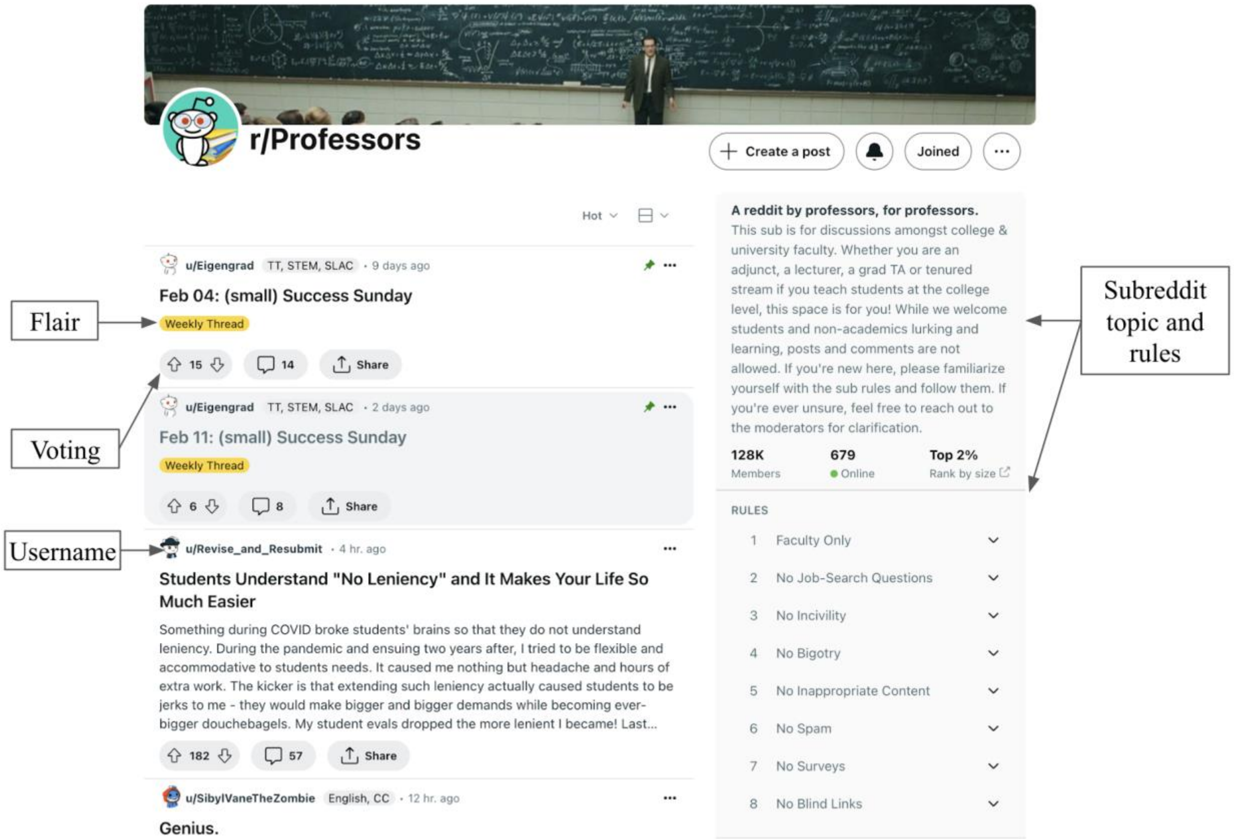
Purpose

With this past research in mind, the purpose of this study is to explore and analyze the volume, engagement, and content of initial reactions to one leading GenAI tool, ChatGPT. To gain a broad understanding, we examined numerous discussions about ChatGPT in education-related affinity spaces on the social media platform, Reddit.

Reddit is a suitable site for examining reactions to a new technology in education for numerous reasons. First, Reddit is big, consistently one of the most popular social media platforms in the United States (fourth in April 2024) with more than two billion monthly visits (Similarweb, 2024). Second, reflecting its motto of "Dive Into Anything" (RedditInc, 2024), Reddit hosts a diverse array of conversations in distinct discussion forums. These discussion forums, called *subreddits*, provide spaces where users engage by posting and commenting (Figure 1). As of 2024, Reddit has more than 100,000 active subreddits (RedditInc, 2024) that cover an extensive spectrum of topics, including serious (e.g., r/Teachers, r/MachineLearning), trivial (e.g., r/DuckDuckJeep, which is dedicated to pictures of ducks with Jeeps), and detrimental (e.g., r/druggardening). Between Reddit's overall size and numerous subreddits, it is likely that users can find subreddits to meet their needs and interests, even if these are very niche.

Figure 1

A Screenshot of the r/Professors Subreddit



In addition to its size and range of topics, Reddit has additional features that support the possibility of observing initial reactions to new technologies like GenAI, and ChatGPT specifically. For example, Reddit allows users to add "flairs" to their posts, which is a tagging system for indexing content within a subreddit. Also, Reddit has a voting system that allows users to *upvote* (i.e., +1) and *downvote* (i.e., -1) posts and comments, and the platform's algorithm prioritizes recent content with the most cumulative votes, making popular topics more visible. Finally, each subreddit is moderated by a team of volunteers who can remove content that is irrelevant to the shared interests of the subreddit. The result is that education-related subreddits like r/Teachers are largely on-topic (Carpenter et al., 2018; Carpenter & Staudt Willet, 2021). However, the process of moderation can leave some users feeling like their legitimate contributions were unfairly excluded and that some subreddits are not as open as they purport to be.

In addition to these platform features, Reddit users have developed norms that can foster open conversations about new technologies. For instance, users' anonymity is the norm—Reddit does not have an identity verification process, and most users use pseudonyms to identify themselves, with no link to their real identities (Haythornthwaite et al., 2018). Anonymity can potentially enable users to share their honest experiences and engage in discussions freely in education-related subreddits (Carpenter & Staudt Willet, 2021; Henninger, 2020; Na & Staudt

Willet, 2022) but can also facilitate the spread of harmful, promotional, or irrelevant content (Massanari, 2017). In addition, anonymity means that posts and comments cannot be definitively attributed to educators—instead, only the content of posts and comments can be determined to be relevant to the educational topic of the subreddit, or not. Finally, in the context of these features and norms, ChatGPT and GenAI discussions may be more likely to occur because Reddit users are more likely to be more technologically adept than the general population (Richard et al., 2021; Simmonds, 2023).

Research Questions

With this context in mind, the purpose of this study is to explore and analyze initial reactions to a leading GenAI tool, ChatGPT. To gain a broad understanding, we examined conversations about ChatGPT in numerous education-related subreddits. We seek to answer three research questions related to the volume, engagement, and content of subreddit discussions in the first few months after ChatGPT's release:

- RQ1. What was the volume of ChatGPT discussions in education-related subreddits in the initial months following the tool's launch?
- RQ2. What was the engagement with ChatGPT discussions in education-related subreddits?
- RQ3. What was the content of ChatGPT discussions in education-related subreddits?

Method

To answer the research questions, we used a naturalistic, unobtrusive approach (Lincoln & Guba, 1985) to collect and analyze *digital traces* (Lee et al., 2017) of conversations about ChatGPT in education-related subreddits, similar to approaches in prior research (e.g., Carpenter et al., 2018; Haythornthwaite et al., 2018; Na & Staudt Willet, 2022; Na et al., 2024; Staudt Willet & Carpenter, 2020, 2021). This approach allowed us to quickly gain a broad perspective on initial reactions to ChatGPT across numerous distinct education-related affinity spaces, at a large scale. These methods provide a complementary approach with a different set of limitations than the self-reported data and narrower context of the survey and interview studies that have examined GenAI and ChatGPT to date. Although not suitable for describing internal motivations or experiences, a digital traces approach offers opportunities to observe how people think and behave naturally—avoiding the confounding effects of self-reports or interventions (Lee et al., 2017).

Data Collection

To collect data, we used the statistical programming languages Python (Python Software Foundation, 2024) and R (R Core Team, 2024) to search for any posts in 25 education-related subreddits containing the keyword text "chatgpt" from January 1, 2022 (much earlier than

ChatGPT's release on November 30, 2022, in case ChatGPT was mentioned prior to its official launch) through March 31, 2023 (four months after release). We purposefully selected the 25 education-related subreddits, starting with the 16 that officially comprise the Reddit Education Network listed in r/education (e.g., r/education, r/Teachers, and r/matheducation). Following explorations from our past Reddit studies (Carpenter & Staudt Willet, 2021; Muljana et al., 2022; Na & Staudt Willet, 2022; Na et al., 2024; Staudt Willet & Carpenter, 2020, 2021), we added nine additional education-related subreddits to include more perspectives from higher education (e.g., r/academia, r/Professors) and K–12 teachers' experiences (e.g., r/TeachersinTransition, r/teaching). Although we collected data from a broad range of education-related affinity spaces, it is important to note that this sample does not represent all educators, because those posting on Reddit are likely to be above-average technology users (Richard et al., 2021; Simmonds, 2023) with an interest in discussing the emerging technology of GenAI. Furthermore, we were only able to collect posts and comments that were publicly accessible at the time of collection in April 2023. Nevertheless, although imperfect, the data we collected do offer a broader perspective on reactions to ChatGPT than most studies to date and offer a useful addition to the growing knowledge base. In total, we collected 345 posts and 6,463 comments pertaining to ChatGPT in 19 education-related subreddits (i.e., six subreddits had no discussions of ChatGPT in the first four months), with the earliest ChatGPT post occurring in r/Teachers on December 6, 2022.

Data Analysis

We conducted a variety of quantitative and computational analyses to answer our research questions. To analyze *volume* (RQ1), we created a scatter plot of posts and comments about ChatGPT over time, separating out the 19 subreddits (Figure 2). To analyze *engagement* (RQ2), we calculated descriptive statistics such as median word count per post and comment by subreddit, response rate to posts, and median length of conversations (Table 1). To analyze *content* (RQ3), we conducted several natural language processing analyses. First, we used *Linguistic Inquiry and Word Count* (LIWC) software (Pennebaker et al., 2015a), a rigorously pre-trained machine learning classifier, to computationally assess 23 language features in the six most popular education-related subreddits (each had at least 50,000 subscribers as of April 5, 2023): r/Teachers, r/education, r/Professors, r/teaching, r/academia, and r/highereducation (Figures 3–4). Specifically, we examined a variety of LIWC measures of language use: four *summary* measures (analytic, clout, authentic, tone), five *affect* measures (positive emotions, negative emotions, anxiety, anger, sadness), seven *cognitive processes* measures (overall, insight, casual, discrepancies, tentative, certainty, differentiation), and seven *personal* measures (work, leisure, home, money, social, family, friend). Finally, we used R (R Core Team, 2024) to perform term-frequency analysis. That is, we identified the most-used terms in ChatGPT posts and comments in the six most popular subreddits, and we then created a heat map visualization of these term frequencies (Figure 5).

Results

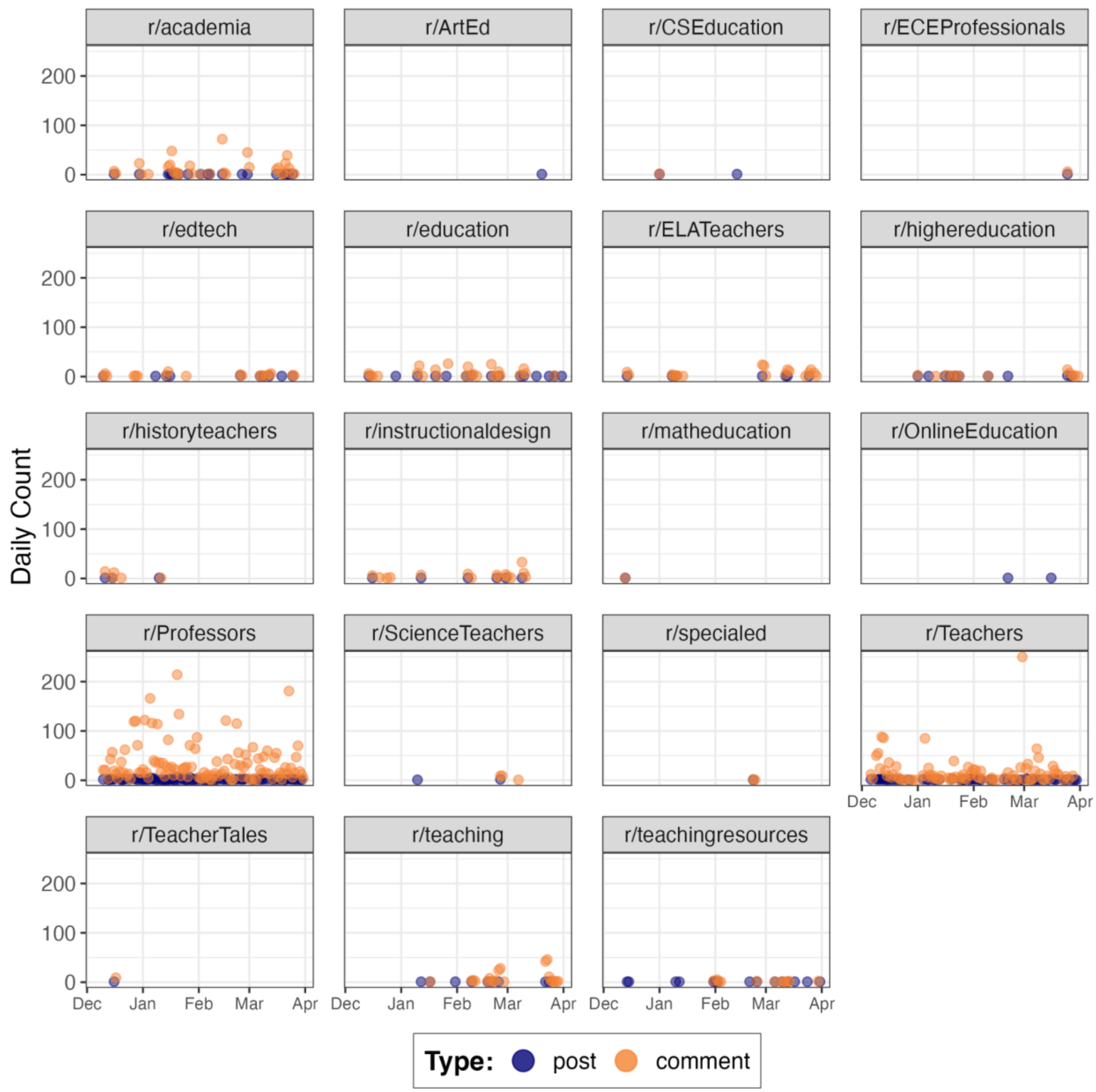
RQ1. What was the volume of ChatGPT discussions in education-related subreddits in the initial months following the tool's launch?

ChatGPT discussions were widespread across various education-related subreddits, but the majority of the discussions took place in the r/Professors and r/Teachers subreddits. The first ChatGPT discussion in an education-related subreddit was in r/Teachers on December 6, 2023—a week after ChatGPT's launch. ChatGPT discussions began in r/Professors (December 10) and r/edtech (December 10) soon after. Six of the education-related subreddits did not have any discussions of ChatGPT in the first four months after its launch.

Among the 19 subreddits that had ChatGPT posts and comments (Figure 2), several volume profiles are evident. The subreddits r/academia, r/education, r/Professors, and r/Teachers had fairly consistent and ongoing ChatGPT discussions throughout the four-month period. Meanwhile, r/edtech, r/ELATeachers, r/highereducation, r/instructionaldesign, r/teaching, and r/teachingresources had numerous ChatGPT discussions, but these were more sporadic. The remaining nine subreddits had a much lower volume, with r/historyteachers, r/matheducation, and r/TeacherTales having a few ChatGPT discussions in the first month but none after that, whereas r/ArtEd, r/ECEProfessionals, r/OnlineEducation, and r/specialed did not have any ChatGPT discussions until the third or fourth month—and even at that point, only had a few posts and comments. Finally, r/CSEducation and r/ScienceTeachers also had low volume, with a few sporadic ChatGPT discussions spread out over time.

Figure 2

Daily Posts and Comments about ChatGPT in Education-Related Subreddits



RQ2. What was the engagement with ChatGPT discussions in education-related subreddits?

We report numerous measures of participants' engagement in 25 education-related subreddits (Table 1), sorted by the total sum of comments and posts about ChatGPT in these spaces through March 2023. We again note that six subreddits did not have any ChatGPT posts during this period. In several subreddits, the volume of ChatGPT discussions is substantial in terms of the total number of posts and comments, as can be observed for r/Professors, r/Teachers, and r/academia in Figure 2 and Table 1. However, even in these cases, the impact on the overall discourse in the subreddit is very low, with ChatGPT only being mentioned in 3.9% of r/Professors posts, in 1.7% of r/academia posts, and just 0.6% of r/Teachers posts. Similarly, although the speech-language pathology subreddit, r/slp (2,798 posts and 37,526 subscribers), the early childhood education subreddit, r/ECEProfessionals (1,284 posts and 26,200 subscribers), and r/TeachersInTransition (896 posts and 6,063 subscribers) were all very active spaces, none of their discussions pertained to ChatGPT, except for one post in r/ECEProfessionals.

The *response rate* (i.e., the likelihood that a ChatGPT post would receive a comment in response) was high for many of the education-related subreddits. For r/Professors and r/Teachers, the response rate was nearly universal, at 96.0% and 94.1%, respectively—this means that nearly every time someone posted about ChatGPT in these subreddits, someone else responded to them. Across the 10 subreddits with at least five ChatGPT posts, the response rate was over 70%, except in the case of r/teachingresources (46.7%).

Despite high response rates, the ChatGPT posts generated differing degrees of sustained interest. In the top-10 subreddits (i.e., those with at least five ChatGPT posts), seven had a median *thread length*—that is, the median number of comments in response to a ChatGPT post—of eight or higher, with r/Professors again having the highest engagement with a median of 15 comments per post. However, posts in r/teachingresources (median thread length zero), r/highereducation (median thread length one), and r/edtech (median thread length four) received many fewer responses.

Finally, the length of ChatGPT posts and comments also varied by subreddit. The median word counts of ChatGPT posts in r/instructionaldesign (147 words), r/Teachers (128 words), r/education (93 words), and r/Professors (81 words) demonstrate more than superficial engagement with ChatGPT in these spaces. We also observe that the median word count of comments on ChatGPT varies much less by subreddit, with most averaging 30–40 words per comment.

Table 1

Engagement in ChatGPT Conversations Across 25 Education-related Subreddits

	Subreddit	Subreddit Subscribers *n*	Total Posts *n*	ChatGPT Posts *n* (%)	Post Word Count median	Response Rate %	Thread Length median	Post Upvote Ratio median	Total ChatGPT Comments *n*	Comment Word Count Median	Earliest ChatGPT Post
1	r/Professors	114,965	3,799	148	81	96.0	15	0.8	3,829	31	12/10/22

				(3.9%)							
2	r/Teachers	419,352	13,298	84 (0.6%)	128	94.1	8	0.7	1,462	32	12/6/22
3	r/academia	57,860	1,332	22 (1.7%)	21	81.8	8	0.8	399	34	12/16/22
4	r/education	166,688	2,390	16 (0.7%)	93	75.0	9	0.7	177	37	12/14/22
5	r/teachingresources	32,329	643	15 (2.3%)	56	46.7	0	0.9	20	20	12/14/22
6	r/highereducation	52,686	674	12 (1.8%)	17	75.0	1	0.8	38	28	12/31/22
7	r/edtech	18,441	258	11 (4.3%)	29	72.7	4	0.8	53	38	12/10/22
8	r/teaching	108,342	2,131	9 (0.4%)	20	77.8	11	1.0	188	34	1/12/23
9	r/ELATeachers	15,990	323	7 (2.2%)	28	100.0	12	0.9	131	35	12/14/22
10	r/instructionaldesign	23,641	726	6 (0.8%)	147	100.0	11	0.8	97	35	12/16/22
11	r/ScienceTeachers	37,097	515	3 (0.6%)	52	33.3	0	1.0	19	34	1/10/23
12	r/historyteachers	12,847	313	3 (1.0%)	58	100.0	14	0.9	29	41	12/11/22
13	r/CSEducation	23,733	77	2 (2.6%)	328	50.0	1	0.8	2	69	1/1/23

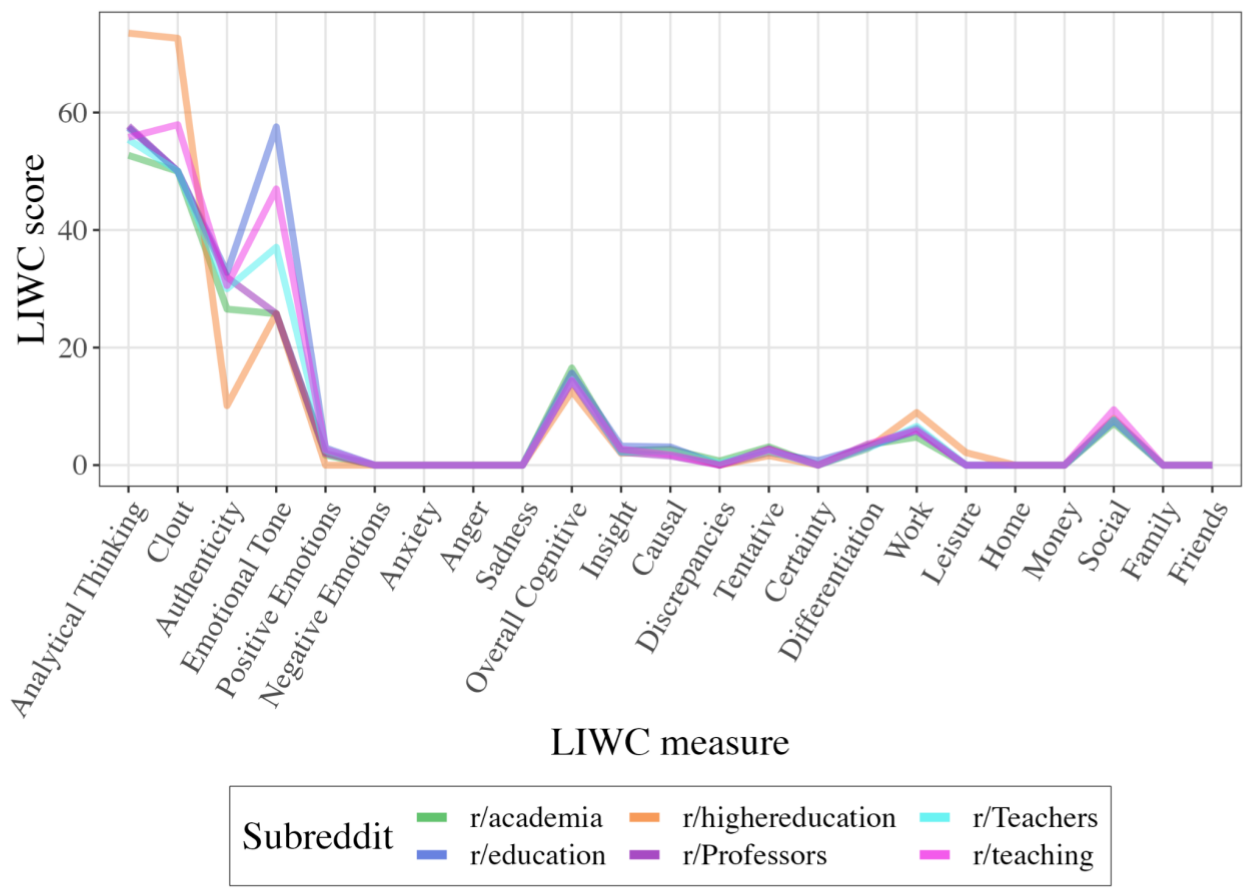
14	r/OnlineEducation	13,973	449	2 (0.4%)	15	0.0	0	0.8	0	0	2/20/23
15	r/ArtEd	6,173	198	1 (0.5%)	9	0.0	0	1.0	0	0	3/20/23
16	r/ECEProfessionals	26,200	1,284	1 (0.1%)	62	100.0	6	0.5	6	22	3/24/23
17	r/TeacherTales	29,919	134	1 (0.7%)	80	100.0	9	0.8	9	14	12/16/22
18	r/matheducation	24,315	282	1 (0.4%)	6	100.0	1	1.0	1	28	12/13/22
19	r/specialed	13,635	537	1 (0.2%)	44	100.0	3	1.0	3	42	2/22/23
20	r/AdultEducation	4,155	24	0 (0.0%)	0	0.0	0	0.0	0	0	NA
21	r/MusicEd	15,906	292	0 (0.0%)	0	0.0	0	0.0	0	0	NA
22	r/TeachersInTransition	6,063	896	0 (0.0%)	0	0.0	0	0.0	0	0	NA
23	r/itinerantteachers	2	6	0 (0.0%)	0	0.0	0	0.0	0	0	NA
24	r/slp	37,526	2,798	0 (0.0%)	0	0.0	0	0.0	0	0	NA
25	r/teacherspromote	468	50	0 (0.0%)	0	0.0	0	0.0	0	0	NA

RQ3. What was the content of ChatGPT discussions in education-related subreddits?

The six largest subreddits were nearly identical across most LIWC categories (Figure 3). All six subreddits had medium levels of overall cognitive processing as well as a small emphasis on insight, casual, and tentative. LIWC analysis also showed more emphasis, in each subreddit, on work and social matters compared to an absence of leisure, home, money, family, and friends.

Figure 3

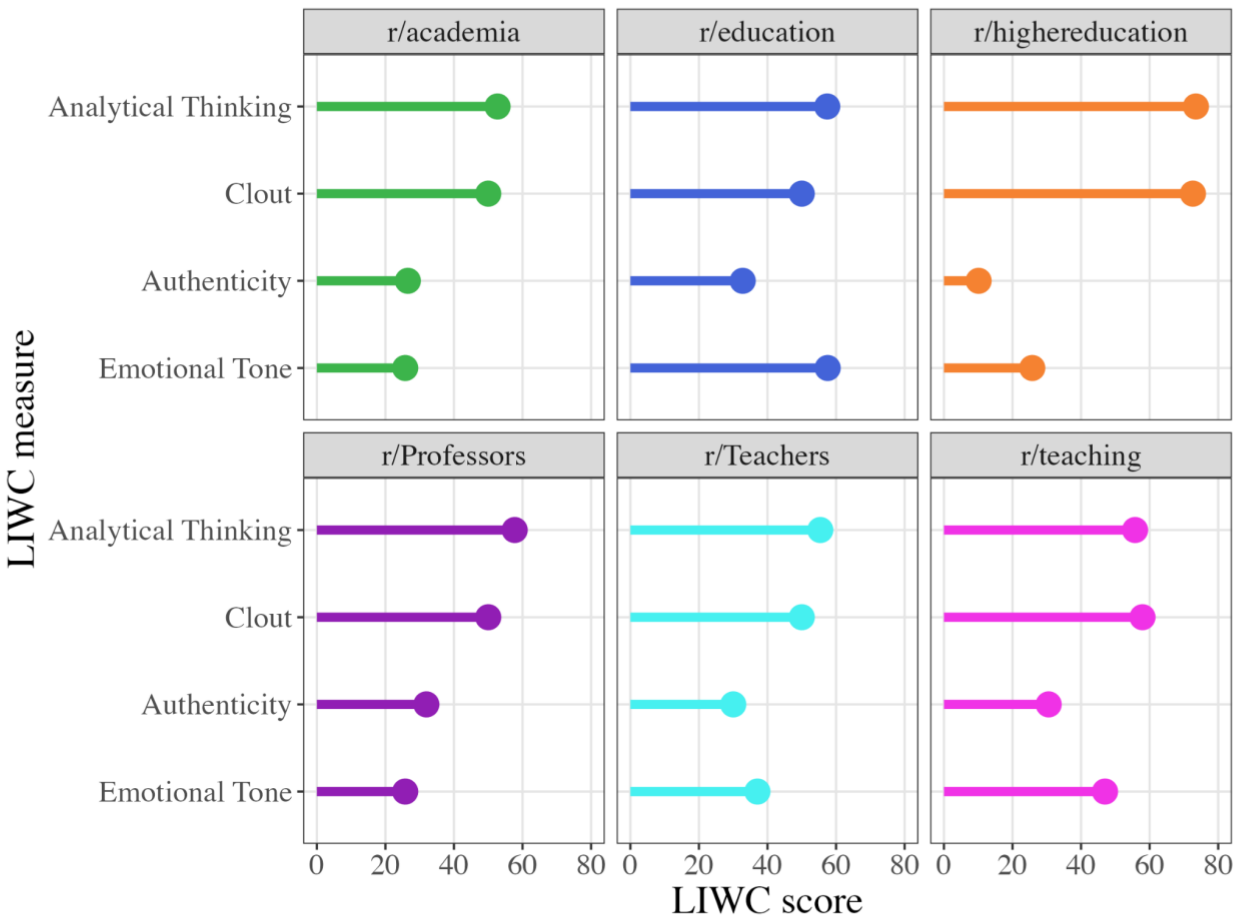
Linguistic Inquiry and Word Count Measures by Subreddit



Content in the six largest subreddits varied across the LIWC summary categories of analytical thinking, clout, authenticity, and emotional tone (Figure 4). The higher *analytical thinking* score in r/highereducation reflects more "formal, logical, and hierarchical thinking" (Pennebaker et al., 2015b, p. 22), whereas the relatively lower score in the other five subreddits reflect "informal, personal, here and now, and narrative thinking." *Clout*, again highest in r/highereducation and relatively high in r/teaching, suggests authorship that is confident and offering an expert's perspective, whereas the relatively lower clout scores in the other four subreddits suggests writing that is more tentative (Pennebaker et al., 2015b). In terms of *authenticity*, r/highereducation is once again the outlier, but in this case, scoring much lower than the other five subreddits, reflecting writing that is more distant and guarded. The other five subreddits' somewhat higher authenticity scores suggest content that is more personal and disclosing (Pennebaker et al., 2015b). Finally, the content of the six largest subreddits varied by *emotional tone* more than any other measure. Pennebaker et al. (2015b) interpreted a higher score to reflect more positive and upbeat writing, whereas a lower score suggested a more negative or downbeat style. This means that r/education appears to be the most optimistic about ChatGPT, whereas r/academia, r/highereduation, and r/Professors are pessimistic. r/Teachers is also on the pessimistic side, but slightly less so, and r/teaching, with an emotional tone score close to 50, showed a more neutral or ambivalent view of ChatGPT.

Figure 4

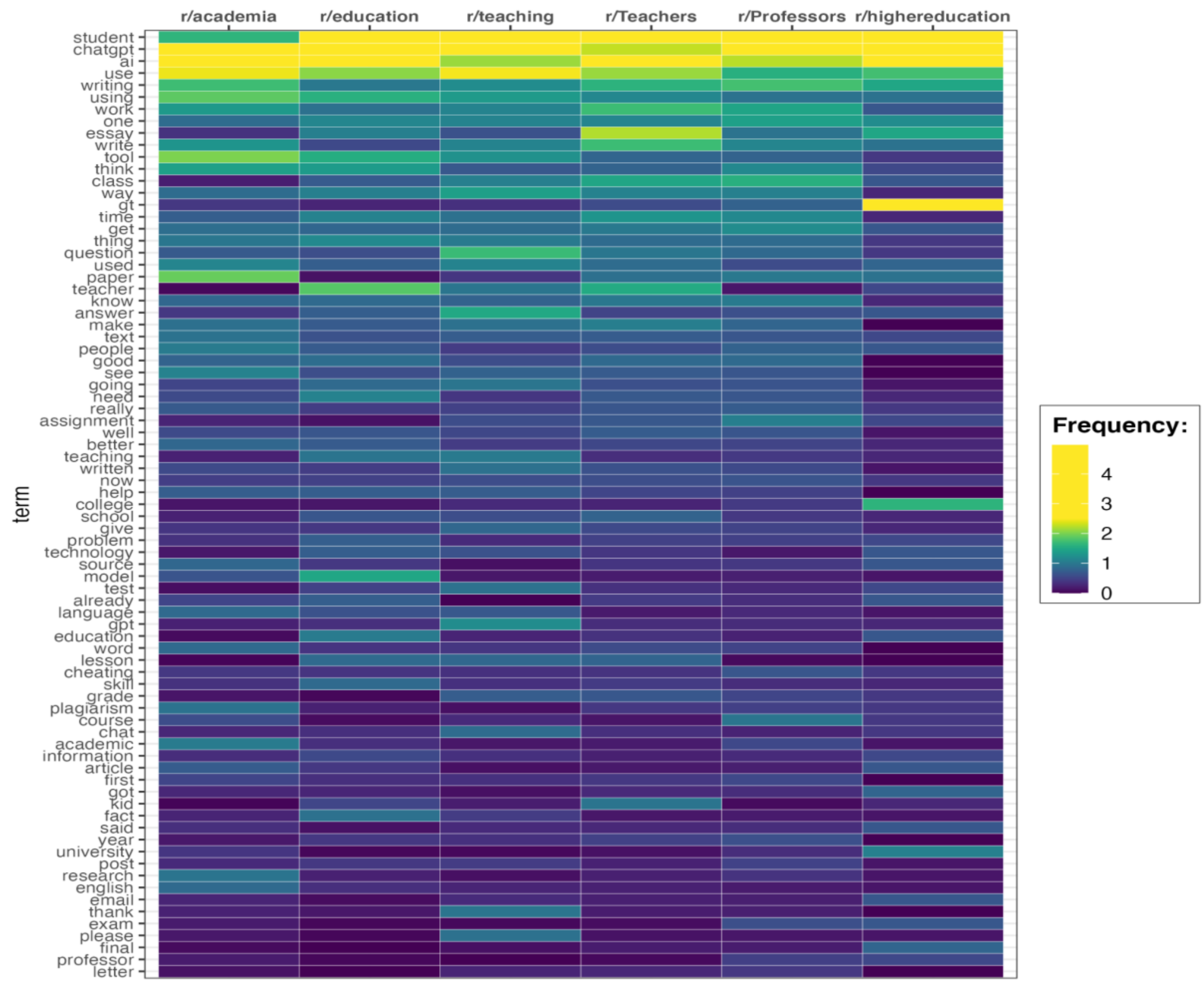
Summary LIWC Measures by Subreddit



Finally, our term-frequency analysis (Figure 5) showed that discussions of ChatGPT in the six largest subreddits most often pertained to *students* (although to a lesser degree in r/academia), *ChatGPT* (all posts would contain ChatGPT as a keyword, but not necessarily all comments associated with those posts), and *AI*. Beyond these commonalities, the subreddits varied slightly by the most-used terms. The columns of Figure 5 are sorted so that the most similar subreddits are next to each other. First, r/academia emphasized *use/using* and *write/writing* (as did other subreddits), with a distinct emphasis on words like *tool*, *paper*, *plagiarism*, *research*, and *English*, more than the other subreddits. This suggests a particular concern for academic dishonesty through ChatGPT. Second, r/education also emphasized *use/using*, but less so *write/writing*, and also included *teacher*, *model*, *skill*, and *fact* more than the other subreddits. This set of terms could suggest a focus in r/education on teachers' role in responding to ChatGPT. Third, in r/teaching, the frequent use of the terms *question*, *answer*, *thank*, and *please* distinguish it from the other subreddits, suggesting a space where participants were actively trying to figure out ChatGPT together. Fourth, r/Teachers includes the terms *essay*, *writing/write, work*, *class*, *think*, and *teacher* relatively more than the other subreddits. This suggests that r/Teachers participants were discussing ChatGPT to understand impacts on teachers' instructional practice, such as essays and writing. Fifth, r/Professors uses the terms *write/writing*, *class*, *course*, and *assignment* at a high rate compared to the other subreddits. This suggests that ChatGPT discussions in r/Professors have addressed the scope of impact at the course level, not just the individualistic perspective of students or instructors. Finally, r/highereducation has a striking rate of inclusion of the terms *GT* and *college/university*, as well as a relatively high use of *essay*. This suggests that ChatGPT discussions in r/highereducation may have focused on Georgia Tech (GT), whose admissions blog (see Clark, 2023a, 2023b) actively encouraged prospective students to use ChatGPT to assist in the college search and application process.

Figure 5

Term Frequency by Subreddit



Discussion

Our purpose in this study is to explore and analyze the volume, engagement, and content of initial reactions to one leading GenAI tool, ChatGPT. We address a gap in the research base by designing a rigorous and systematic approach to gaining a broad understanding of ChatGPT reactions by analyzing discussions in 25 education-related subreddits across the first four months following ChatGPT's launch.

When considered in aggregate, a first major theme in the findings are the patterns of both similarities and differences across various subreddits—reinforcing past evidence that when digital spaces are organized around a simple principle of shared interests, participants can choose how to use and fill those spaces to meet their needs. For instance, our findings from 25 subreddits are reminiscent of Carpenter and colleagues' (2022) conclusions from 16 education-related X/Twitter hashtags—especially that different affinity spaces meet different needs. For example, here it seems evident that r/academia is meeting a slightly different need than r/Teachers. While both subreddits host ChatGPT discussions centered on students and AI, relatively consistent in volume over time (albeit with r/Teachers as a higher volume), r/academia emphasized issues of academic dishonesty while r/Teachers focused more on impacts to instructional practice. Understandably, r/academia also seemed to take a more pessimistic view of ChatGPT compared to r/Teachers, as measured by the LIWC emotional-tone score. In fact, all three higher education subreddits (r/academia, r/Professors, and r/highereducation) were more pessimistic than the general education/K–12 subreddits (r/Teachers, r/Teaching, and r/education). Given that the five most frequently mentioned terms (i.e., students, ChatGPT, AI, use/using, and write/writing) reflect discussions on how students might use ChatGPT for writing tasks, the heightened level of pessimism in higher-education-related subreddits makes sense because higher education places great importance on writing and academic integrity (Boehm et al., 2009).

A second major theme in the findings is the relatively low volume of ChatGPT discussions against the backdrop of regular and ongoing discussions in education-related subreddits. At most, 1 in 23 posts (4.3%) were about ChatGPT in r/edtech—the highest rate in any of the education-related subreddits. The subreddit with the most ChatGPT posts by far, r/Professors, saw 1 in 26 posts (3.9%) pertaining to ChatGPT. In r/Teachers, the largest education-related subreddit, by far, in terms of subscribers, had only 1 in 158 posts (0.6%) on ChatGPT. It is possible that participants in these spaces saw more ChatGPT content than the raw numbers suggest because of Reddit's algorithms. Still, it is likely that media outlets—including academic journals—have contributed to the overinflated attention given to ChatGPT (e.g., Bahroun et al., 2023; Lo, 2023), continuing historic patterns of hype around educational technologies (e.g., Cuban, 1986, 2003).

Given the scarcity of ChatGPT discussions in education-related subreddits, those who did participate may be viewed as innovators or early adopters who generally have a deeper interest in technological advancements than the majority. Thus, despite the infrequency of ChatGPT posts, the existing discussions were marked by a consistent and sustained *volume* across the four-month period. Furthermore, numerous *engagement* metrics (e.g., response rate, thread length, word count) and the LIWC score for analytical thinking were relatively high. This suggests interest in scrutinizing ChatGPT's strengths, weaknesses, and potential applications—at least among a few early adopters. The ability for a small subset of the overall subreddit participants to create and engage with topics and content important to them—even while most other users are not impacted—again demonstrates the flexibility of affinity spaces that are defined simply by a shared interest. In this case, even within a single subreddit, some users can continue regular, ongoing discussions while others are free to react to and examine an emerging technology like ChatGPT. This is reminiscent of how X/Twitter users have been observed to use the same hashtag affinity space for different purposes (Greenhalgh et al., 2020).

Implications

Implications for Practitioners

The results suggest that practitioners can look to education-related subreddits to glean insights on ChatGPT, GenAI, and other emerging technologies from the reactions of early adopters. These discussions can serve as a reference point for exploring the possibilities and perils of new tools for instructional practice as well as their own self-directed professional learning. However, echoing Carpenter and colleagues' (2022) admonition from their study of 16 education-related X/Twitter hashtags, it is important that practitioners be aware that different education-related subreddits have been used for different purposes (e.g., Carpenter & Staudt Willet, 2021; Staudt Willet & Carpenter, 2021). Each subreddit is an affinity space loosely organized around a shared interest, but from there, what users do with the space can vary substantially. Practitioners should explore several different subreddits that might be relevant to their own level (e.g., r/ECEProfessionals, r/Professors) or subject area (e.g., r/ELATeachers, r/ScienceTeachers) in addition to the broad subreddits (e.g., r/Teachers, r/teaching). Even when focused on something as specific as reactions to a new technology, our findings show that participants in these spaces take different approaches. Depending on a practitioner's needs and interests, they may find some subreddits more suitable than others.

Implications for Leaders and Policymakers

For educational leaders and policymakers, discussions in education-related subreddits can serve as valuable indicators of popular and trending topics that may be worth addressing from their positions of influence, especially as they develop guidelines and policies governing the use of GenAI in education. For instance, the differences in volume—both in terms of the number and frequency of ChatGPT posts in various education-related subreddits—suggest that concern about ChatGPT in its first four months was not shared equally across different corners of education. These differences are reinforced by the varied levels of engagement and varied levels of analytical thinking and emotional tone in different subreddits, indicating that emerging technologies like ChatGPT and other GenAI tools can elicit diverse reactions and perspectives.

Being able to follow these ChatGPT discussions in situ will allow educational stakeholders to see early reactions before perceptions have been shaped by broader discourse on social media and traditional media outlets. Viewing these discussions in education-related subreddits could be particularly advantageous because Reddit users are above-average technology users (Richard et al., 2021; Simmonds, 2023) who can offer a window into the perceptions and experiences of early adopters in the diffusion of innovation process (Bennett, 2014).

Implications for Researchers

For educational researchers, the data mining and analytics methods used in this study could be applied to monitor and assess emerging trends in education through measures of volume, engagement, and content. This monitoring could be automated to alert various educational stakeholders, including practitioners, leaders, and policymakers. The trends would not necessarily be limited to reactions to new technologies but could also include responses to societal changes or new legislation—or even unexpected disasters that prompt the need for immediate response and forms of *just-in-time* professional development (Greenhalgh & Koehler, 2017). Reddit would likely be a good source for data mining information spanning many aspects of education. LIWC measures, especially analytical thinking and emotional tone, plus term-frequency analysis seem to be a rapid-yet-robust way to analyze textual data. This approach updates and applies, in situ, strategies for monitoring well-being through diary entries (Tov et al., 2013), resulting in a powerful method for understanding rapid reactions across education.

Limitations and Future Research

Future research should continue collecting posts and comments from these 25 education-related subreddits—and any additional relevant affinity spaces that can be identified—to see how ChatGPT and broad GenAI conversations further progress. Analyses of this digital-trace data could be expanded as well, perhaps using supervised machine learning classification to assess similarities and differences between these emerging discussions more rigorously. Furthermore, because Reddit is not representative of all educational stakeholders—and likely leans toward more tech-savvy users—future research should seek to explore and analyze reactions to GenAI tools among all educators, especially those who would typically be late adopters of emerging technologies. Regardless of approach, much more work is needed to understand reactions and responses to emerging technologies, with a specific focus on GenAI in the near future.

Conclusion

Incorporating technology into education has long prompted strong reactions, whether resistance or hype. The recent rise to prominence of GenAI and the debates sparked by ChatGPT specifically are the latest manifestation of both technological resistance and hype. The potential of GenAI to both enhance and challenge teaching, learning, and the systems of education (Bahroun et al., 2023; Chiu, 2023) warrants deliberate attention and more rigorous response. For instance, one insight from this current study is that no more than 4.3% of posts in any subreddit were about ChatGPT. This finding can be interpreted from a sociohistorical perspective (Moore et al., 2024) to regard the technology in a new light: when ChatGPT is discussed, engagement is high and a variety of topics are covered (hype)—but more than 95% of the time, regular discussions continue as before (resistance). That is, there is potential, but this potential must be viewed realistically. The work of systematically and rigorously evaluating reactions to ChatGPT and GenAI—to understand these tools from a sociohistorical perspective—must continue as emerging technologies will continue to intersect and impact education.

Author Note

The authors report no conflicts of interest in conducting this study. The study was approved by the Institutional Review Board (IRB) at the authors' home institution. Materials for data analysis are shared through GitHub: https://github.com/bretsw/reddit-chatgpt/

References

Bahroun, Z., Anane, C., Ahmed, V., & Zacca, A. (2023). Transforming education: A comprehensive review of generative artificial intelligence in educational settings through bibliometric and content analysis. *Sustainability*, *15*(17), 12983. https://doi.org/10.3390/su151712983

Bennett, E. (2014). Learning from the early adopters: Developing the digital practitioner. *Research in Learning Technology*, *22*, 21453. http://doi.org/10.3402/rlt.v22.21453

Boehm, P. J., Justice, M., & Weeks, S. (2009). Promoting academic integrity in higher education. *The Community College Enterprise*, *15*(1), 45–61. https://home.schoolcraft.edu/cce/search-archives/289

Bozkurt, A., & Sharma, R. C. (2023). Generative AI and prompt engineering: The art of whispering to let the genie out of the algorithmic world. *Asian Journal of Distance Education, 18*(2). https://doi.org/10.5281/zenodo.817494

Bozkurt, A. (2023). Generative artificial intelligence (AI) powered conversational educational agents: The inevitable paradigm shift. *Asian Journal of Distance Education, 18*(1), 198–204. https://doi.org/10.5281/zenodo.7716416

Carpenter, J., McDade, C., & Childers, S. (2018, March). Advice seeking and giving in the Reddit r/Teachers online space. In *Proceedings of the society for information technology & teacher education international conference* (pp. 2207–2215). Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/p/182831/

Carpenter, J. P., & Staudt Willet, K. B. (2021). The teachers' lounge and the debate hall: Anonymous self-directed learning in two teaching-related subreddits. *Teaching and Teacher Education, 104*, 103371. https://doi.org/10.1016/j.tate.2021.103371

Carpenter, J., Tani, T., Morrison, S., & Keane, J. (2022). Exploring the landscape of educator professional activity on Twitter: An analysis of 16 education-related Twitter hashtags. *Professional Development in Education, 48*(5), 784–805. https://doi.org/10.1080/19415257.2020.1752287

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access*, *8*, 75264–75278. https://doi.org/10.1109/ACCESS.2020.2988510

Chen, X., Xie, H., Zou, D., & Hwang, G. J. (2020). Application and theory gaps during the rise of artificial intelligence in education. *Computers and Education: Artificial Intelligence, 1*, 100002. https://doi.org/10.1016/j.caeai.2020.100002

Chiu, T. K. (2023). The impact of Generative AI (GenAI) on practices, policies and research direction in education: A case of ChatGPT and Midjourney. *Interactive Learning Environments*, 1–17. https://doi.org/10.1080/10494820.2023.2253861

Clark, R. (2023a, July 20). *Juniors. Can we chat(GPT)?* Georgia Tech Admission Blog. https://sites.gatech.edu/admission-blog/2023/07/20/juniors-can-we-chatgpt/

Clark, R. (2023b, July 27). *Seniors, can we ChatGPT?* Georgia Tech Admission Blog. https://sites.gatech.edu/admission-blog/2023/07/27/seniors-can-we-chatgpt/

Cotton, D. R., Cotton, P. A., & Shipway, J. R. (2023). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International*, 1–12. https://doi.org/10.1080/14703297.2023.2190148

Cuban, L. (1986). *Teachers and machines: The classroom of technology since 1920*. Teachers College Press.

Cuban, L. (2003). *Oversold and underused: Computers in the classroom*. Harvard University Press.

Dai, W., Lin, J., Jin, H., Li, T., Tsai, Y. S., Gašević, D., & Chen, G. (2023, July). Can large language models provide feedback to students? A case study on ChatGPT. In *2023 IEEE International Conference on Advanced Learning Technologies (ICALT)* (pp. 323–325). IEEE. https://doi.org/10.1109/ICALT58122.2023.00100

Davies, R. S., West, R. E. (2014). Technology integration in schools. In J. Spector, M. Merrill, J. Elen, & M. Bishop (Eds.), *Handbook of research on educational communications and technology* (pp. 841–853). Springer. https://doi.org/10.1007/978-1-4614-3185-5_68

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

ElSayary, A. (2023). An investigation of teachers' perceptions of using ChatGPT as a supporting tool for teaching and learning in the digital era. *Journal of Computer Assisted Learning*. https://doi.org/10.1111/jcal.12926

Frei-Landau, R., Muchnik-Rozanov, Y., & Avidov-Ungar, O. (2022). Using Rogers' diffusion of innovation theory to conceptualize the mobile-learning adoption process in teacher education in the COVID-19 era. *Education and Information Technologies, 27*(9), 12811–12838. https://doi.org/10.1007/s10639-022-11148-8

Gee, J. P. (2004). *Situated language and learning: A critique of traditional schooling*. Routledge.

Greenhalgh, S. P., & Koehler, M. J. (2017). 28 days later: Twitter hashtags as "just in time" teacher professional development. *TechTrends, 6*1, 273–281. https://doi.org/10.1007/s11528-016-0142-4

Greenhalgh, S. P., Rosenberg, J. M., Staudt Willet, K. B., Koehler, M. J., & Akcaoglu, M. (2020). Identifying multiple learning spaces within a single teacher-focused Twitter hashtag. *Computers & Education, 148*, 103809. https://doi.org/10.1016/j.compedu.2020.103809

Habibi, A., Muhaimin, M., Danibao, B. K., Wibowo, Y. G., Wahyuni, S., & Octavia, A. (2023). ChatGPT in higher education learning: Acceptance and use. *Computers and Education: Artificial Intelligence*, *5*, 100190. https://doi.org/10.1016/j.caeai.2023.100190

Hagendorff, T. (2020). The ethics of AI ethics: An evaluation of guidelines. *Minds and Machines*, *30*(1), 99–120. https://doi.org/10.1007/s11023-020-09517-8

Haythornthwaite, C., Kumar, P., Gruzd, A., Gilbert, S., Esteve del Valle, M., & Paulin, D. (2018). Learning in the wild: Coding for learning and practice on Reddit. *Learning, Media and Technology*, *43*(3), 219–235. https://doi.org/10.1080/17439884.2018.1498356

Henninger, N. M. (2020). "I gave someone a good death": Anonymity in a community of Reddit's medical professionals. *Convergence: The International Journal of Research into New Media Technologies, 26*(5–6), 1391–1410. https://doi.org/10.1177/1354856519847329

Huang, A. Y., Lu, O. H., & Yang, S. J. (2023). Effects of artificial intelligence-enabled personalized recommendations on learners' learning engagement, motivation, and outcomes in a flipped classroom. *Computers & Education*, *194*, 104684. https://doi.org/10.1016/j.compedu.2022.104684

Hung, J., & Chen, J. (2023). The benefits, risks and regulation of using ChatGPT in Chinese academia: A content analysis. *Social Sciences, 12*(7), 380. https://doi.org/10.3390/socsci12070380

Hwang, G. J., Xie, H., Wah, B. W., & Gašević, D. (2020). Vision, challenges, roles and research issues of Artificial Intelligence in Education. *Computers and Education: Artificial Intelligence, 1*, 100001. https://doi.org/10.1016/j.caeai.2020.100001

Iqbal, N., Ahmed, H., & Azhar , K. A. (2022). Exploring teachers' attitudes towards using Chatgpt. *Global Journal for Management and Administrative Sciences, 3*(4), 97–111. https://doi.org/10.46568/gjmas.v3i4.163

Kalolo, J. F. (2019). Digital revolution and its impact on education systems in developing countries. *Education and Information Technologies, 24,* 345–358. https://doi.org/10.1007/s10639-018-9778-3

Kelly, S. M. (2023, January 26). ChatGPT passes exams from law and business schools. *CNN*. https://www.cnn.com/2023/01/26/tech/chatgpt-passes-exams/index.html

Lee, R. M., Fielding, N. G., & Blank, G. (2017). Online research methods in the social sciences: An editorial introduction. In N. G. Fielding, R. M. Lee, & G. Blank (Eds.), *The SAGE handbook of online research methods* (2nd ed.). SAGE.

Lee, Y. H., Hsieh, Y. C., & Hsu, C. N. (2011). Adding innovation diffusion theory to the technology acceptance model: Supporting employees' intentions to use E-learning systems. *Journal of Educational Technology & Society, 14*(4), 124–137.

Lincoln, Y. S., & Guba, E. G. 1985. *Naturalistic inquiry*. SAGE.

Lo, C. K. (2023). What is the impact of ChatGPT on education? A rapid review of the literature. *Education Sciences, 13*(4), 410. https://doi.org/10.3390/educsci13040410

Mailizar, M., Almanthari, A., & Maulina, S. (2021). Examining teachers' behavioral intention to use E-learning in teaching of mathematics: An extended TAM model. *Contemporary Educational Technology, 13*(2), ep298. https://doi.org/10.30935/cedtech/9709

Mandal, R., & Mete, J. (2023). Teachers' and students' perception towards integration of artificial intelligence in school curriculum: A survey. *International Journal of Multidisciplinary Educational Research, 12*(7), 5.

Martin, D. (2023, June 12). *The ChatGPT-fueled AI gold rush: How solution providers are cashing in*. CRN. https://www.crn.com/news/software/the-chatgpt-fueled-ai-gold-rush-how-solution-providers-are-cashing-in

Massanari, A. (2017). #Gamergate and the Fappening: How Reddit's algorithm, governance, and culture support toxic technocultures. *New Media & Society, 19*(3), 329–346. https://doi.org/10.1177/1461444815608807

Moore, S., Hedayati-Mehdiabadi, A., Law, V., & Kang, S. P. (2024). The change we work: Professional agency and ethics for emerging AI technologies. *TechTrends, 68,* 27–36. https://doi.org/10.1007/s11528-023-00895-1

Moura, A., & Carvalho, A. A. A. (2024, February). Teachers' perceptions of the use of artificial intelligence in the classroom. In *International Conference on Lifelong Education and Leadership for All (ICLEL 2023)* (pp. 140–150). Atlantis Press.

Muljana, P. S., Staudt Willet, K. B., & Luo, T. (2022). Adjusting sails for changing winds: Exploring Reddit use for professional purposes in higher education. *Journal of Computing in Higher Education, 34*(3), 679–707. https://doi.org/10.1007/s12528-022-09317-2

Na, H., & Staudt Willet, K. B. (2022). Affinity and anonymity benefitting early career teachers in the r/Teachers subreddit. *Journal of Research on Technology in Education*. https://doi.org/10.1080/15391523.2022.2150727

Na, H., Staudt Willet, K. B., Shi, H., Hur, J., He, D., & Kim, C. (2024). Initial discussions of ChatGPT in education-related subreddits. *Journal of Research on Technology in Education*. https://doi.org/10.1080/15391523.2024.2338091

OpenAI. (2022, November 30). *Introducing ChatGPT*. https://openai.com/blog/chatgpt/

OpenAI. (2023, March 14). *GPT-4*. https://openai.com/research/gpt-4

Oravec, J. A. (2023). Artificial intelligence implications for academic cheating: Expanding the dimensions of responsible human-AI collaboration with ChatGPT. *Journal of Interactive Learning Research*, *34*(2), 213–237. https://www.learntechlib.org/primary/p/222340/

Pennebaker, J. W., Booth, R. J., Boyd, R. L., & Francis, M. E. (2015a). *Linguistic inquiry and word count* (Version LIWC2015) [Computer software]. Pennebaker Conglomerates. https://www.liwc.app/

Pennebaker, J. W., Booth, R. J., Boyd, R. L., & Francis, M. E. (2015b). *Linguistic inquiry and word count: LIWC2015 operator's manual*. Pennebaker Conglomerates. https://www.liwc.app/static/documents/LIWC2015%20Manual%20-%20Operation.pdf

Perault, M. (2023). Section 230 won't protect ChatGPT. *Journal of Free Speech Law, 3*, 363–374. https://heinonline.org/HOL/P?h=hein.journals/jfspl3&i=363

Picciano, A. G. (2019). Artificial intelligence and the academy's loss of purpose. *Online Learning, 23*(3), 270–284. https://doi.org/10.24059/olj.v23i3.2023

Pichai, S., & Hassabis, D. (2023, December 6). *Introducing Gemini: Our largest and most capable AI model*. https://blog.google/technology/ai/google-gemini-ai/

Pokrivcakova, S. (2019). Preparing teachers for the application of AI-powered technologies in foreign language education. *Journal of Language and Cultural Education*, *7*(3), 135–153. https://doi.org/10.2478/jolace-2019-0025

Python Software Foundation. (2024). *Python* [Computer software]. https://python.org/

RedditInc. (2024). Homepage - Reddit. https://www.redditinc.com/

R Core Team. (2024). *R: A language and environment for statistical computing* (Version 4.3.3) [Computer software]. https://www.R-project.org/

Richard, B., Sivo, S. A., Ford, R. C., Murphy, J., Boote, D. N., Witta, E., & Orlowski, M. (2021). A guide to conducting online focus groups via Reddit. *International Journal of Qualitative Methods, 20*. https://doi.org/10.1177/16094069211012217

Robinson, B., Czauderna, A., & von Gillern, S. (2023). "I think I get why y'all do this now": Reckoning with Elden Ring's difficulty in an online affinity space. *Games and Culture,* 15554120231203134. https://doi.org/10.1177/15554120231203134

Rogers, M.E. (2003) *Diffusion of Innovations* (5th ed.). Free Pass.

Similarweb. (2024, May 17). *Reddit.com competitive analysis, marketing mix and traffic*. Similarweb. https://www.similarweb.com/website/reddit.com

Simmonds, R. (2023, September 1). *Reddit statistics for 2023: Demographic, usage & traffic data*. Foundation Marketing. https://foundationinc.co/lab/reddit-statistics/

Staudt Willet, K. B., & Carpenter, J. P. (2020). Teachers on Reddit? Exploring contributions and interactions in four teaching-related subreddits. *Journal of Research on Technology in Education*, *52*(2), 216–233. https://doi.org/10.1080/15391523.2020.1722978

Staudt Willet, K. B., & Carpenter, J. P. (2021). A tale of two subreddits: Change and continuity in teaching-related online spaces. *British Journal of Educational Technology*, *52*(2), 714–733. https://doi.org/10.1111/bjet.13051

Stokel-Walker, C., & Van Noorden, R. (2023). What ChatGPT and generative AI mean for science. *Nature (London), 614*(7947), 214–216. https://doi.org/10.1038/d41586-023-00340-6

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research*, *81*(1), 4–28. https://doi.org/10.3102/0034654310393361

Topsakal, O., & Topsakal, E. (2022). Framework for a foreign language teaching software for children utilizing AR, voicebots and ChatGPT (large language models). *The Journal of Cognitive Systems, 7*(2), 33–38. https://doi.org/10.52876/jcs.1227392

Tov, W., Ng, K. L., Lin, H., & Qiu, L. (2013). Detecting well-being via computerized content analysis of brief diary entries. *Psychological Assessment*, *25*(4), 1069–1078. https://doi.org/10.1037/a0033007

Weller, M. (2020). *25 years of ed tech*. Athabasca University Press.

Wingo, N. P., Ivankova, N. V., & Moss, J. A. (2017). Faculty perceptions about teaching online: Exploring the literature using the technology acceptance model as an organizing framework. *Online Learning*, *21*(1), 15–35. https://doi.org/10.24059/olj.v21i1.761

Wolf, R. R., & Wolf, A. B. (2023). Using AI to evaluate a competency-based online writing course in nursing. *Online Learning*, *27*(3), 41–69. https://doi.org/10.24059/olj.v27i3.3974

Woodruff, K., Hutson, J., & Arnone, K. (2023). Perceptions and barriers to adopting artificial intelligence in K–12 education: A survey of educators in fifty states. In S. Mistretta (Ed.), *Reimagining education—The role of e-learning, creativity, and technology in the post-pandemic era.* IntechOpen. https://doi.org/10.5772/intechopen.1002741

Zhang, K., & Aslan, A. B. (2021). AI technologies for education: Recent research & future directions. *Computers and Education: Artificial Intelligence*, *2*, 100025. https://doi.org/10.1016/j.caeai.2021.100025

A Case Study Investigating the Utilization of ChatGPT in Online Discussions

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Abstract

This study explored the impact of integrating ChatGPT into asynchronous online discussions. The analysis encompassed students' log data from Canvas and their perspectives on using ChatGPT. Results revealed a significant enhancement in overall discussion participation when ChatGPT is encouraged, emphasizing its potential as a catalyst for constructive conversations and the development of generic skills. Students also acknowledge ChatGPT's positive influence on critical thinking and knowledge exploration. In summary, integrating ChatGPT not only enhances participation and engagement but also fosters a sense of community, promotes online interaction, and cultivates essential skills. This study concluded by discussing issues associated with using ChatGPT for online discussions and highlighting implications for its appropriate integration into online discussion boards.

Keywords: ChatGPT, artificial intelligence (AI), online discussions, online learning, critical thinking

Lin, X., Luterbach, K., Gregory, K. H., & Sconyers, S. E. (2024). A Case Study Investigating the Utilization of ChatGPT in online discussions. *Online Learning, Volume 28,*(2), (124-149). DOI: 10.24059/olj.v28i2.4407

The widespread use of technology and the availability of online learning in higher education have created numerous opportunities for learners, providing them with greater access, flexibility, and convenience at a reduced cost (Buelow et al., 2018). According to the National Center for Education Statistics (2020), in the fall of 2019, 33% of postbaccalaureate students in the U.S. enrolled exclusively in distance courses. Online learning comes in two primary forms: asynchronous and synchronous. Asynchronous online learning involves the delivery of course content and instruction without real-time communication between students and the instructor, whereas synchronous learning takes place in real-time. Asynchronous online learning is often considered the preferred method for online learners (Radford et al., 2015) due to several advantages. First, this format allows for 24/7 access to learning materials from any location with an internet connection. Second, learners have the flexibility to manage their learning at their own pace, as they can allocate time based on their personal schedules (Hrastinski, 2008). Lastly, learners can engage in more structured discussions and express well-organized thoughts on asynchronous platforms like discussion boards (Hrastinski, 2008).

Among various online teaching strategies, instructors employ online discussion boards to facilitate interactions for content learning and reflective inquiries (Ruiz et al., 2006). This aspect of asynchronous learning alleviates the pressure on learners who may not be ready to share their responses, thereby promoting deeper learning and encouraging valuable contributions to their peers' learning experiences (Brierton et al., 2016). Additionally, participating in discussions is often beneficial for learning in online courses as it facilitates the exchange of ideas and thoughts (Lindeman, 1926). Moreover, online discussions contribute to enhanced interactions and foster cognitive presence by challenging and improving learners' understanding (Galikyan & Admiraal, 2019).

However, a prevalent issue in asynchronous online discussions is limited student contribution (LSC) (Hewitt, 2005), where students either fail to contribute to the discussion board or procrastinate in responding to their peers' posts. Previous studies have suggested various approaches to address the issue of LSC, such as implementing active learning activities like case studies and integrating different technology tools, including memes. For instance, in a recent study conducted by Lin (2024), a student-developed case study activity was introduced in asynchronous online discussions that required students to interact with each other through developing their own cases and analyzing their peers' cases. The analysis of students' feedback revealed that the activity had a positive impact on their learning experiences. The case study activity stimulated critical thinking regarding the discussion topic and provided valuable resources for online learners. Furthermore, the case study activity fostered a high level of interaction among students within the discussion board. Similarly, the use of online memes as a facilitator was found to significantly enhance learner engagement in asynchronous online discussion boards (Lin & Sun, 2023). This discussion activity provided individuals with a means to express their emotions and feelings, offering a valuable outlet for learners when faced with new learning experiences. Additionally, it fostered a sense of community, promoting social support and mutual assistance in the pursuit of new knowledge.

As technology continues to rapidly advance, particularly with the emergence and progress of artificial intelligence (AI), various applications have been developed to benefit online learners. One notable example is the recent development of ChatGPT, an advanced chatbot that uses state-of-the-art AI and natural language processing (NLP) technologies. Recent studies have highlighted the advantages of leveraging this tool in online learning. Qadir (2022) and Zhai (2022) suggested that ChatGPT has the potential to enhance students' independent learning practices by assisting in the creation of personalized learning plans. Similarly, Lin (2023) concluded that ChatGPT can support online learners in setting learning goals, accessing available resources, designing customized learning plans, monitoring progress, and reflecting on learning experiences. Gregory et al. (in press) required education students to use ChatGPT to generate classroom assessments and found that they appreciated using ChatGPT as a tool as it provided a strong starting point for curriculum design, which ultimately deepened their level of critical thinking and analysis. With the increasing use of ChatGPT and other large language models as a tool in online learning, the purpose of the present study is to explore the use of ChatGPT for asynchronous online discussions, and to inform guidelines for effectively applying ChatGPT in asynchronous online discussion boards. The research questions for this study include:

- How does the use of ChatGPT for asynchronous online discussions affect students' overall discussion participation?
- How does the use of ChatGPT contribute to the development of asynchronous online discussions?

Literature Review

Limited Student Contribution (LSC)

LSC is defined as a situation where students make few or no postings, exhibit surface-level critical thinking, or engage in low-level knowledge construction (Hew et al., 2010). LSC in online discussions can have a significant impact on the effectiveness and dynamics of the learning environment, potentially hindering the achievement of desired learning outcomes and impeding the collaborative nature of the online learning experience. Specifically, when students contribute minimally or infrequently, the interactions among learners become sparse, resulting in a lack of diverse perspectives, critical thinking, and the exchange of ideas (Guzdial, 1997; Hewitt, 2005). Effective online discussions rely on active student participation and engagement. Contributions from multiple students foster a sense of community, promote peer interaction and collaboration, and facilitate the exploration of different viewpoints and perspectives (Lin, 2024; Lin & Sun, 2024). However, when student contributions are limited, the richness of the learning experience may suffer. Discussions may lack depth and meaningfulness, becoming shallow exchanges of information rather than opportunities for in-depth analysis and synthesis (Khine et al., 2003; Fung, 2004). Moreover, LSC can hinder the development of important skills, such as critical thinking, communication, and argumentation. When students contribute minimally, they miss out on valuable opportunities to refine their reasoning, challenge their assumptions, and expand their understanding through interactions with their peers (Cheung & Hew, 2005; Khine et al., 2003).

Researchers have identified several factors that contribute to LSC, including not perceiving the need for online discussions, uncertainty about what to contribute, lack of critical thinking skills, and being content with providing superficial answers. Regarding specifics, there are various reasons behind students' limited participation in online discussion forums. First, if students are already attending face-to-face courses or lack interest in the discussion topics, they may not see the necessity to engage in online discussions (Zhao & McDougall, 2005). Additionally, the absence of clear expectations or incentives, such as grades, can also contribute to LSC (Dennen, 2005). Furthermore, students' uncertainty about what to contribute acts as a barrier to their active participation (Fung, 2004; Khan, 2005). Similar to how a blank document can be daunting for a writer, students may experience a "writer's block" (Hew et al., 2007, p. 575) when it comes to determining what to write in the discussion forum. Moreover, the use of discussion prompts or questions that elicit a single, factual answer can exacerbate the issue of students struggling to identify what to contribute. Once one student has provided the correct response, there may be no perceived need for further contribution from other students (Dennen, 2005). Lastly, students' contributions to online discussions often demonstrate surface-level critical thinking, characterized by unsupported conclusions or judgments, incomplete solutions or explanations, and mere agreement with others without further exploration (Khine et al., 2003). Additionally, students may focus primarily on answering questions rather than engaging in deeper knowledge construction. Cheung and Hew (2005) discovered that students mainly expressed their opinions in response to their peers' queries, aligning with Gunawardena et al.'s (1997) Phase I level of knowledge construction, which emphasizes information sharing and results in basic question-and-answer sessions with limited involvement in higher-level knowledge construction phases. Therefore, it is important to engage students in online discussions effectively, thus enhancing their learning experiences, fostering deeper critical thinking, and promoting meaningful engagement in knowledge construction within the online learning environment.

Developing Effective Online Discussions

To promote active engagement in discussion activities, instructors should establish a clear purpose and set expectations (DeNovelles et al., 2014; Han & Hill, 2006). Creating general guidelines that encourage collaboration and the sharing of diverse perspectives can motivate students to collaboratively construct knowledge on the discussion board (DeNoyelles et al., 2014). Generating more responses and meaningful interactions can be achieved by posing thought-provoking questions that simulate traditional classroom dialogues (Levine, 2007). The use of open-ended questions and the requirement for learners to respond to one another also enhance student involvement (Carwile, 2007). Encouraging learners to conduct independent research and respond to comments and questions from their peers further fosters active participation and interactions (Carwile, 2007). Lastly, incorporating graded discussions can act as a catalyst for encouraging learners to actively participate in conversations. An et al. (2009)

emphasized that without the requirement for peer interaction in online environments, voluntary interactions among learners are infrequent.

Meanwhile, several recommendations have been proposed to address the issue of LSC in online discussions. First, instructors should provide clear explanations regarding the purpose of the online discussion to ensure that students understand its significance and actively participate (Cheung & Hew, 2005). Without a clear understanding of the purpose, students may lose interest and engagement. Therefore, explicitly stating the instructor's expectations plays a crucial role in increasing student participation in online discussions (Jung et al., 2002). To address students' uncertainty about what to contribute, two guidelines have been suggested. One approach is to provide online scaffolds, such as clarification or elaboration questions, counterarguments, and context- or perspective-oriented questions (Choi et al., 2005). These scaffolds encourage students to think critically and consider different aspects of the problems beyond the initial questions provided. By acting as a starting point, these scaffolds facilitate students in generating their own questions and actively contributing to the discussion boards. Furthermore, to combat surface-level critical thinking and promote higher-level knowledge construction, it is essential to enhance students' critical thinking skills (Hew et al., 2005). For instance, incorporating the Socratic questioning model, which includes questions of clarification, assumptions, reasons, and evidence, into teaching can help students demonstrate higher levels of critical thinking (Yang et al., 2005). By fostering deeper analysis and evaluation, these strategies encourage students to engage more critically and constructively in online discussions.

Using ChatGPT for online learning

Previous studies indicated that using technology would facilitate effective online discussions, further optimizing students' learning experience (Kumi-Yeboah et al., 2020; Liu & Yu, 2023). Particularly, technology has the potential to facilitate active learning and encourage learner participation in discussion activities (Stephenson, 2018). One example of such technology is ChatGPT, an AI-powered chatbot that uses a large language model with over 175 billion parameters to process and respond to natural language input (Floridi & Chiriatti, 2020). This word-driven dialogue system is capable of assisting in cross-domain problem-solving and generating content to address user inquiries (Luan et al., 2024a). Since its release in November 2022, over one million users signed up for ChatGPT within a week (Haque et al., 2022). Chatbot use has sparked a debate among educators regarding its impact on the teaching profession and student learning outcomes. While some scholars, such as Qadir (2022) and Zhai (2022), believe that ChatGPT has the potential to promote independent learning practices by facilitating customized learning plans, others, like Kung et al. (2023) and Cotton et al. (2023), raise concerns about the obsolescence of traditional online exams and the automation of the teaching profession. Despite differing perspectives, ChatGPT, as a newly developed chatbot, offers several enticing features for learners. It provides immediate feedback and guidance, supports personalized learning experiences, and assists in complex problem-solving. Moreover, ChatGPT's availability 24/7 makes it accessible to learners in asynchronous online learning contexts. Learners can ask

ChatGPT questions related to their learning goals and receive prompt feedback and suggestions, and it can track learners' progress and offer recommendations for further learning opportunities.

Finding and accessing resources is a crucial component of self-directed learning in asynchronous online learning contexts, as learners are expected to actively seek out opportunities and materials to support their own learning. However, some learners may encounter difficulties in locating available resources, particularly interactive and multimedia materials. To overcome this challenge, ChatGPT could play a valuable role by providing external and pertinent resources based on learners' personalized learning plans, complementing the materials provided by their instructors (Lin, 2023; Lin et al., 2024; Luan et al., 2024b). If learners could share their personalized learning plan with ChatGPT, this tool could offer recommendations such as online articles, videos, and multimedia resources that align with their specific learning objectives. Additionally, ChatGPT could suggest relevant books, journals, publications, blogs, and social media groups related to team-based learning, thereby fostering peer learning and facilitating the exchange of ideas. By using ChatGPT in this way, learners would have access to a wide range of resources that support their learning goals and enhance their overall learning experience.

In terms of using ChatGPT for online discussions, Lin and Schmidt (2023) noted that ChatGPT could serve as a catalyst for discussions. Specifically, instructors can present students with case-study-like examples of conversations between individuals and ChatGPT on specific topics, such as climate change or healthcare reform. Students could then discuss and critically evaluate the validity and accuracy of ChatGPT's responses. This process can foster the development of critical thinking skills and initiate a dialogue about the course material. By questioning the responses generated by ChatGPT, students learn to assess the reliability and credibility of different information sources. They also become adept at identifying biases and assumptions and acquire strategies for verifying and validating information. Through this interactive process, students can deepen their understanding of the topic and engage in constructive discussions that consider diverse viewpoints and perspectives. Using ChatGPT in online discussions provides an opportunity for students to actively engage with the technology and apply critical thinking to evaluate its outputs. By analyzing and discussing the responses generated by ChatGPT, students develop their ability to think critically, evaluate information, and engage in meaningful discussions. This approach not only enhances their understanding of the subject matter but also cultivates important skills that can be applied beyond the online learning environment.

However, there is a lack of empirical research examining the use of ChatGPT for asynchronous online discussions. To address this gap, this case study aims to investigate how ChatGPT influences students' online discussion experience and their expectations regarding the design of the discussion activity, which involves student use of ChatGPT in asynchronous online discussions. Furthermore, this research will contribute to the limited literature base on generative AI tools in online learning environments by exploring the impact of ChatGPT on students' online learning, such as the development of critical thinking skills, along with the facilitation of meaningful discussions. Ultimately, it is the intent that this empirical study will provide valuable insights and practical recommendations for instructors and course designers seeking to effectively integrate ChatGPT into their online teaching practices.

Method

Through a mixed-method design, this study examined students' behavioral log data from Canvas—the learning management system (LMS), their feedback from surveys exploring critical thinking skills and the discussion activity experience, as well as their feedback from five open-ended questions regarding the use of ChatGPT in online discussion boards. The log data was used to objectively track students' engagement levels. The quantitative data from surveys enabled exploration of the statistical significance of any observed differences in critical thinking skills. Activity experience data provided insights into students' overall discussion participation. Lastly, the qualitative data from open-ended questions investigated ChatGPT's contribution to the development of asynchronous online discussions by further analyzing students' experiences with using ChatGPT for online discussions, capturing insights and perspectives that may not be evident through quantitative measures alone (Creswell & Creswell, 2017). This mixed-method approach enabled pursuit of a comprehensive understanding of the impact of using ChatGPT for asynchronous online discussions.

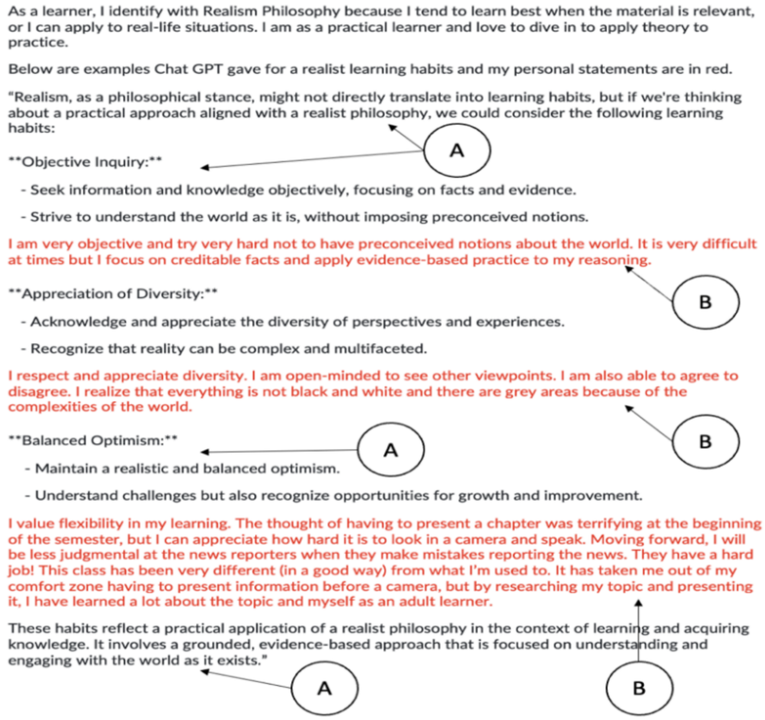
Activity Design

In two sections of the same graduate-level online course in the fall semester of 2023, ChatGPT was integrated into the graded discussion activities, each with specific deadlines and requirements for thread posting and responding. This fully asynchronous online course provided a comprehensive introduction to the historical and philosophical underpinnings of adult and community education, along with an exploration of the field's nature and breadth. The instructor provided step-by-step instructions for using ChatGPT for online discussions, as follows:

1. The instructor shared guidelines and rules (see Appendix A) related to how to use ChatGPT, highlighting examples of prompts to generate discussion posts and responses to others' threads.
2. Following the guidelines and rules, students used ChatGPT to participate in the discussion boards. While posting and responding to threads using ChatGPT, students were required to critique and reflect on the information generated by this AI-driven tool and must not simply copy and paste the information (see Figure 1).
3. Students were requested to send their conversations with ChatGPT to the instructor for each discussion activity

Figure 1

Example of a Student's Reflection With AI-generated Information



As a learner, I identify with Realism Philosophy because I tend to learn best when the material is relevant, or I can apply to real-life situations. I am as a practical learner and love to dive in to apply theory to practice.

Below are examples Chat GPT gave for a realist learning habits and my personal statements are in red.

"Realism, as a philosophical stance, might not directly translate into learning habits, but if we're thinking about a practical approach aligned with a realist philosophy, we could consider the following learning habits:

Objective Inquiry:

- Seek information and knowledge objectively, focusing on facts and evidence.
- Strive to understand the world as it is, without imposing preconceived notions.

I am very objective and try very hard not to have preconceived notions about the world. It is very difficult at times but I focus on creditable facts and apply evidence-based practice to my reasoning.

Appreciation of Diversity:

- Acknowledge and appreciate the diversity of perspectives and experiences.
- Recognize that reality can be complex and multifaceted.

I respect and appreciate diversity. I am open-minded to see other viewpoints. I am also able to agree to disagree. I realize that everything is not black and white and there are grey areas because of the complexities of the world.

Balanced Optimism:

- Maintain a realistic and balanced optimism.
- Understand challenges but also recognize opportunities for growth and improvement.

I value flexibility in my learning. The thought of having to present a chapter was terrifying at the beginning of the semester, but I can appreciate how hard it is to look in a camera and speak. Moving forward, I will be less judgmental at the news reporters when they make mistakes reporting the news. They have a hard job! This class has been very different (in a good way) from what I'm used to. It has taken me out of my comfort zone having to present information before a camera, but by researching my topic and presenting it, I have learned a lot about the topic and myself as an adult learner.

These habits reflect a practical application of a realist philosophy in the context of learning and acquiring knowledge. It involves a grounded, evidence-based approach that is focused on understanding and engaging with the world as it exists."

Note. A: Information generated by ChatGPT

B: Student's reflection towards AI-generated information

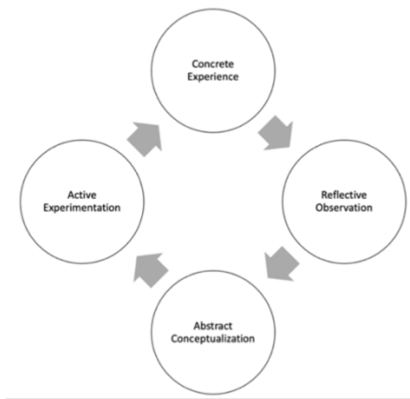
Experiential learning theory

The present study used Kolb's Experiential Learning Theory (ELT, 1984) to design the discussion activity. Experiential learning theory was defined as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb 1984, p. 41). In other words, the ELT denotes an approach to curriculum development and modification that focuses on firsthand experiences. It aims to provide a concrete understanding of how to teach specific courses, with the ultimate objective of improving student learning through experiential methods.

The ELT involves a four-step learning process (see Figure 2), which includes (1) concrete experience, (2) reflective observation, (3) abstract conceptualization, and (4) active experimentation. Specifically, in the concrete experience stage, learners engage personally with everyday situations, relying on feelings, open-mindedness, and adaptability. In reflective observation, learners comprehend situations from various perspectives, emphasizing objectivity and thoughtful judgment without necessarily taking action. In the abstract conceptualization stage, learners use ideas, logical approaches, and theories, emphasizing systematic planning to solve practical issues. Finally, in active experimentation, learners actively apply their knowledge, experimenting with real-life situations and adopting a practical approach rather than merely observing. Effective learning usually takes place as learners navigate through this four-stage cycle, moving from concrete experience to observing and reflecting on it (e.g., Abdulwahed & Nagy, 2009; Konak et al., 2014).

Figure 2

Example of a Student's Reflection With AI-generated Information



Based on the ELT, in the Concrete Experience phase, students reflected on the discussion topics through the lens of their learning and everyday experiences. This initial step encouraged a personal connection to the subject matter, fostering open-mindedness and adaptability. Next, during the Reflective Observation stage, students used ChatGPT by experimenting with various prompts to seek relevant information related to the discussion topics. This step aligns with Kolb's notion of observing and reflecting on experiences, emphasizing a thoughtful examination without immediate action. Moving on to the Abstract Conceptualization phase, students critically evaluated the information generated by ChatGPT. They integrated this AI-generated knowledge with their own thoughts to formulate a comprehensive and reflective discussion thread. This stage focuses on using logical approaches and theories to systematically plan and address issues. Finally, in the Active Experimentation stage, students interacted with their peers by reading and commenting on others' threads. This interaction involves a synthesis of information from both human and AI sources, encouraging students to apply their combined knowledge to critically contribute insights.

Data Collection

Participants (n = 27) were recruited from two sections of a 15-week course taught by the same instructor in the fall semester of 2023. Log data on students' overall discussion board participation were collected from the LMS for ten weeks, the period during which ChatGPT was allowed and encouraged for use. Additionally, anonymous questionnaire responses were gathered on the first day of the course and at the end of the semester to explore students' perceptions of using ChatGPT for online discussions. Through the collection and analysis of learner feedback, we aimed to explore strategies and effective practices for instructors integrating ChatGPT into online learning environments.

A total of 21 students completed both pre- and post-surveys (response rate was 77.8%). According to the self-introductions in the LMS, students had diverse backgrounds, including K–12 education, adult and higher education, workforce training and development, and medical education. All students were identified as adult learners with full-time jobs and/or family responsibilities. This study was approved by the Institutional Review Board (IRB).

Instruments

The critical thinking abilities of students were assessed using the Critical Thinking Scale, which was adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich et al. (1991). The Critical Thinking Scale consisted of five items that evaluated the degree to which students employed their existing knowledge to address novel situations, solve problems, make decisions, and engage in critical evaluation aligned with rigorous standards of excellence. To better align with the objectives of this study, the researchers made certain modifications to the wording of the items. Sample questions include "*I often find myself questioning things I hear or read in the discussion board to decide if I find them convincing*," and "*I treat the posts generated by ChatGPT as a starting point and try to develop my own ideas about it in the discussion board*." Students completed this 5-point Likert scale survey on the first day of the course and at the end of the course. Cronbach's alpha for Critical Thinking was 0.879.

Students completed two additional instruments toward the end of the course. First, the Course Experience Questionnaire (CEQ), developed by Wilson et al. (2006), examined students' experiences using ChatGPT for online discussions. The CEQ consisted of 23 items rated on a 5-point Likert scale, ranging from "1 Definitely disagree" to "5 Definitely agree." In line with the objectives of this study, certain words in the questionnaire were revised by the researchers to ensure the relevance and alignment of the items with the research purpose. Five factors were examined, including Good Teaching (GT) with six items (e.g., *The instructor of this course motivated me to do my best work while using ChatGPT for online discussions*), Clear Goals and Standards (CG) with three items (e.g., *It's always easy to know the standard of the activity expected*), Generic Skills (GS) with six items (e.g., *As a result of engagement in this activity, I feel more confident about tackling unfamiliar problems*), Appropriate Assessment (AA) with three items (e.g., *To do well to complete this activity, all you really need is a good memory*), and Appropriate Workload (AW) with two items (e.g., *We are generally given enough time to understand the things we have to learn while completing this activity*). Cronbach's alpha for these variables are 0.676 (CG), 0.831 (GS), 0.737 (GT), 0.788 (AW), and 0.763 (AA).

Lastly, we used Brookfield's Critical Incident Questionnaire (CIQ), which involved the incorporation of five open-ended questions. The CIQ serves as a valuable tool for instructors to gain a deeper understanding of the classroom experience from the students' perspective. Widely employed in adult and higher education, it provides an alternative approach for learners to express their observations regarding what is effective and what is not functioning optimally (Brookfield, 2015). In our study, we made adaptations to these open-ended questions to align them with the specific requirements of the course activity. This modification aimed to encourage participants to share comprehensive information, provide feedback, and contribute their ideas in their own authentic voices, specifically focusing on the use of ChatGPT for online discussions. Sample questions included "*At what moment in the discussion board did you feel most engaged with what was happening?*" and "*At what moment in the discussion board were you most distanced from what was happening?*"

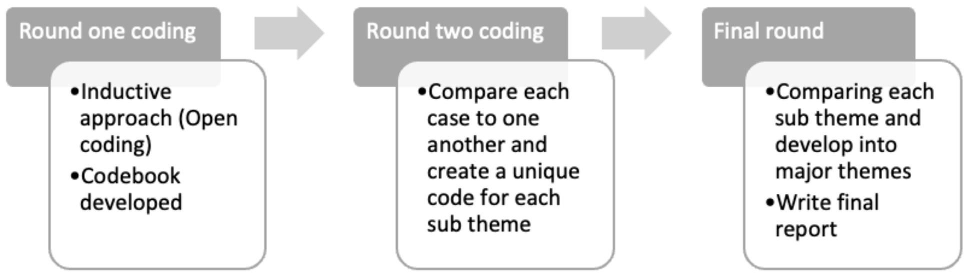
Data Analysis

The quantitative data analysis involved the use of IBM® SPSS Statistics software. First, log data from the LMS was analyzed through a one-way ANOVA to examine whether students' discussion board participation and overall course participation varied for the same course taught by the same instructor in fall 2023 when ChatGPT was encouraged, compared to spring 2023 and fall 2022 where ChatGPT was not allowed. Furthermore, among students in fall 2023, an independent sample t-test was used to explore their overall course participation log data between those who used ChatGPT and those who did not. Next, a paired t-test was employed to explore learners' critical thinking skills derived from the pre- and post-test surveys. Following that, descriptive statistics were calculated to examine the CEQ results, investigating their perspectives regarding the use of ChatGPT for online discussions.

To complement the quantitative data results, a multiple-case study approach was employed to qualitatively analyze learners' responses to open-ended questionnaires. The case study method was particularly valuable in addressing the "how" and "why" aspects of class engagement, focusing on contemporary events while allowing minimal control over the data by the researchers (Yin, 2014). Each participant was treated as an individual case in this study, all belonging to two sections of the same course, taught by the same instructor who designed and facilitated the discussion activity. Thematic analysis, following Braun and Clarke's (2006) guidelines, was applied to examine the feedback provided by class members. This approach facilitated the presentation of learners' authentic voices. The initial coding phase relied on each participant's responses, leading to the creation of a codebook. In the second round of analysis, an inductive open-coding approach was used, with the authors comparing notes to identify major themes. Finally, the themes were refined in the final round, ensuring the production of robust and compelling results for the study (Thornberg & Charmaz, 2014; Yin, 2014). Figure 3 illustrates the rationale and progression of the case design and data analysis process.

Figure 3

Multiple-case Study Coding Steps



Results

How does the use of ChatGPT for asynchronous online discussions affect students' overall discussion participation?

First, we compared students' overall weekly discussion board participation, which was accumulated through the count of times they contributed to the discussion board pages, among fall 2023 ($N_{student} = 27$), spring 2023 ($N_{student} = 11$), and fall 2022 ($N_{student} = 21$) using one-way ANOVA. The LMS log data results indicate that no significant difference was found in students' discussion participation between spring 2023 and fall 2022 when ChatGPT was not allowed ($p = 0.286$). However, there were significantly higher counts of times contributed to the discussion board when ChatGPT was involved in fall 2023, with an average of 70.1 counts of times in the discussion board ($M_{fall2023} = 70.1$, $SD = 10.44$), compared to the discussion board where ChatGPT was not involved in spring 2023, with an average of 43 counts of times ($M_{spring2023} = 43$, $SD = 3.8$), and in fall 2022, with an average of 46.6 counts of times ($M_{fall2022} = 46.6$, $SD = 9$), with a large effect size ($F_{(2, 41)} = 31.82$, $p < .001$, $\eta^2 = 0.63$), as presented in Table 1. When comparing students' overall course participation, one-way ANOVA results demonstrated no significant difference among students from these three semesters ($p = 0.43$).

Table 1

Comparison of Discussion Forum Participation Across Semesters

	Fall 2023		Spring 2023		Fall 2022				
	M	SD	M	SD	M	SD	$F_{(2,41)}$	*p*-value	Partial η^2
Average counts of times	70.1	10.44	43	3.8	46.6	9.0	31.82	<.001	0.63

When specifically examining fall 2023, during which ChatGPT was encouraged in the discussion board, over half of the class (55.6%) used this tool in at least two discussion activities, ranging from 2 to 10 participated discussion activities using ChatGPT ($M = 5.6$) across the ten weekly activities. Students who used ChatGPT for discussions had higher overall course participation ($M = 82.78$, $SD = 14.48$) compared to those who did not use ChatGPT ($M = 71$, $SD = 18.84$). However, no significant difference was found between these two groups ($p = 0.14$).

How does the use of ChatGPT contribute to the development of asynchronous online discussions?

Next, we examined how ChatGPT contributes to the development of asynchronous online discussions by examining students' overall perspectives on using ChatGPT for online discussions in fall 2023. Descriptive analysis (see Table 2) shows that students had a positive experience with this activity. Specifically, students believed that this activity has clear goals and rules to follow for completing assignments. They also reported that using ChatGPT for online discussions may develop generic skills and abilities, which may include problem-solving, analytic skills, confidence in tackling unfamiliar situations, the ability to plan work, and written communication skills. Additionally, students agreed that the instructor offered a high level of teaching quality in guiding them using ChatGPT. Finally, students expressed that this activity has a fair workload to complete, and the instructor provided an appropriate assessment to evaluate their use of ChatGPT for online discussions.

Table 2

Descriptive Analysis of Course Experience Questionnaire (CEQ)

	M	SD
Clear goals	4.05	0.64
Generic skills	4.09	0.60
Good teaching	4.33	0.49
Appropriate workload	3.92	0.71
Appropriate assessment	3.70	0.88

In terms of critical thinking, students demonstrated a high level of critical thinking both before ($M = 3.77$, $SD = 0.77$) and after ($M = 3.80$, $SD = 0.42$) using ChatGPT for online discussions. No significant differences were found according to the paired t-test ($p = .45$). It is probable that the online discussion board itself is an activity that motivates students to apply their existing knowledge to address novel situations, solve problems, make decisions, and engage in critical evaluation aligned with rigorous standards of excellence (Lin et al., 2023), even without involving ChatGPT.

Finally, thematic analysis was conducted to analyze the students' responses to open-ended questions, and three themes were generated: (1) ChatGPT makes discussions engaging, (2) ChatGPT motivates effective learning, and (3) challenges of using ChatGPT.

Theme one: ChatGPT makes discussions engaging

Students believed that using ChatGPT made the online discussion engaging. First, they reported that reading what ChatGPT produced was engaging, as one learner stated, "I felt the most engaged when reading the answers that ChatGPT came up with." Meanwhile, they expressed that to "critique the information generated by ChatGPT is engaging." This tool furthermore encourages interaction among peers because "Using the ChatGPT was helpful, because it was very engaging to see others' responses from ChatGPT which made me want to participate in the forum even more." Finally, ChatGPT could help expand on responses and ideas because "With some topics covered in class, ChatGPT came up with some ideas I should have thought about or remembered as part of that topic." Moreover, this tool could create engaging communications, as one student noted,

> I think the ChatGPT was a very helpful tool. I did not use it consistently but I did when I felt challenged or simply wanted the extra support in a particular topic. I think it also helped us communicate with one another to better expand on responses and ideas provided within our discussions.

Theme two: ChatGPT motivates effective learning

ChatGPT could help clarify challenging discussion topics, and "it [ChatGPT] was effective when there was a difficult topic or theory being discussed in class." Specifically, a majority of students mentioned that ChatGPT can be used as a starting point especially with challenging topic. Indeed, participants stated, "It [ChatGPT] did assist me in starting the conversation," and "ChatGPT is another tool that can be used to start and create conversations." Moreover, this tool "was very helpful in answering questions and understanding the topics," and would help students "stay relevant in the conversation when my thoughts and understandings of the concepts were not at the level of my peers' comprehension or experience." Furthermore, gaining a better understanding of the topic with the help of ChatGPT, learners may feel confident with their discussion posts, as one noted,

> I felt most engaged when I fully understood the questions, how to answer and it was applicable to my life. I think the ChatGPT also assisted in providing me feedback to ideas and concepts I had not considered which helped me feel even more confident in my responses.

Additionally, ChatGPT could aid learners in finding information across various resources, as one learner noted, "I'm glad to have the tool on hand! It has been very helpful in finding answers and provides a lot of details where I may have to search many different sites on the internet in its place." They were also "impressed about the amount of information that

ChatGPT would provide." Lastly, ChatGPT could motivate brainstorming, as one student reported,

> I was shocked that we were allowed to use ChatGPT for the discussion boards because I thought that it would be frowned upon. But I am glad we were introduced to it here. It helped my brainstorming processes and allowed me to see more perspectives towards a topic.

Likewise, another student expressed,

> I found it most helpful during brainstorming process of task. I would have an idea that I want to go with, and then I would use ChatGPT to provide additional information. It allowed my process to go much more smoothly.

In short, students believed that "referring to ChatGPT responses enriched our answers." Yet, they also suggested, "Only when we were challenged to use it more as a starting point and encouraged to interact with the feedback, did it become more engaging and truly enriching to the learning process."

Lastly, ChatGPT could motivate their critical thinking, as one learner mentioned, "After getting ideas from ChatGPT, it helps me to critically think about discussion points I wanted to cover." For instance, ChatGPT could provide new perspectives toward a topic, as one participant expressed, "I feel the ChatGPT helped fill the gap in times when I felt most vulnerable or lacking in knowledge of content." Students also believed that "critique information generated by ChatGPT motivates deep understanding." Moreover, ChatGPT would empower learning when combining learners' own interpretations with AI-generated information, as one participant stated, "I enjoyed using ChatGPT as a learning tool and I believe with our own interpretations and ideas added it is an effective learning tool." However, it is significant to reflect on ChatGPT's answers instead of simply copying and pasting, as one participant highlighted, "Interacted with it [ChatGPT] could expand my understanding of the topic."

Theme three: Challenges of using ChatGPT

However, several challenges were raised by students, including issues with the length and similarity of responses generated by ChatGPT, as well as concerns about the adequacy of AI-generated content. First, they complained that "when others chose to use ChatGPT in every discussion post, I felt those were the longest to reply back to as a lot of the information was AI generated," thereby "disconnected may occur when classmates' ChatGPT responses seemed to be very long and all very similar." As a result, one student "opted to not use ChatGPT in my discussion boards, and I felt more engaged when I did not rely on it for every discussion post." Meanwhile, students reported that not every learner were able to reflect and critique in-depth on the information generated by ChatGPT, as one noted, "Not everyone elaborates more on what they found in ChatGPT." Furthermore, some believed that "what the AI generates isn't in-depth enough," and "ChatGPT was great, but it didn't challenge us to think about a topic as hard."

Therefore, they "still had to dig deep to understand some of the information." To address these issues, some students suggested, "It [ChatGPT] is a new tool and should continue to be explored especially in how to input details to achieve better results." Additionally, having examples from peers showing how to interact with ChatGPT would be helpful, as one participant noted,

> There was a point where the professor praised a student for how the student had not just copied and pasted their ChatGPT response, but rather interacted with it in order to advance our understanding. It eventually led to my own interactive engagement.

Discussion

Results indicate that when ChatGPT was encouraged in the discussion board, students' overall discussion participation significantly increased compared to semesters when ChatGPT was not allowed. Specifically, in fall 2023, students contributed nearly twice as many times to the discussion board compared to spring 2023 and fall 2022, respectively. This finding supports earlier conclusions that ChatGPT could act as a catalyst for online discussions (Lin & Schmidt, 2023). Concurrently, the results show that students' overall course participation, including tasks such as written assignment and final project completion, quiz-taking, video watching, across the three semesters remains consistent. Furthermore, students who used ChatGPT exhibited similar overall course participation compared to those who did not use this tool. With findings that highlight improvements in students' discussion board engagement, the consistent overall course participation findings somewhat indirectly suggest that ChatGPT may play a role in enhancing students' online discussion participation.

Furthermore, the findings reveal that students overwhelmingly had a positive experience with the integration of ChatGPT into online discussions. Specifically, they recognized the potential of ChatGPT to cultivate generic skills, such as problem-solving, analytic abilities, confidence in addressing novel situations, planning skills, and improved written communication (Wilson et al., 2006). Moreover, they expressed appreciation for the instructor's high-quality teaching in guiding them through the use of ChatGPT. Finally, students found the workload to be fair and valued the instructor's provision of appropriate assessments to evaluate their use of ChatGPT in online discussions. Specifically, students believed that ChatGPT could make online discussions engaging, especially when reading and critiquing what ChatGPT generated. ChatGPT is also considered a useful tool for motivating interactions by expanding on responses and thoughts, thereby leading to engaging communications. Moreover, ChatGPT may facilitate effective learning through various means. For instance, it could help students clarify challenging discussion topics and initiate conversations, as noted by previous scholars who highlighted ChatGPT's effectiveness in complex problem-solving (Qadir, 2022; Zhai, 2022). Furthermore, ChatGPT provides learners with a variety of resources to facilitate their learning. In an age of information explosion, sometimes it is challenging for learners to locate available and useful resources. However, ChatGPT, capable of engaging in conversational interactions and addressing follow-up questions, seamlessly provides an extensive array of relevant and additional resources to support learners in enhancing their overall learning experience (Lin, 2023)

Additionally, sometimes students have no clue about what to contribute to the discussion, and such uncertainty acts as a barrier to their active participation (Fung, 2004; Khan, 2005). While using ChatGPT as a discussion starter, the different perspectives ChatGPT provides would encourage students to brainstorm and enable them to think of the topic from different perspectives, further motivating students' critical thinking. In other words, ChatGPT could enlighten students with new ideas. ChatGPT proved beneficial in bridging knowledge gaps, ensuring relevance in conversations even when participants may have lacked a comprehensive understanding of the content or found themselves at a different level of comprehension or experience compared to their peers. Lastly, ChatGPT could enhance students' learning experience when they contemplate how to integrate their own interpretations with the AI-generated content. These results confirm the earlier claim that students could enhance their understanding of a subject and engage in constructive discussions that consider various viewpoints and perspectives by questioning and reflecting on the responses generated by ChatGPT (Lin & Schmidt, 2023).

However beneficial at times, students encountered several challenges when ChatGPT was incorporated into the online discussions. For instance, they perceived a disconnection when confronted with lengthy and redundant responses generated by ChatGPT. Another issue pertained to the insufficient elaboration of AI-generated content, with some learners merely copying and pasting answers to the discussion board without deeper contemplation of the topic. Additionally, the information produced by ChatGPT was occasionally deemed superficial, prompting students to explore deeper to enhance their understanding. Interestingly, the need to explore issues more deeply due to the surface-level nature of AI-generated content could be seen as a mechanism that fosters students' critical thinking when they use ChatGPT for discussions, thus leading to deeper knowledge construction. Yet, this study does not provide statistical evidence specifically indicating an increase in critical thinking skills after a semester of using ChatGPT as a tool in discussion activities. It is assumed that the online discussion board already functions as an activity encouraging students to apply their existing knowledge in addressing unfamiliar situations, solving problems, making decisions, and engaging in critical evaluation, adhering to high standards of excellence, even without the direct involvement of ChatGPT. Further research is required to explore this aspect.

Overall, as mentioned by Lin and Schmidt (2023), incorporating ChatGPT into online discussions enables students to actively engage with the technology and apply critical thinking. By analyzing and discussing AI-generated responses, students can develop their critical thinking skills and judiciously evaluate information, which amplify engagement in meaningful participation in discussions. The use of ChatGPT in online discussions not only establishes effective discussions through active student participation and engagement but also nurtures a sense of community, promotes online interaction, and incorporates diverse viewpoints and perspectives (Lin, 2023; Lin & Schmidt, 2023). In essence, the potential of ChatGPT to increase students' discussion participation aids in reducing the LSC, thereby fostering deep and meaningful conversations. This, in turn, contributes to the development of skills such as critical thinking, communication, and argumentation (Fung, 2004; Khine et al., 2003).

To better integrate ChatGPT into online discussion, this study presents several strategies. First, when designing the activity, it is important for the instructor to align the goals and rules of the ChatGPT-involved discussions clearly, ensuring a well-defined structure for completing assignments. This clarity will contribute to students' understanding and engagement. Moreover, instructors should provide examples demonstrating how to effectively interact with ChatGPT in online discussions. They should also offer examples of prompts for students to refer to when using ChatGPT for specific discussion topics, aiming to stimulate more results-oriented conversations. Furthermore, instructors should provide clear guidance on the effective use of ChatGPT and lucid instructions that help students contribute insightful discussion posts in order to foster critical thinking and meaningful interactions. Additionally, concerning the workload, instructors should strive to maintain a fair balance in the tasks associated with ChatGPT-involved discussions, ensuring that the workload is reasonable and conducive to a positive learning experience. Lastly, instructors should continue to refine and implement appropriate assessments that accurately evaluate students' use of ChatGPT for online discussions. This process reinforces the effectiveness of this educational tool and helps prevent students from simply copying and pasting AI-generated content without in-depth elaboration. In other words, instructors could share examples to encourage students' deep analysis and critical engagement with AI-generated responses, thus guiding students to go beyond surface-level interaction and truly integrate ChatGPT's output with their own critical thinking and learning objectives.

Conclusions

In sum, this study highlights the multifaceted impact of integrating ChatGPT into online discussions. The findings indicate a significant enhancement in students' overall discussion participation when ChatGPT was encouraged, demonstrating its potential as a catalyst for constructive conversations. Students expressed a positive experience, recognizing ChatGPT's contribution to facilitating engaging communications in asynchronous online discussions. Despite encountering challenges such as perceived disconnection and superficial responses, students acknowledged ChatGPT's role in motivating critical thinking and knowledge exploration. In short, incorporating ChatGPT into online discussions not only enhances student participation and engagement but also cultivates a sense of community, promotes online interaction, and contributes to the development of essential skills for a comprehensive and enriched learning experience.

Regarding limitations, first, the sample size of the study (N = 21) is small to conduct pre- and post-tests focusing on students' critical thinking and overall discussion activity experience. Therefore, future studies should recruit more participants to either support or challenge the present findings. Second, due to the limited class size of graduate-level courses, it is suggested to conduct the activity in a larger program especially in undergraduate courses. Moreover, due to the diversity among student groups, the analysis of log data across various semesters could potentially affect the examination of students' overall course and/or discussion participation. Therefore, future studies should investigate the effectiveness of ChatGPT on student participation by randomly assigning them to experimental groups within the same semester. Furthermore, students' characteristics, such as their AI literacy, readiness for AI tools, educational background, and technical proficiency, may influence their using ChatGPT in discussion participation. Thus, future studies should consider including these factors to deepen the analysis of how students engage with ChatGPT in asynchronous online discussions.

Further, since students were not required to solely use ChatGPT for information searches, it is possible that other tools, including search engines, books, and other AI tools, were used during their learning. Therefore, future activity designs should control for these variables. Lastly, because Canvas does not categorize overall course participation log data into specific course assignments and tasks for individual students, it is challenging to determine whether students using ChatGPT significantly contribute more to online discussions compared to those who do not. Therefore, future research should devise a method to examine individual students' discussion board participation, specifically comparing this type of participation among students who use ChatGPT to those who do not. Further research could also explore the reasons why some students choose not to use ChatGPT, thus providing a comprehensive examination of issues related to the integration of ChatGPT in online discussion and beyond.

Conflict of Interest

All authors declare that they have no conflicts of interest.

References

Abdulwahed, M., & Nagy, Z. K. (2009). Applying Kolb's experiential learning cycle for laboratory education. *Journal of Engineering Education, 98*(3), 283–294.

An, H., Shin, S., & Lim, K. (2009). Different instructor facilitation approaches affect students' interactions during asynchronous online discussions. *Computers & Education, 53*(3), 749–760. https://doi.org/10.1016/j.compedu.2009.04.015

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brierton, S., Wilson, E., Kistler, M., Flowers, J., & Jones, D. (2016). A comparison of higher order thinking skills demonstrated in synchronous and asynchronous online college discussion posts. *Nacta Journal*, *60*(1), 14–21.

Brookfield, S. D. (2015). Critical reflection as doctoral education. *New Directions for Adult and Continuing Education, 2015*(147), 15–23. https://doi.org/10.1002/ace.20138

Buelow, J. R., Barry, T. A., & Rich, L. E. (2018). Supporting learning engagement with online students. *Online Learning*, *22*(4), 313–340. https://doi.org/10.24059/olj.v22i4.1384

Carwile, J. (2007). A constructivist approach to online teaching and learning. *Inquiry*, *12*(1), 68–73.

Cheung, W. S., & Hew, K. F. (2005). How can we facilitate students' in-depth thinking and interaction in an asynchronous online discussion environment? *A case study. Proceedings of the Association for Educational Communications and Technology, USA, 28*(114–121).

Choi, I., Land, S. M., & Turgeon, A. J. (2005). Scaffolding peer-questioning strategies to facilitate metacognition during online small group discussion. *Instructional Science*, *33*, 483–511. https://doi.org/10.1007/s11251-005-1277-4

Cotton D. R., Cotton P. A., & Shipway J. R. (2023). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International*, 1–12. https://doi.org/10.1080/14703297.2023.2190148

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches.* Sage.

Dennen, V. P. (2005). From message posting to learning dialogues: Factors affecting learner participation in asynchronous discussion. *Distance Education, 26*(1), 127–148. https://doi.org/10.1080/01587910500081376

DeNoyelles, A., Mannheimer Zydney, J., & Chen, B. (2014). Strategies for creating a community of inquiry through online asynchronous discussions. *Journal of Online Learning & Teaching*, *10*(1), 153–165.

Floridi L., & Chiriatti M. (2020). GPT-3: Its nature, scope, limits, and consequences. *Minds and Machines, 30*(2), 681–694. https://doi.org/10.1007/s11023-020-09548-1

Fung, Y. Y. (2004). Collaborative online learning: Interaction patterns and limiting factors. *Open Learning: The Journal of Open, Distance and e-Learning, 19*(2), 135–149. https://doi.org/10.1080/0268051042000224743

Galikyan, I., & Admiraal, W. (2019). Students' engagement in asynchronous online discussion: The relationship between cognitive presence, learner prominence, and academic performance. *The Internet and Higher Education, 43*, 100692. https://doi.org/10.1016/j.iheduc.2019.100692

Gregory, K. H., Luterbach, K., Lin, X., & Sconyers, S. (in press). Elementary educators' perceptions of the ethical use of ChatGPT as a classroom assessment generator. In H. Crompton & D. Burke (Eds.), *Artificial Intelligence Applications in K–12: Theories, Ethics, and Case Studies for Schools*. Routledge.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research, 17*(4), 397–431. https://doi.org/10.2190/7MQV-X9UJ-C7Q3-NRAG

Guzdial, M. (1997). Information ecology of collaborations in educational settings: Influence of tool. In R. Hall, N. Miyake, & N. Enyedy (Eds.), *Proceedings of Computer-Supported Collaborative Learning'97* (pp. 83–90). Toronto, Ontario, Canada.

Han, S., & Hill, J. R. (2006). Building understanding in asynchronous discussions: Examining types of online discourse. *Online Learning, 10*(4), 29–50. https://doi.org/10.24059/olj.v10i4.1744

Haque M. U., Dharmadasa I., Sworna, Z. T., Rajapakse R. N., & Ahmad H. (2022). I think this is the most disruptive technology: Exploring sentiments of ChatGPT early adopters using Twitter data. *arXiv preprint.* https://arxiv.org/pdf/2212.05856.pdf

Hew, K. F., Cheung, W. S., & Ng, C. S. L. (2010). Student contribution in asynchronous online discussion: A review of the research and empirical exploration. *Instructional Science, 38,* 571–606. https://doi.org/10.1007/s11251-008-9087-0

Hewitt, J. (2005). Toward an understanding of how threads die in asynchronous computer conferences. *Journal of the Learning Sciences, 14*(4), 567–589. https://doi.org/10.1207/s15327809jls1404_4

Hrastinski, S. (2008). Asynchronous and synchronous e-learning: A study of asynchronous and synchronous e-learning methods discovered that each supports different purposes. *EDUCAUSE Quarterly, 31*(4), 51–55.

Jung, I., Choi, S., Lim, C., & Leem, J. (2002). Effects of different types of interaction on learning achievement, satisfaction and participation in web-based instruction. *Innovations in Education and Teaching International, 39*(2), 153–162. https://doi.org/10.1080/13558000210121399

Khine, M. S., Yeap, L. L., & Chin Lok, A. T. (2003). The quality of message ideas, thinking and interaction in an asynchronous CMC environment. *Educational Media International, 40*(1–2), 115–126. https://doi.org/10.1080/0952398032000092161

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development.* Prentice Hall.

Konak, A., Clark, T. K., & Nasereddin, M. (2014). Using Kolb's Experiential Learning Cycle to improve student learning in virtual computer laboratories. *Computers & Education, 72*, 11–22. https://doi.org/10.1016/j.compedu.2013.10.013

Kumi-Yeboah, A., Sallar, A. W., Kiramba, L. K., & Kim, Y. (2020). Exploring the use of digital technologies from the perspective of diverse learners in online learning environments. *Online Learning, 24*(4), 42–63. https://doi.org/10.24059/olj.v24i4.2323

Kung T. H., Cheatham M., Medenilla, A., Sillos, C., De Leon L., Elepaño, C., & Tseng V. (2023). Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models. *PLOS Digital Health, 2*(2), e0000198. https://doi.org/10.1371/journal.pdig.0000198

Levine, S. (2007). The online discussion board. *New Directions for Adult and Continuing Education, 2007*(113), 67–74. https://doi.org/10.1002/ace.248

Lin, X. (2023). Exploring the role of ChatGPT as a facilitator for motivating self-directed learning among adult learners. *Adult Learning,* https://doi.org/10.1177/10451595231184928

Lin, X. (2024). Using a student-developed case study activity for online discussion guided by a three-tier case method model. *Adult Learning, 35*(1), 34–47. https://doi.org/10.1177/10451595231151732

Lin, X., Chan, R. Y., Sharma, S., & Bista., K. (2024). The impact of Artificial Intelligence (AI) on global higher education: Through the lens of ChatGPT. In X. Lin, R. Y. Chan, S. Sharma, K. Bista. (Eds.), *ChatGPT and global higher education: Artificial intelligence in teaching and learning* (pp. 1–17). STAR Scholars Press.

Lin, X., & Schmidt, S. W. (2023). Making ChatGPT work for you. *eLearn Magazine.* https://doi.org/10.1145/3594636

Lin, X., & Sun, Q. (2023). Student-generated memes as a way to facilitate online discussion for adult learners. *Psychology in the Schools, 60*(12), 4826–4840. https://doi.org/10.1002/pits.22884

Lin, X., & Sun, Q. (2024). Discussion activities in asynchronous online learning: Motivating adult learners' interactions. *The Journal of Continuing Higher Education, 72*(1), 84–103. https://doi.org/10.1080/07377363.2022.2119803

Lin, X., Sun, Q., & Zhang, X. (2023). Increasing student online interactions: Applying the video timeline-anchored comment (VTC) tool to asynchronous online video discussions. *International Journal of Human–Computer Interaction*, 1–13. https://doi.org/10.1080/10447318.2023.2247554

Lindeman, E. C. (1961). *The meaning of adult education.* Oklahoma Research Center for Continuing Professional and Higher Education.

Liu, M., & Yu, D. (2023). Towards intelligent e-learning systems. *Education and Information Technologies*, *28*(7), 7845–7876. https://doi.org/10.1007/s10639-022-11479-6

Luan, L., Lin, X., Dai, Y., Hu, S., & Sun, Q. (2024a). Exploring the cognitive dynamics of artificial intelligence in the post-COVID-19 and learning 3.0 era: A case study of ChatGPT. *Asian Journal of Distance Education, 19*(2), 1-10. https://doi.org/10.5281/zenodo.10990472

Luan, L., Lin, X., Dai, Y., Allen, L., & Hu, S. (2024b). Transforming STEM education: Leveraging ChatGPT for enhanced learning in psychology and neuroscience. In X. Lin, R. Y. Chan, S. Sharma, & K. Bista. (Eds.), *ChatGPT and global higher education: Artificial intelligence in teaching and learning* (pp. 100–121). STAR Scholars Press.

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). *A manual for the use of the motivated strategies for learning questionnaire (MSLQ).* National Center for Research to Improve Postsecondary Teaching and Learning. http://files.eric.ed.gov/fulltext/ED338122.pdf

Qadir, J. (2022). Engineering education in the era of ChatGPT: Promise and pitfalls of generative AI for education. *TechRxiv*. https://doi.org/10.36227/techrxiv.21789434.v1

Radford, A. W., Cominole, M., & Skomsvold, P. (2015). *Demographic and enrollment characteristics of nontraditional undergraduates: 2011–12.* Web Tables. NCES 2015-025. National Center for Education Statistics.

Ruiz, J. G., Mintzer, M. J., & Leipzig, R. M. (2006). The impact of e-learning in medical education. *Academic Medicine*, *81*(3), 207–212. https://doi.org/10.1097/00001888-200603000-00002

Stephenson, J. (Ed.). (2018). *Teaching & learning online: New pedagogies for new technologies*. Routledge.

Thornberg, R., & Charmaz, K. (2014). Grounded theory and theoretical coding. In U. Flick (Ed.), *The SAGE handbook of qualitative data analysis* (pp. 153–169). Sage.

University of Phoenix. (2019). *University of Phoenix academic annual report.* https://www.phoenix.edu/content/dam/ altcloud/doc/about_uopx/Academic-Annual-Report-Digital-2019.pdf

Wilson, K. L., Lizzio, A., & Ramsden, P. (1997). The development, validation and application of the Course Experience Questionnaire. *Studies in Higher Education, 22*(1), 33–53.

Yang, Y. T. C., Newby, T. J., & Bill, R. L. (2005). Using Socratic questioning to promote critical thinking skills through asynchronous discussion forums in distance learning environments. *The American Journal of Distance Education, 19*(3), 163–181.

Yin, R. K. (2014). *Case study research: Design and methods (applied social research methods).* Sage.

Zhai, X. (2022). ChatGPT user experience: Implications for education. *SSRN.* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4312418

Zhao, N., & McDougall, D. (2005, October). Cultural factors affecting Chinese students' participation in asynchronous online learning. In *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 2723–2729). Association for the Advancement of Computing in Education. https://www.learntechlib.org/primary/p/21612/

Appendix A

Grand Rule for Using ChatGPT for Online Discussions

- Maintain Respectful and Professional Communication:
  - Treat all participants, including ChatGPT, with respect and professionalism.
  - Use language that is courteous, inclusive, and free from derogatory or offensive remarks.
- Stay Focused on the Discussion Topic:
  - Generate discussion posts and responses that directly relate to the topic under discussion.
  - Avoid unrelated tangents or digressions that may derail the conversation.
- Ensure Authentic Engagement:
  - Provide thoughtful and genuine contributions to the discussion, reflecting your own perspectives and insights.
  - Use ChatGPT as a tool to enhance your ideas and expression, rather than relying solely on its responses.
- Properly Attribute Contributions:
  - Clearly indicate whether a particular statement or viewpoint is generated by ChatGPT or is your own input.
  - Acknowledge and give credit to other reliable sources used in your statements.
- Regularly Review and Edit ChatGPT Output:

    - Carefully review the output generated by ChatGPT for accuracy, clarity, and relevance to the discussion.
    - Edit or refine the generated content as necessary to ensure coherence and alignment with the topic.
- Seek Clarification and Ask Questions:
    - If uncertain about ChatGPT's response or the meaning behind it, seek clarification from the instructor.
    - Pose thoughtful questions to stimulate further discussion and encourage deeper engagement.
- Submit Conversations with ChatGPT:
    - Submit your conversations with ChatGPT to the instructor for each discussion activity.
    - This allows for analysis and feedback on your utilization of ChatGPT and aids in assessing your critical thinking skills.

Below are specific rules when using this tool on the discussion board:

- If copying an exact text generated by such tools, put the text in quotation marks; cite ChatGPT that generated the text and include the prompt used to generate the text in the reference section of your thread.

Example:

Original text generated by ChatGPT: “Online learning provides flexibility and accessibility to a diverse range of learners, accommodating various schedules and geographical locations.”

John’s post in the discussion thread: “I agree with the point made by ChatGPT that ‘Online learning provides flexibility and accessibility to a diverse range of learners, accommodating various schedules and geographical locations.’ This aligns with my own experiences as an online learner. However, I would like to explore further how online learning can address specific challenges faced by students with different learning styles.”

Generated text citation: ChatGPT. (2023). “Online learning provides flexibility and accessibility to a diverse range of learners, accommodating various schedules and geographical locations.” [Prompt: Discuss the advantages of online learning.]

- If paraphrasing a text generated by such tools, do not put the text in quotation marks but cite the tool which generated the original text; and include the prompt used to generate the original text in the reference section of your thread.

Example:

Original text generated by ChatGPT: "The impact of technology on education has revolutionized the way we learn, allowing for personalized and adaptive learning experiences tailored to individual needs."

John's post in the discussion board: According to the insights provided by ChatGPT, technology has brought about a transformative shift in education, enabling customized and adaptive learning opportunities that cater to the unique requirements of each learner.

Paraphrased text citation: ChatGPT. (2023). The impact of technology on education has revolutionized the way we learn, allowing for personalized and adaptive learning experiences tailored to individual needs. [Prompt: Discuss the role of technology in education.]

- If you use the tool to edit/modify your own original text, you do not need to cite it.

Graduate Teacher Education Students Use and Evaluate ChatGPT as an Essay-Writing Tool

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Abstract

Artificial intelligence (AI) has been evolving since the mid-twentieth-century when luminaries such as Alan Turing, Herbert Simon, and Marvin Minsky began developing rudimentary AI applications. For decades, AI programs remained pretty much in the realm of computer science and experimental game playing. This changed radically in the 2020s when commercial vendors such as OpenAI and Google developed generative AI programs (ChatGPT and Bard) using large language modelling (LLM). As a result, generative AI is now being considered for use in all walks of life, including education. In spring 2023, when ChatGPT burst into the public psyche, twenty-five education students in the author's graduate seminar were invited to participate in a qualitative study using ChatGPT as an essay-writing tool. Fifteen accepted the offer. The purpose in doing this was to give students in this seminar the opportunity to use ChatGPT in a supportive environment and to collect qualitative data via descriptive written evaluation and a focus group to comment on their experiences using ChatGPT. All of these students have master's degrees in education and experience as teachers in New York City schools. Their training and experience give them keen insights into pedagogical practice making them ideally suited to evaluate ChatGPT as an essay-writing tool. This article reports on the results of this study. Key findings indicate that the vast majority of these students had a good experience in using ChatGPT for their essays. Many, especially the secondary school teachers, would use it in their own classes.

Keywords: artificial intelligence, generative AI, ChatGPT, graduate teacher education, qualitative research

Picciano, A.G. (2004). Graduate Teacher Education Students Use and Evaluate ChatGPT as an Essay-Writing Tool. *Online Learning*, *Volume 28*(2), (150-169). DOI: 10.24059/olj.v28i2.4373

In a recent book, Mustafa Suleyman (2023), the co-founder of DeepMind and a major voice in the field of artificial intelligence (AI), commented that humanity stands at a turning point in its history. He compares the development and deployment of AI to the discovery of fire, the invention of the wheel, and the harnessing of electricity. He sees the potential of AI technologies as vast, profound, and capable of unlocking the secrets of the universe, to say nothing of its effect on our daily lives (Suleyman, 2023). There is little doubt that some aspects of Suleyman's predictions will occur; the question is when. Neither he nor anyone else can answer this difficult question.

Various forms of AI have been evolving since the middle of the twentieth century. Luminaries such as Alan Turing, Herbert Simon, and Marvin Minsky made significant contributions to the field. For decades, AI programs remained pretty much within the realm of computer science and experimental game playing. However, the twentieth century brought major AI development as mega corporations such as Apollo (Google's parent company), Microsoft, Apple, and Amazon started making billions of dollars in investments in this technology. These investments bore fruit in November 2022, when OpenAI launched its generative AI program, ChatGPT, using large language modelling (LLM) software. ChatGPT and other generative programs such as Google's Bard and Lensa AI have now brought AI to the masses. As a result, generative AI is now being used in all walks of life. The number of job postings mentioning GPT or ChatGPT on LinkedIn grew 21-fold in nine months since the chatbot was released in November 2022, according to a report on AI in the workforce. Postings for AI engineers more than doubled between April and June 2023, making it the third-fastest growing job on the platform (Kimbrough et al., 2023). "AI" was named the word of the year for 2023 by Collins Dictionary.

The purpose of this article is to report on the use of a generative AI program, ChatGPT, by a class of graduate teacher education students. In spring 2023, when ChatGPT attracted a good deal of public attention, 25 education students in the author's graduate seminar were invited to participate in a qualitative evaluation of the use of ChatGPT as a tool for completing an essay assignment. Fifteen (N = 15) students accepted the offer. The purpose of this exercise was twofold:

- To give students in this seminar the opportunity to use this new AI software in a supportive environment.
- To collect qualitative data from them on their experiences using the software.

All of these students have master's degrees in education and experience as teachers in New York City schools. Their training and experience give them keen insights into pedagogical practice, making them ideally suited to evaluate ChatGPT as an instructional tool. This article will report on their evaluations

For the purposes of this article, it is important to define generative AI as well as distinguish it from general AI. AI is a broad field or science in which machines are taught to develop humanlike capabilities. General AI occurs at the point when AI can learn human cognitive skills (Suleyman, 2023, p. vii) and is still years away from full development.

Generative AI, on the other hand, is here now. It is a technology within the field of artificial intelligence that uses neural networks, similar to the human nerve system, to generate new and original content. It can produce a wide variety of data, including text, images, audio, and video. Generative AI can also create content, such as synthetic data, code, simulations, and more by identifying patterns and structures within existing data. Generative AI builds upon technologies like large language models (LLMs), which are trained on vast amounts of data, enabling them to predict and develop data such as original images or text structured in sentences and paragraphs. This article focuses specifically on the use of a generative AI program, ChatGPT, that is currently being used by millions of people throughout the world. The GPT in ChatGPT stands for "Generative Pre-trained Transformers." It is a large language model (LLM) that is based on the concept of a *transformer*, first introduced in 2017 by researchers at Google (Vaswani et al., 2017). A transformer derives meaning from long sequences of text to understand how different words or semantic components might be related to one another, then determines how likely they are to occur in proximity to one another. These transformers are run unsupervised on a vast corpus of natural language text in a process called *pretraining* (that's the *P* in GPT), before being fine-tuned by human beings interacting with the model.

Review of the Literature

Since generative AI, especially in the form of ChatGPT, became popular in the general public only in late 2022, its research base is growing. Material, mostly in the form of reviews of its deployment in education has begun to appear. For example, Bahroun, Anane, Ahmed, and Zacca (2023) in a review of 207 papers concluded:

> This review paper presents a comprehensive analysis of generative artificial intelligence (GAI) in education… This study begins with a content analysis that explores GAI's transformative impact in specific educational domains…. The versatile applications of GAI encompass assessment, personalized learning support, and intelligent tutoring systems. Ethical considerations, interdisciplinary collaboration, and responsible technology use are highlighted, emphasizing the need for transparent GAI models and addressing biases. Subsequently, a bibliometric analysis of GAI in education is conducted, examining prominent AI tools, research focus, geographic distribution, and interdisciplinary collaboration. ChatGPT emerges as a dominant GAI tool, and the analysis reveals significant and exponential growth in GAI research in 2023. Moreover, this paper identifies promising future research directions, such as GAI-enhanced curriculum design and longitudinal studies tracking its long-term impact on learning outcomes. These findings provide a comprehensive understanding of GAI's potential in reshaping education and offer valuable insights to researchers, educators, and policymakers interested in the intersection of GAI and education. (Bahroun, Anane, Ahmed, and Zacca, 2023, p. 1)

Other reviews, like Mao, Chen, & Liu (2023); Ahmad, Murugesan, & Kshetri (2023); and Taniga (2023), have a similar focus and conclude that generative AI is enjoying increased use by faculty and students alike. Teachers are using generative AI for lesson planning and to develop curriculum material for classes, according to a national survey conducted by the Walton Family

Foundation (2023). Key findings were that 51% of teachers reported using ChatGPT, with 40% using it at least once a week, and 53% expecting to use it more this year. Twenty-two percent of K–12 students said they use the technology on a weekly basis or more (Walton Family Foundation, 2023). A survey conducted by the Pew Research Center in 2023 also found that 20 percent of secondary school students who are aware of ChatGPT use it for their schoolwork (Sidoti & Gottfried, 2023). However, a concern expressed in an ACE Survey Report was that "students with higher academic performance were significantly more likely to use [generative] AI tools than were students with lower academic performance" (Schiel, Bobek, & Schnieders, 2023). Deng and Yu (2023), in a meta-analysis on the efficacy of generative AI on ten instructional factors, found that it could have a significant positive effect on four of the factors including student learning achievement. However, they rejected generative AI effects on the other six. Huang, Hew, & Fryer (2022), in a review of generative AI on language learning, concluded:

> Our findings revealed three technological affordances: timeliness, ease of use, and personalization; and five pedagogical uses: as interlocutors, as simulations, for transmission, as helplines, and for recommendations. Chatbots appeared to encourage students' social presence by affective, open, and coherent communication. Several challenges in using chatbots were identified: technological limitations, the novelty effect, and cognitive load. (Huang, Hew & Freyer, 2022, p. 237)

The major focus of this study is the use of ChatGPT by students as an essay-writing tool. Students may evaluate ChatGPT in this regard for the quality of the essay they produce, its ease of use, its time efficiency, or its help in developing their language skills. ChatGPT might also be evaluated differently depending on the characteristics and abilities of the students. Since ChatGPT only became popularly available in late 2022, the research on it is modest. Basic, Banovac, Kruzic and Jerkovic (2023) in a study of ChatGPT as an assistant for essay writing commented that it is unknown how Chat GPT performs as a student writing tool. They further commented that their study was the "first" that tested ChatGPT as an essay writing assistance tool. One of their important findings was that students using ChatGPT to write an essay did not perform better than students not using it. They also found that ChatGPT did not improve or accelerate their essay-writing time. This is an important comment since it has been assumed that generative AI software would be used as a convenience and timesaver for writing an essay. Fauzi et al. (2023) in a review of ChatGPT literature for improving productivity concluded that students found it provides useful information, it improves time efficiency, and helps improve language skills. Yifan, Mengmeng, & Omar (2023) in a survey of 355 students in five Malaysian universities found that students used ChatGPT because of its ease of use, and convenience for a host of academic activities including writing assignments. They also suggest that:

> The combination of ChatGPT and education can provide support for students' papers, assignments, tests, etc.…[it) can also make significant contributions to improving the quality of student productivity, helping university students improve language skills, and providing certain support and motivation. These time-saving

> methods will enable university students to continue using ChatGPT…ChatGPT can also provide self-directed adaptation services for students with learning disabilities, which helps promote fairness and inclusiveness in education. (Yifan, Mengmeng & Omar, 2023, p. 2187)

Several researchers, Barrot, (2023); Yan (20232); and Zou & Huang (2023), also suggest that ChatGPT can have beneficial effects for second-language students. Song & Song (2023) in a mixed methods study of the impact of AI-assisted language learning on Chinese English as a Foreign Language (EFL) students' writing skills and writing motivation concluded:

> Quantitative analysis reveals significant improvements in both writing skills and motivation among students who received AI-assisted instruction compared to the control group. The experimental group demonstrates enhanced proficiency in various aspects of writing, including organization, coherence, grammar, and vocabulary. Qualitative findings showcase diverse perspectives, ranging from recognition of AI's innovative instructional role and its positive influence on writing skills and motivation to concerns about contextual accuracy and over-reliance." (Song & Song)

To conclude this review of the literature, an important area of concern regarding the use of generative AI is whether the "human" element of teaching and learning may be compromised (Henane, 2023; Lo, 2023; and Global Services in Education, 2023). They raise pedagogical questions related to the social and emotional aspects of learning. For example, Henane (2023) commented: "AI may excel in numerous tasks, but it will never possess the capacity to teach a child how to love, care, express their feelings, and develop their unique personality." Parra (2024) likewise in an article examining "critical conversations" in AI concluded: "We need to focus on the humans and the relationships."

The goal of this research project was to provide a supportive environment wherein experienced teachers who are also graduate students were given the opportunity to use and experience generative AI (as provided by ChatGPT). They were also tasked with evaluating it as a tool for writing essays for themselves and their own students.

Methodology

This study uses qualitative research to evaluate ChatGPT as an essay writing tool. Elements of Creswell's (2009) characteristics for qualitative research were followed, including:

- the use of a natural (class) setting
- collect multiple sources of data
- researchers as instruments
- inductive data analysis
- participants meaning

The participants in this study were enrolled in a required graduate course in the Administration and Supervision Program at Hunter College. The program has selective admission requirements as follows:

- A master's degree from an accredited institution with a Grade Point Average (GPA) of at least 3.0.
- Permanent or professional New York State (NYS) certification as a teacher and/or pupil personnel service provider within grades pre-K–12.
- A minimum of three years of approved teaching and/or school service within grades pre-K–12 under regular appointment (or its equivalent for counselors, social workers, and school psychologists) or two years approved teaching and/or school service and at least one year of relevant management/leadership experience.

The students in this program are generally well-organized, focused on their studies, and have good writing skills. Twenty-five students were enrolled in this course in spring 2023.

The students were offered the option to do an essay (see Appendix A) using ChatGPT. Fifteen students volunteered to use ChatGPT for this assignment. The basic characteristics of these students are:

- Gender: 10 females; 5 males.
- Teaching Level: 7 high school teachers; 4 middle school teachers; 4 primary school teachers.
- Average Age: 32.6 years.
- Average teaching experience: 9.2 years.

To provide a supportive environment as specified above, there was a one-hour introduction to ChatGPT geared to the essay assignment. Students were free to ask any questions about the assignment including the use of ChatGPT. During the semester, there were three progress reporting sessions during which students could also ask any questions they had about the assignment. During these sessions, several students asked for technical guidance about formulating ChatGPT questions.

The two major data collection tools for this study were the student essays and a focus group discussion. The student essays required them to answer a series of questions related to their experiences using ChatGPT (see Appendix A). In addition to preparing the written essay, the students participated in a two-hour focus group discussion after they completed their assignments. The student responses to the questions on the essay and comments made during the focus group discussion were the sources of data for this study.

Findings

The findings that follow contain excerpts of student responses to the prompts that they were required to answer in the assignment:

1. How well did you feel ChatGPT assisted you in completing the assignment?
2. Do you believe that you could have done as good, better, or not as good a paper without using ChatGPT?
3. Would you allow students to use ChatGPT in your own classes?
4. Recommendations and comments on particular K–12 student populations.

These questions also follow from the issues raised in the above review of the literature specifically to those related to using ChatGPT as an essay-writing exercise. Comments that were particularly pertinent or were repeated by more than one student have been italicized. Appendix B has two samples of unabridged student responses to give the reader a better understanding of the depth of their thinking on ChatGPT.

Student Overall Comments

Below are samples of comments from students taken verbatim from their responses on the essay assignment or during the focus group discussion.

> Student LAA: I think ChatGPT did a decent job of creating a skeleton for this essay. The writing it produced is coherent and technically sound. It uses language that is appropriate for the task and mirrors academic writing and structure. The content of the essay it produces is dependent on the way you phrase your question. When I entered the prompt for the assignment as it was written, the essay was pretty general and not too dissimilar from what you might read in a newspaper book review. When I tweaked the prompt to be more specific like, "Write a 1500-word essay reviewing Linda Villarosa's book *Under the Skin*. Identify the key themes/points of view of the author(s) and how they are important to education research," *it produced the beginning of a higher quality essay.*
>
> Student DFF: I believe that without using AI I could have written a similarly strong essay, *but it would have likely taken me more time* to generate my ideas.
>
> Student LRR: Overall, this was extremely helpful in organizing my thoughts and assisting me in planning how I wanted to construct my response. The program did not provide me with any novel insights into the book that I could not garner myself through reading it, but it did help me take such a large amount of information and dilute it to its main points. I suppose I would have done this myself, if not for ChatGPT, *but it expedited the process* and might be more accurate and succinct than my own bulleting key ideas list would be.
>
> Student JRR: ..it helped me overcome writer's block by providing new ideas and fresh perspectives on the novel. .. It provided ways to find and access a wide range of sources and references. .. ChatGPT provided suggestions for improving the flow, structure, and coherence of my essay, *helping me to refine my writing skills and produce well-crafted work.*

> Student GSS: I found ChatGPT to be the most useful for summarizing the key points and finding relevant quotes for analysis. These are fairly objective tasks, so ChatGPT's output was a more than sufficient substitute for my own work. In fact, the AI has the edge here because it was able to complete these two tasks much more quickly than I could (instantaneous vs. needing some thought and chew time). While I have confidence that I ultimately would have been able to do as good or better of a job at this area of the task, ChatGPT wins in this scenario because it cut down my time working on the more cut-and-paste tasks and left me with more energy to engage more deeply in my own analysis….*ChatGPT is insufficient, however, when it comes to offering opinions on topics, or actually engaging with the quotes it found.*
> Student MEE: *I could have written a better paper without using ChatGPT* because the intelligence only came up with what I asked it to do. I would have been more impressed if it did not require me to specifically tell it to write the text using imagery as the focus.
>
> Student SMM: *What I felt was missing from ChatGPT's responses, and what I added, was a deeper analysis of the text and more thoughtful and critical connections to the work of contemporary scholars within educational research today.* That said, I could have likely continued to pose more questions or prompts to ChatGPT to elicit a more detailed response. However, I wished to make those connections myself in order to deepen my own understanding and push my own thoughts and reflection.
>
> Student SHM: I recognize ChatGPT's review as failing to appreciate or even identify the utility of the eight approaches that Rollins has successfully introduced in classrooms where acceleration is favored over remediation. Despite its repeated use of the word "engaging," ChatGPT shows an inability to engage in the higher-order thinking required to cite any level of detail in comparing, contrasting or distinguishing between instructional strategies that Rollins has found in classrooms that have successfully embraced acceleration and those that have defaulted to remediation. Instead, the chatbot refers vaguely to the "importance of creating a learning environment that is both challenging and engaging" and "the need to scaffold instruction and differentiate learning to meet the needs of all students" with "graphic organizers, cooperative learning, and task rotation." *None of this generic information would help an educator or administrator decide whether Rollins offers anything that would be of value in a classroom. In short, ChatGPT barely reaches the second level of Bloom's Taxonomy.*

Several themes recurred in the above. First, most of the students had positive experiences. For example, student DFF commented that ChatGPT helped refine their writing skills and helped to develop the beginning of a "high-quality essay." Student JRR commented "... ChatGPT provided suggestions for improving the flow, structure, and coherence of my essay, *helping me to refine my writing skills and produce well-crafted work."*

Second, three students (DFF, LRR, GSS) mention the efficiency of using ChatGPT. Student DFF stated "I could have written a similarly strong essay, *but it would have likely taken me more time* to generate my ideas."

Third, several students, while finding aspects of ChatGPT beneficial, also expressed reservations. Student SMM stated: "*What I felt was missing from ChatGPT's responses, and what I added, was a deeper analysis of the text and more thoughtful and critical connections to the work of contemporary scholars within educational research today."* Student MEE commented: *"I could have written a better paper without using ChatGPT."* Student SHM was very critical of OpenAI and compared its output to the lower rungs of Bloom's Taxonomy.

Would You Allow Students to Use ChatGPT in Your Own Classes?

> Student LRR: I am a second-grade teacher, so *ChatGPT isn't very relevant.*
>
> Student OMM: I would consider allowing students to use this for writing assignments, but *I would hesitate with my middle schoolers. We already have a ton of plagiarism issues* because the students don't fully understand how to use sources instead of copying/pasting google searches.
>
> Student WPP: I teach IB History and recently the International Baccalaureate established a policy allowing students to use and cite ChatGPT in their writing. As a result, *I would allow students in my class to use it for their work as long as they follow the proper parameters in citing the work.*

To summarize, the high school teachers would be willing to experiment with using ChatGPT, the primary and middle school teachers less so.

ChatGPT and Specific Student Populations

The following responses reflect a variety of thoughts on specific student populations.

Equity

> Student SMM: I am undecided on whether or not I would *consistently* allow my students to utilize ChatGPT. On one hand, I think it removes barriers for many students who have reading problems and grapple with a text, and who may be struggling to synthesize their ideas, connections, and analysis of the text. To that end, Chat GPT could provide access and entry points to rich and complex texts for many students who may otherwise avoid such literature or topics. *It could be seen as a vehicle for equity in classrooms and institutions.* On the other hand, perhaps it removes the work of critical analysis for students, and requires too little of them, and may end up stymying their ability to become critical-thinkers and change-makers.

ESL Students

> Student KAA: I feel that Chat GPT has the power to be an extremely useful tool for ESL students or students who are writing below grade level. *It is very helpful to be provided a model example and that is not always given to you when given an assignment in school.*

> Student ZCC: *I am a Bilingual School Counselor and many of my students are ESL* learners and this tool can be useful for them…, *it can be a good starting point for the learning experience* and students can build and push themselves to dive further into the information while also being critical of the information that is gathered by this tool. I believe educators can find a way to make this tool work for both them and the student's learning experience.

> Student MEE: The majority of the students I teach are newly arrived ESL in the United States, as such, writing often causes them anxiety. By using this technology to brainstorm assignments, *it would show them how to write a basic essay and not stare at a blank page, perplexed by what they have to do.*

Math Students

> Student KAA: What's interesting to me about the discussion around ChatGPT is that math teachers have been dealing with this issue for over ten years. *When I first started my career in 2014, I quickly learned about "photomath." Photomath is an app that allows you to scan a math problem and it instantly answers the problem for you and provides all steps.*

Special Education

> Student KAA: Some of my co-workers have been utilizing ChatGPT *to create IEP goals for their students.* I was amazed with how capable it was at any task it was given which is why I wanted to utilize it for this assignment.

The number of comments about the benefits of ChatGPT for specific student groups was of particular interest. This was explored this during the focus group session and the students were adamant in what they saw as benefits of a generative AI tool for students who struggle with writing in general, for ESL students, and for special education students. This issue will be discussed further in the section that follows.

Discussion

The timing of this study—early in the spring 2023 semester—should be kept in mind throughout the discussion of the findings. ChatGPT had just become popular and many people including the participants of this study were minimally aware of it or any other generative AI tools. For the most part, teachers in K–12 schools and colleges were just familiarizing themselves with this technology with few using it in any meaningful way. Regardless, the majority of the participants in this study found that ChatGPT saved time in writing their essays, was easy to use, and helped generate ideas to get them started. However, several other findings are worth mentioning.

First, some participants found that ChatGPT "provided new ideas and fresh perspectives," "summarized the key points," and "helped take such a large amount of information and dilute it to its main points." Others questioned the quality of the ChatGPT responses and stated that "OpenAI did not provide me with any novel insights" and "ChatGPT is insufficient, however, when it comes to offering opinions." The mix of opinions here represent similar findings in other studies of generative AI. Deng and Yu (2023) mentioned earlier found it had a significant positive effect on only four of ten factors. Basic, Banovac, Kruzic and Jerkovic (2023) in a study of ChatGPT as an assistant for essay writing commented that there were mixed results but that it did not perform better than students not using it. I believe that as these students and others make greater use of ChatGPT and other generative AI programs they will become more proficient in eliciting responses that might better meet their needs.

Second**,** a number of students complimented ChatGPT's assistance in writing their essays. These comments related to helping with writer's block, getting their writing started, and helping to organize one's thoughts. Even if they thought they could write a better essay, some appreciated ChatGPT's assistance. Some also extended their opinions on ChatGPT's writing to its effect on their own students. They saw it as helping issues of inequity for students who have trouble writing in general especially ESL students whose first language is not English. This is consistent with a number of other studies mentioned in the research literature such as Barrot (2023); Yan (2023); Zou & Huang (2023); and Song & Song (2023). One student, KAA, commented that ChatGPT was being used to assist in writing Individual Evaluation Plans (IEPs) for students with special needs. Recently, there have been a number of articles in the professional media that support the potential of generative AI to address equity issues. Cohen (2023) in a piece for The Core Collaborative sees ChatGPT as a starting point in a pursuit of more equitable educational practices, and

> …its potential is to support neurodiverse students, students from marginalized populations, and students from non-traditional families. It is important to recognize that achieving true equity in education requires a comprehensive approach and cannot be accomplished by any single tool or solution. However, ChatGPT can play a crucial role in helping us work towards a more inclusive and equitable education system. (Cohen, 2023)

Others such as Hall (2023) have commented that ChatGPT "levels the playing field" for people with disabilities and de Haas (2023) goes so far as to label ChatGPT a "game changer for people with dyslexia" who have trouble writing. However, as mentioned earlier in this article, early research indicated that higher performing students were significantly more likely to be using generative AI tools than were lower-performing students (Schiel, Bobek, & Schnieders, 2023).

Third**,** Student SMM commented:

> What I felt was missing from ChatGPT's responses, and what I added, was a deeper analysis of the text and more thoughtful and critical connections to the work of contemporary scholars within educational research today. That said, I could have likely continued to pose more questions or prompts to ChatGPT to elicit a more detailed response. However, I wished to make those connections

> myself in order to deepen my own understanding and push my own thoughts and reflection.

They went on to say that "… perhaps it removes the work of critical analysis for students, and requires too little of them, and may end up stymying their ability to become critical thinkers." Several other students, particularly in the focus group discussion, raised concerns about their students becoming too dependent upon ChatGPT for content or for writing. Questions were raised about controlling students' use and possible dependency on ChatGPT. Comments raised about student dependency also segued into the issue of ethics and plagiarism. This is a major issue already for many teachers at any level; ChatGPT might just add to it. It behooves the teaching profession to recognize this and do what it can to advise students about ethical considerations of using generative AI. This might in fact be the major question for years to come as generative AI moves beyond its beginning stages and matures.

Conclusion

Generative AI in the form of ChatGPT entered the consciousness of the world in late 2022. The data for this study was collected in early 2023 when ChatGPT was still a new phenomenon. The findings support other studies conducted on generative AI that concluded that it saved time, helped get the writing process started, and could be beneficial for certain student populations (Fauzi et al., 2023; Yifan, Mengmeng, & Omar, 2023; Song & Song, 2023). The graduate students evaluating ChatGPT in this study, who themselves are K–12 teachers, saw it as a tool that they will have to consider in their own teaching. They will be faced with pedagogical, policy and ethical issues as generative AI becomes part of their instructional repertoire and as expressed by other researchers (Deng and Yu, 2023; Banovac, Kruzic, and Jerkovic, 2023; Huang, Hew, & Fryer, 2022).

Generative AI is still a young technology that is growing in capability and its most significant advances are yet to come. Microsoft and Google are already integrating generative AI into their search engines and other products. In the near future, generative AI will integrate with massive cloud computing, robotics, and synthetic biology and likely begin to evolve to more general AI with capabilities far beyond the generative model. This integration will occur as digital technology exponentially accelerates, building upon advanced nanotechnology and quantum computing. AI in all of its ramifications will be a focal point as humankind functions in most of its endeavors, including education.

Declarations

Funding

This research received no external funding.

Institutional Review Board Consent

This project was reviewed by the City University of New York Institutional Review Board. Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest

The author declares no conflict of interest.

References

Ahmad, N., Murugesan, S., & Kshetri, N. (2023). Generative artificial intelligence and the education sector. *Computer*, *56*(6). https://ieeexplore.ieee.org/document/10132034

Bahroun, Z., Anane, C., Ahmed, V., & Zacca, A. (2023). Transforming education: A comprehensive review of generative artificial intelligence in educational settings through bibliometric and content analysis. *Sustainability*, *15*, 12983. https://www.mdpi.com/2071-1050/15/17/12983

Barrot, J. S. (2023). Using ChatGPT for second language writing: Pitfalls and potentials. *Assessing Writing*, *57*, 100745. https://doi.org/10.1016/j.asw.2023.100745

Bašić, Ž., Banovac, A., Kružić, I., & Jerković, I. (2023). Better by you, better than me? Chat GPT-3 as writing assistance in students' essays. https://www.semanticscholar.org/reader/5c125a2d0ed00185a08c67ee64b9d29250fd5274

Creswell. J. W. (2009). *Research design: Qualitative, Quantitative, and mixed methods design* (3rd ed.). Sage.

Cohen, Z. (2023, January 17). Can ChatGPT be the key to achieving educational equity? *The Core Collaborative.* https://thecorecollaborative.com/can-chat-gpt-be-the-key-to-achieving-educational-equity/

de Haas, A. A. (2023, March 3). ChatGPT: A game-changer for dyslexics. *News & Views from Davis Dyslexia Association International*. https://blog.dyslexia.com/chat-gpt-for-dyslexics/

Deng, X., & Yu, Z. (2023) A meta-analysis and systematic review of the effect of chatbot technology use in sustainable education. *Sustainability*, *15*, 2940. https://doi.org/10.3390/su15042940

Global Services in Education (2023). *AI in education: Embracing a human-centered approach to learning*. https://www.gsineducation.com/blog/ai-in-education-embracing-a-human-centered-approach-to-learning

Henane, S. (2023). Teachers: The indispensable human element in the age of AI. *Math Bridge Builders Newsletter*. https://www.linkedin.com/pulse/teachers-indispensable-human-element-age-ai-samia-henaine/

Hall, M. (2023, February 3). ChatGPT "levels playing field" for people with disabilities. *News Nation.* https://www.newsnationnow.com/business/tech/chatgpt-levels-playing-field-for-people-with-disabilities/

Huang, W. J., Hew, K. F., & Fryer, L. K. (2022). Chatbots for language learning—Are the really useful? A systematic review of chatbot-supported language learning. *Journal of Computer Assisted Learning*, *38*, 237–257. https://onlinelibrary.wiley.com/doi/epdf/10.1111/jcal.12610

Kimbrough, K., Carpanelli, M., Raghavan, S., Kaura, A., & Erer, M. (2023). Future of work report: AI at work. *Linkedin*. future-of-work-report-ai-august-2023.pdf (linkedin.com)

Lo, L. (2023). Human meets AI: Helping educators navigate their emotions about technological change. *EdSurge*. https://www.edsurge.com/news/2023-08-04-human-meets-ai-helping-educators-navigate-their-emotions-about-technological-change

Mao, J., Chen, B., & Liu, J. C. (2023). Generative artificial intelligence in education and its implications for assessment. *TechTrends.* https://doi.org/10.1007/s11528-023-00911-4

Parra, J. (2024). Social media and artificial intelligence: Critical conversations and where do we go from here. *Education Sciences*, *13*, 845. https://www.mdpi.com/journal/education/special_issues/T3XIO39D6Z

Schiel, J., Bobek, B. L., & Schnieders, J. C. (2023). High school Students' use and impressions of AI tools. *ACT*. https://www.act.org/content/dam/act/secured/documents/High-School-Students-Use-and-Impressions-of-AI-Tools-Accessible.pdf

Sidoti, O., & Gottfried, J. (2023, November 16). *About 1 in 5 U.S. teens who've heard of ChatGPT have used it for schoolwork*. Pew Research Center. https://www.pewresearch.org/short-reads/2023/11/16/about-1-in-5-us-teens-whove-heard-of-chatgpt-have-used-it-for-schoolwork/

Song, C., & Song, Y. (2023). Enhancing academic writing skills and motivation: Assessing the efficacy of ChatGPT in AI-assisted language learning for EFL students. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1260843

Suleyman, M. (2023). *The coming wave: Technology, power and the 21st century's greatest dilemma*. Crown Publishing Co.

Tanjga, M. (2023). E-learning and the use of AI: A review of current practices and future directions. *Qeios*. https://doi.org/10.32388/ap0208

Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A., Kaiser, L., & Polosukhin, I. (2017). Attention is all you need. https://arxiv.org/pdf/1706.03762.pdf

Walton Family Foundation (2023, March 1). *ChatGPT used by teachers more than students, new survey from Walton Family Foundation finds*. https://www.waltonfamilyfoundation.org/chatgpt-used-by-teachers-more-than-students-new-survey-from-walton-family-foundation-finds

Yan, D. (2023). Impact of ChatGPT on learners in a L2 writing practicum: An exploratory investigation. *Education and Information Technologies*. https://doi.org/10.1007/s10639-023-11742-4

Yifan, W., Mengmeng, Y., & Omar, M. K. (2023). “A friend or a foe" Determining factors contributed to the use of ChatGPT among university students. *International Journal of Academic Research in Progressive Education and Development 12*(2): 2184–2201. https://www.researchgate.net/publication/372829470_A_Friend_or_A_Foe_Determining Factors_Contributed_to_the_Use_of_ChatGPT_among_University_Students

Zou, M., & Huang, L. (2023). The impact of ChatGPT on L2 writing and expected responses: Voice from doctoral students. *Education and Information Technology*. https://doi.org/10.1007/s10639-023-12397-x

Appendix A

Student Book Assignment

Read One of the Following

(The students could select one of twenty books from a reading list. Below is a sample of these books.)

Brady, T. (2021). *Three ordinary girls: The remarkable story of three Dutch teenagers who became spies, saboteurs, NAZI assassins and WW II heroes.* New York: Citadel Press.

Caro, R.A. (2019). *Working: Researching, interviewing, writing.* New York: Alfred Knopf.

Villarosa, L. (2022). *Under the skin: The hidden toll of racism on American lives and on the healthof our nation.* New York: Penguin/Random House.

Write an essay reviewing one of the books above. Answer why you selected this book for your assignment and indicate whether it met your expectations. Also make sure to identify the key themes/points of view of the author(s) and how they are important to education research. Conclude your essay with a clear statement on whether you agree with the author’s positions. Please write seven pages and absolutely no more than nine double-spaced (Times Roman 12-Font) pages. Due March 6th.

For students opting to use ChatGPT.

ASSIGNMENT NO. 1 ADDENDUM

Assignment No. 1 essentially remains the same as described earlier in this syllabus except that students have the option of using ChatGPT software to assist in writing their papers. Students are responsible for using ChatGPT as best they can.

I would suggest that you start your ChatGPT session with a request as follows.

“Write an essay reviewing (give full citation of the book you are reading. For example: (Blight, D. W. (2018). *Frederick Douglas: Prophet of freedom.* New York : Simon & Schuster.) Answer why you selected this book for your assignment and indicate whether it met your expectations. Also make sure to identify the key themes/points of view of the author(s) and how they are important to education research. Conclude your essay with a clear statement on whether you agree with the author’s positions.“

You can use the essay produced by ChatGPT as the beginning of your paper. To complete the assignment, you will likely have to write approximately four-five more pages rather than the seven as indicated in the original Assignment No. 1. You can use your own discretion as to how many additional pages you need to complete the assignment. You can ask ChatGPT follow-up questions if you wish.

I would also like you to add one paragraph to this assignment at the end of your paper answering the following as best you can.

How well did you feel ChatGPT assisted you in completing the assignment?

Do you believe that you could have done as good, better, or not as good paper without using ChatGPT?

Would you consider allowing students in your own classes to use ChatGPT for essay assignments?

What recommendation do you have, if any, for other teachers or educators in using ChatGPT?

How old are you in years?

How long in years have you been a teacher or otherwise involved in educati

Appendix B

Two Samples of Unabridged Student Responses.

Sample 1 – Their report was based on Freire, P. (2000). *Pedagogy of the oppressed*.

ChatGPT User Questions and Responses

How well did you feel ChatGPT assisted you in completing the assignment?

As an educator I always have my reservations when it comes to artificial intelligence, AI. On a daily basis I see my students that are high schoolers struggling with basic writing. Instead, they are absorbed in social media feeds and often have difficulty in participating in conversations that are both informal and academic. Therefore, I was unsure if ChatGPT would be another one of those tools that prevent students from thinking critically on their own. I thought to myself would using ChatGPT cause more harm than good.

After using ChatGPT I would have to say that I see it as an extremely useful tool if used with some restrictions. Using ChatGPT allowed me to see if my own interpretations of the text were in alignment with what Paulo Freire was saying about the oppressed and non oppressed classes. It provided me with a starting point on where to begin this essay and how to divide the book's distinct four chapters into distinct sections to comment upon. What I did appreciate is that the AI in ChatGPT noted that it does not have the faculty to take an affirmative stance. Therefore, I believe ChatGPT is a worthwhile place to generate some initial thoughts on a topic. From a teacher's perspective ChatGPT can be used as an entry point for students that struggle with engaging with a topic or need further clarification about. Also, I believe that coming up with how to formulate the question for ChatGPT does require critical thinking from its user. Overall, I would not be opposed to having students use this tool as a source, however I would not allow them to use it as a replacement for writing papers. I still want students to engage in thinking critically about a topic on their own and generate their own opinions. They still need to practice the skills and exercise the standard conventions of English in their academic writing without the support of artificial intelligence. It should be a tool, rather than a crutch or replacement.

Do you believe that you could have done as good, better, or not as good paper without using ChatGPT?

As cliche as it may sound, two heads are better than one, even if one of these heads is artificial intelligence. I do believe I could have done as good of a job on the paper without using ChatGPT because of my own intrinsic motivation. I would have done my own research to see if my understanding of the text was in alignment with other readers and critics. It would take a lot more time and effort, however. ChatGPT provided me with a concise summary of the text and provided me with a blueprint of the major themes that I should not overlook such as how many of our education systems continue to perpetuate forms of oppression. I think ChatGPT lacked its level of analysis regarding the main themes in the text. Most of the summaries were very surface level without saying if Freire's views were correct or flawed. There is also no direct textual evidence from the text (ex. quotes) in the response.

Would you consider allowing students in your own classes to use ChatGPT for essay assignments?

I would consider allowing students in my own classes to use ChatGPT for essay assignments as a source. For example, I would have students read the material first on their own and then use ChatGPT as a way of checking for understanding. I would not be opposed to having students cite from it, however I still would want students to write their own essays. I fear with heavy reliance on ChatGPT, writing in academic settings may be phased out. Being able to write critically about a topic on your own is essential for college and career readiness.

What recommendation do you have, if any, for other teachers or educators in using ChatGPT?

The recommendation I have for other teachers or educators in using ChatGPT is to use it as a place to create lessons. Have students think critically about how to form questions that yield responses. The act of thinking how to formulate a question makes students engage with the subject matter. Another way to use ChatGPT is to have students comment on the quality and validity of its responses. Are they high quality? Are they biased? Are they incorrect? If we accept everything ChatGPT tells us we become what Paulo Freire feared, empty vessels. ChatGPT becomes a depositor, using a banking method of education. We become the empty vessels that simply receive without thinking.

How old are you in years?

I am twenty-eight years old.

How long in years have you been a teacher or otherwise involved in education?

I have been teaching for seven years.

Sample 2 – Their report was based on Brady, T. (2021). *Three ordinary girls: The remarkable story of three Dutch teenagers who became spies, saboteurs, NAZI assassins and WW II heroes.*

Chat GPT Reflection

I feel that ChatGPT assisted me significantly more than I thought it would on this assignment. When we were first given the ChatGPT option, I instantly knew I wanted to pick that one. ChatGPT is something that has come up in my household many times. My husband works in technology sales and everyone at work has been using ChatGPT to write their emails to potential clients. My best friend works in social media, and she has used ChatGPT to come up with clever ideas to pitch to her clients. Some of my coworkers have even tried to utilize ChatGPT to create IEP goals for their students. I was amazed with how capable it was at any task it was given which is why I wanted to utilize it for this assignment.

While I absolutely understood why I wanted to read this book, I did struggle with its connection to educational research. I knew that only one of the main characters experienced a traditional education and I saw how the German invasion impacted her education. But I was really struggling with how the book connected to educational research specifically. ChatGPT was able to point me in the right direction and then I was able to follow my own thoughts moving forward. Without using ChatGPT, I may have had to switch books because I would not be able to fully complete this assignment. Because of this, I think using ChatGPT for essay assignments is a good idea. It can help students who are struck and need a little help getting started. However, students must be reminded that when it comes to test day, this resource will not be available to them, and they will have to come up with this information on their own.

What's interesting to me about the discussion around ChatGPT is that math teachers have been dealing with this issue for over ten years. When I first started my career in 2014, I quickly learned about "photomath." Photomath is an app that allows you to scan a math problem and it instantly answers the problem for you and provides all steps. There are also the websites WolframAlpha, Symbolab, and Mathway that can solve equations. At first, we tried to figure out a way to make sure students were not using these resources. However, we very quickly realized this would be impossible once they leave our classrooms. As a result, I always require students to turn in their work with all steps included for their homework assignments. This way, even if a student does utilize Photomath, at least they took the time to copy down the steps and solutions and **hopefully**, they were paying attention to those steps and can remember to apply those steps on a future assessment. If used authentically and correctly, these resources can be **extremely** useful. Photomath, just like ChatGPT, provides a model example for students to use. They can then take that model and edit it to be their own or use it as inspiration for another problem/assignment. These resources are not going anywhere and are most likely only going to become “smarter.” Because of this, I feel that we must embrace them.

I also feel that Chat GPT has the power to be an extremely useful tool for ESL students or students who are writing below grade level. It is very helpful to be provided a model example and that is not always given to you when given an assignment in school. Chat GPT allows you to input your prompt and utilize their response as a model example. ENL students can practice their reading and writing skills and format their assignment in a similar way. Besides ENL students, I really think all students would benefit from this. If we teach students the importance of not plagiarizing and teach them how to use ChatGPT to **aid** their writing process, I believe it can be a very successful tool. Of course, the one argument is that students will struggle to come up with their own original ideas and become too reliant on this tool; however, if they use it enough, they’ll have a “toolbox” filled with ideas and will most likely be able to recycle one that they have already come across.

Lastly, I believe that when teachers incorporate ChatGPT, photo math or other AI apps/websites, they are letting their students know that they are aware they exist. Not only are they telling them they know they exist, but if they are teaching them **how** to successfully take advantage of the tools and make them their own, it becomes a more positive learning experience. A big issue that I have come across is that the NYCDOE has already blocked ChatGPT from being accessed on their public WIFI’s. Because of this, students would not be able to use this in the computer labs or their devices if they are using the school’s internet. I’m curious how teachers who are using this in class are getting around this issue.

I am 31 years old, and this is my 9th year teaching. *(I also got my first masters in curriculum development and educational technology, and we spent a lot of time talking about AI and how to not feel threatened by it and instead embrace it.)*

Introduction to OLJ Section II

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In addition to the special issue on online learning in the age of AI, this issue also contains 12 articles from our regular submission process. These articles cover a broad range of topics including “bichronous” online learning, student satisfaction and engagement, three articles on online learning during the COVID pandemic, connectivist learning theory and more.

The first paper in this section is “Bichronous Online Learning: Perspectives, Best Practices, Benefits, and Challenges from Award-Winning Online Instructors” by Florence Martin of North Carolina State University, Swapna Kumar and Albert Ritzhaupt of the University of Florida, and Drew Polly of the University of North Carolina, Charlotte. As indicated by the title this paper investigates the intentional blended of synchronous (real-time) and asynchronous (time delayed) modes of learning in online environments. While students frequently seek out online degree programs prioritizing flexibility and convenience offered through asynchronous options, synchronous approaches can provide unique benefits. Meta-analytic evidence suggests that such integration improves student learning outcome relative to asynchronous only modes. This study offers effective instructional strategies, devised by award-winning faculty, for the mindful integration of the two modalities.

While the literature on online student satisfaction is voluminous and dates back decades, scholarly work on online program satisfaction is scarcer. In “A Framework for Evaluating Online Degree Programs through Student Satisfaction” authors Zikai Zhou and Sharon Rouse of the University of Southern Mississippi develop and test a new framework for understanding the factors that contribute to student satisfaction at the program level. Combining factors identified in the literature the authors propose six factors that significantly predict variance in student rating or online programs. The factors relate to the program, courses, instructors, technical considerations, student self-directedness and employment related concerns. The authors provide more detail on each of these and demonstrate the relationships using factor and regression analysis.

The next paper in section two is “Students’ Expectations and Experiences About Engagement Strategies in Online Courses: A Mixed Methods Study”, by Murat Turk and Ali Ceyhun Muftuoglu of the University of Oklahoma, Sinem Toraman Turk of the Yale School of Public Health, and Ozlem Karakaya and Kadir Karakaya of Iowa State University. What does it mean to be engaged in an online environment? This question has been explored by numerous scholars in recent years and the foundational understanding seems to include not only cognitive, behavioural and affective dimensions of engagement, but also asks with whom or what do students engage? Is there engagement with instructors, with peers, with multimodal content, and is this engagement appropriately self-directed? Using Bolliger and Martin’s model of online engagement and modifying their questionnaire built on the model, this study used a mix method approach to develop visualizations to better illustrate how the framework applies in real world online settings. Quantitative results show that the participants overall perceived online engagement strategies regarding peer engagement, instructor engagement, self-directed engagement, and multimodal engagement were important and necessary. The qualitative findings suggest that the participants' actual experiences of engagement strategies differed based on context. In combination these results established the importance of all four dimensions of engagement strategies. The central finding might be how relatively unimportant peer engagement was to students, given the last half decade in which researchers have focused on the design, facilitation and direction of collaborative learning activities in the service of activating the power of peer interaction and learning (and the last twenty+ years of urging this in online environments). We need to better understand these results and these authors call for additional research with different and larger samples.

The next three studies all take on learning during the COVID pandemic. In "Memorization and Performance During Pandemic Remote Instruction: Evidence of Shifts from an Interactive Textbook", Jose Salas, Mary Tucker and Ji Son of California State University, Los Angeles and Xinran Wang of Vanderbilt University, consider the problematic beliefs that many students hold about memorization and math learning. While many students endorse beliefs that memorization is the best way to learn math, the empirical evidence is that holding such beliefs is correlated with lower performance on math assessments. As a result of the pandemic, many colleges that had little experience with online learning were forced into emergency remote instruction resulting in a new educational context. In this context, the authors note that many longstanding policies were relaxed. For example, exams and assignments were now often open book, open note, open Internet, and sometimes untimed. In these circumstances, in which memorization might seem less advantageous, do students still hold these beliefs? The study also researched a large and complex system of education – the public higher education system of California, composed of the community colleges, four-year comprehensive colleges and universities offering graduate degrees. The authors note that previous research indicates that memorization beliefs among students at these different institution types would differ, with learners at open-enrollment community colleges more likely to endorse beliefs about the utility of memorization than learners at more selective graduate-level institutions – and that these beliefs would be reflected in lower performance among students who do hold them. The study uses data collected in an online interactive statistics textbook used by courses initially held in-person, which were moved to remote learning after the COVID-19 pandemic began. Collecting and analyzing data on more than 2500 students who used this textbook at these different institution types, the authors conclude that beliefs in the utility of memorization correspond with lower performance across institution types, but that students in more selective colleges are less likely to have these beliefs and more likely to demonstrate better performance. Interestingly, memorization beliefs did not change even as the context of study went online where open-book, open-note, open Internet assessments were more common. Some of these results are muddied by the differential impacts of the pandemic on students with fewer resources, who endured more responsibilities, difficulties, and higher levels of anxiety. It is also unclear to what extent the assumed contextual changes were actually present. Were the assessments actually unmonitored, open-book, and untimed? Data is not presented to support this assumption and many institutions around the US rushed to implement academic integrity assurances such as online proctoring during emergency remote instruction. Clearly additional research is needed but this study does supply researchers with a strong multi-institutional and longitudinal foundation from which to begin.

Another study investigating the impact of the pandemic is "Online Learning Anxiety and Academic Self-Efficacy During the COVID-19 Crisis", by Wisam Chaleila, Enas Qadan, Lena Gnaim-Abu Touma, Ibtihal Assaly, Usnat Atamna, Halah Habayib, and Areej Masarweh of Al-Qasemi Academic College, Baqa-El-Gharbia, Israel. These authors note that it is well established that the pandemic caused significant anxiety, but that the relationship between increased anxiety and other important psychological factors shaping learning, such as academic self-efficacy (ASE), have not been fully explored. The study used survey methods and analyses of statistical difference with 781 students from dozens of countries and found that academic self-efficacy was not significantly correlated with online learning anxiety (OLE). In fact, in some instances students with higher levels of anxiety about aspects of online learning (anxiety about academic assessment, technical problems, and communication problems) had higher levels of ASE. The study provides information about other aspects of OLE and recommendations related to students, faculty, institutions, and policies.

In "Towards Connectivism: Exploring Student Use of Online Learning Management Systems During the COVID-19 Pandemic", authors Dapeng Liu of Baylor University with Lemuria Carter and Jiesen Lin of the University of Sydney, Australia examined 129,567 activity logs in the institution's learning management system (LMS) to understand patterns of behaviour of 313 students with low, average, and high grades. Noting that connectivist theory posits that learning in online environments is a function of linkages between people, resources, and supports, the authors demonstrate clearly that students at varying levels of performance have significantly different profiles in terms of their behavioural engagement with resources such as course files, discussion forums, the gradebook, and online quizzes. Higher performing students engage significantly more with files, quizzes, and discussion forums, but not with the gradebook. While education research can frequently be considered a science of common sense, these results display a level of specificity that is quite stark and may point the way to the development of strategies to help lower performing students.

The next paper in section two, "Learner Perceptions of the Feedback Process in the Online Component of a Blended Course", by Anna Moni of Deree -The American College of Greece, Athens, Greece provides a critical review of research on feedback models in educational settings. The author notes that, despite the broad consensus on the importance of formative feedback to improving learning, there is little agreement on a single effective feedback approach across disciplinary contexts and learning modalities. However, context matters and in this paper the author focuses on the feedback model conceptualized in a Matrix of Feedback for Learning in the online component of an English for Academic Purposes (EAP) blended course. The study notes the importance of how feedback models are received by students and investigates the perceptions learners have of the feedback process used in the asynchronous part of the course. The model includes three kinds of feedback (feed-up, feed-back, feed-forward) at four levels (task, process, regulatory, and self). Aiming to sample the complete target population, the study was conducted across three semesters (spring 2022 N=73, summer 2022 N=15, and fall 2022 N=121) with 13 course sections taught by seven different EAP instructors. The full paper provides detailed results of learner perceptions of the types and levels of feedback provided in the asynchronous component of the blended course including positive and negative attitudes. The study also provides some future directions for research on feedback in online and blended contexts.

In “The Effects of Short Online Pedagogical Courses on University Teachers’ Conceptions of Learning and Engaging Students during Lectures,” authors Trang Nguyen, Henna Vilppu, and Mari Murtonen of the University of Turku, and Ilona Södervik of the University of Helsinki, Finland explore the effects of faculty professional development on knowledge about teaching and learning. The paper discusses the high costs of providing professional development and the need to ensure faculty have a firm foundation in pedagogical knowledge. They developed an online course through which faculty gain better understanding of the importance of student prior knowledge and how to build that understanding into more engaging classwork. One goal was to reduce or eliminate the belief that “learning is remembering” and replace it with a more nuanced understanding of learning (e.g. as a constructive process). Through the short, online, pedagogical course they document growth in understanding (especially among the least knowledgeable) from pre-test to post-test. The authors conclude that short online pedagogical programs for university faculty can be an effective and efficient solution for the development of active learning of students in higher education.

The next paper in this section is Multifaceted Challenges and Opportunities: Concurrent Mixed Methods Research to Investigate Chinese Exchange Students’ Experiences in the U.S. Transnational Online Learning Ecology” by Xinyue Ren of Old Dominion University and Yi Zhou of Guangxi University, China. International and transnational education has been used to enhance higher education in China for decades. In light of travel restrictions caused by the pandemic, many Chinese exchange students had to stay home and experience online and distance instruction in a transnational context, rather than in the conventional manner. This created a new educational context with its own opportunities and challenges. The purpose of this study was to investigate Chinese exchange students’ perceptions and experiences in transnational distance education offered by a university in the United States. Specifically, the authors asked how the transnational online learning environment influenced Chinese exchange students’ satisfaction with their learning satisfaction. Using regression analyses and qualitative exploration, the authors detect patterns in the data that predict and explain student satisfaction levels with their experiences.

The final paper in this issue is “A Systematic Literature Review of Online Academic Student Support in Higher Education,” by Chris Walsh, Leicha A. Bragg, Marion Heyeres, Ana Yap, and Michael Ratcliff, of Victoria University, Melbourne, Australia. Student support for ensuring academic success is a significant component of classroom-based higher education. For decades institutions have been working to implement similar support for fully online students. This paper provides an updated account of these supports post COVID-19, when most of higher education had to at least experiment with forms of distance learning. Many institutions which were previously not deeply committed to online education have expanded their online curricular options and now must consider how to support new populations of students attending the college. This systematic literature review provides an overview of research on online academic student support in higher education. The synthesis of the findings reported outcomes on students' improved engagement, access to support and usage patterns, satisfaction, academic performance, motivation, creativity, self-efficacy, retention or course completion, and social benefits. This suggests that institutions that are new to online education have a considerable range of options to think through, prioritize, implement, and assess.

Many thanks to Aras Bozkurt and Haesol Bae for their efforts on the special issue of the journal. Many hours were dedicated to communicating, screening, reviewing, and editing this extensive issue and we are appreciative for all of their work. Also a huge thank you to our other editors, authors, reviewers, copyeditors and the staff at OLC for their many contributions to support the success of the journal.

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Bichronous Online Learning: Perspectives, Best Practices, Benefits, and Challenges from Award-Winning Online Instructors

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Abstract

Bichronous online learning is the intentional blending of asynchronous and synchronous online learning experiences. Twelve award-winning online instructors participated in interviews to discuss best practices they use, and benefits and challenges in bichronous online courses. When sharing best practices for bichronous online courses, online instructors explained how they combined best practices in asynchronous and synchronous online learning. Asynchronous online best practices included course design and structure, resources, and instructor presence; and synchronous online best practices focused on formats, activities, and content of synchronous sessions, and community-building. The best practices, benefits and challenges discussed in this paper have implications for instructors who currently teach in a bichronous online format or may be considering it in the future, and for instructional designers and administrators who work with faculty on offering courses in this modality. Based on the data, the intentional blending of synchronous and asynchronous components has a lot of potential to enhance students' online learning experiences.

Keywords: Bichronous online learning, best practices, online instructor perspectives

Martin, F., Swapna, K., Ritzhaupt, A., Polly, D. (2024). Bichronous online learning: Perspectives, best practices, benefits, and challenges from award-winning online instructors. *Online Learning*, *Volume 28*(2), (175-201). DOI: 10.24059/olj.v28i2.3945

The National Center for Education Statistics (NCES) reported that approximately 71% of students enrolled in postsecondary education have enrolled in at least one distance education course (NCES, 2022). Today, distance education courses in institutions of higher education are most often delivered through online learning. The COVID-19 pandemic has further highlighted the importance and potential of online learning, leading to increased online course offerings both during and after the debut of the COVID-19 pandemic. Learners are also looking for educational options that fit their individual needs and preferences, including flexible scheduling, personalized learning experiences, and access to a wider range of courses and programs. Typically, online courses are delivered using different modalities including asynchronous and synchronous. Asynchronous online learning refers to anytime, anywhere learning, and synchronous online learning refers to anywhere, real-time learning. Rather than comparing the two modalities, Martin et al. (2020) coined the term, *bichronous online learning* to denote the intentional blending of asynchronous and synchronous online learning. The term *bichronous* refers to the two different time frames that are used in this mode of learning: synchronous activities that occur at the same time as other learners in the course, and asynchronous activities that can be completed at any time. This approach allows learners to have more control over their learning experience and to engage with course materials in a way that best suits their individual learning preferences and schedules.

Conceptual Framework

Bichronous online learning is becoming increasingly popular in online education because it allows for a flexible learning experience. It provides opportunities for learners to interact and collaborate with their peers and instructors, while still allowing them to work at their own pace and schedule. Research has individually described best practices for asynchronous and synchronous online learning, though there is limited discussion in the research on best practices for blending asynchronous and synchronous online learning.

Figure 1

Conceptual Model for Bichronous Online Learning

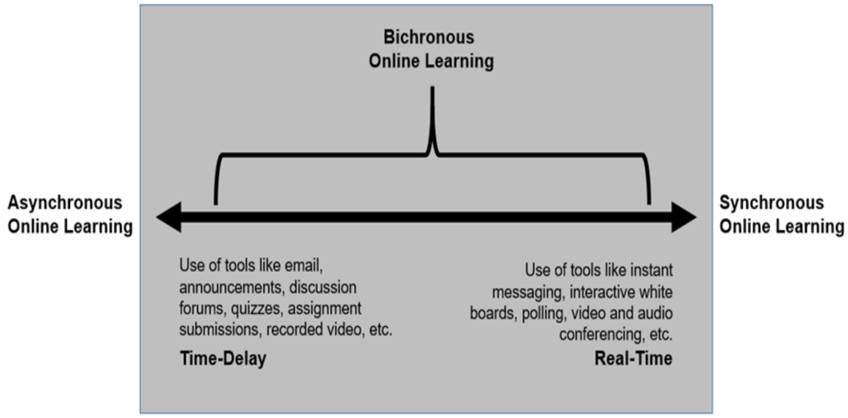

Figure originally published in Martin et al. (2020)

Best Practices for Asynchronous Online Learning

The research-based best practices on asynchronous online learning emphasize the importance of course design, course activities, assessment, and feedback. Research on asynchronous online learning cites the importance of well-designed courses where the course material is easy to find and the functionality of the course is easy to decipher (Czerkawski & Lyman, 2016; Shelton & Saltsman, 2011). Using specific instructional design models and frameworks has also been found to be critical to students' positive course experiences.

In terms of asynchronous online courses, research-based best practices focus on instructor presence. This typically is seen through interaction on discussion boards, responses to questions via learning management systems or e-mail and feedback on assignments (Oyarzun et al., 2017; Peterson, 2016). Specific to feedback, research indicates that learners' experience in a course is significantly influenced by the amount and type of feedback that they receive (Lumabi & Tabajen, 2021; Peterson, 2016). Feedback should be timely, specific and aligned to course objectives (Peterson, 2016). Additionally, feedback should give learners a clear understanding of actionable next steps for future assignments (Lumabi & Tabajen, 2021).

Effective designers and instructors of asynchronous online courses intentionally integrate assessment and the evaluation of learners into their course design process. In many cases assessment is driven by course goals, program goals, and requirements for accreditation (Guerrero-Roldán & Noguera, 2018). Assessment should be authentic and embedded in relevant course activities whenever possible instead of feeling like an additional assignment or burden (Conrad & Openo, 2018). Studies have indicated that designers and instructors of asynchronous courses use a variety of assessment strategies, including projects, portfolios, multimedia resources, discussion boards and research papers (Sun et al., 2008). Assessments and assignments should include clearly defined rubrics that explicitly tell the learners what the expectations are and how their work will be evaluated (Wang & Chen, 2017).

Best Practices for Synchronous Online Learning

In the case of synchronous components of online courses, the design of the course focuses on the design of learning experiences that occur during real-time online course meetings as well as course activities that happen before and after course meetings. Course activities should help to build community among learners which may include the use of the chat window, breakout rooms, or collaborative activities and discussions (Gillett-Swan, 2017; Kara, 2021). Learners have reported in multiple studies that they want to be able to socialize and interact with other learners during synchronous sessions (Richardson et al., 2017).

Additionally, since synchronous online sessions meet in real-time, the design of synchronous components should include activities that enhance what learners could do on their own time (Kara, 2021). In some cases, instructors have effectively designed courses where they provide learners with videos to view or content to read before the synchronous session so that the synchronous meeting can focus more on the application and discussion of content with which learners have previously interacted (Strelan et al., 2020). This approach increases the social interaction of learners, and also allows the course instructor to design more experiences that involve higher-level thinking and the synthesis of course concepts (Strelan et al., 2020).

Research on the facilitation of synchronous components clearly indicates that instructors should have a strong presence and be engaged in synchronous learning experiences (Martin et al., 2018). Research-based activities related to instructor facilitation include creating a sense of community with ice breakers or other opening activities, clearly stating goals and objectives, facilitating discussions and activities in the main room or in breakout rooms, teaching content, conducting formative assessment, and answering questions to clarify assignments or misconceptions that learners may have (Martin et al., 2018; Kara, 2021; Richardson et al., 2017).

Assessment and evaluation can occur either during synchronous sessions or outside of the course meetings (Conrad & Openo, 2018). In many cases, assessment is driven by course goals, program goals, and requirements for accreditation (Guerrero-Roldán & Noguera, 2018). Research suggests that a combination of assessments during both synchronous and asynchronous times provide instructors with a more robust sense of learners' performance, which is a benefit to online courses and makes it a bichronous online course.

Benefits of Bichronous Online Learning

Prior research has shown that the blending of asynchronous and synchronous interactions in online learning has several advantages including improved learning outcomes (Farros et al., 2020), decreases in withdrawal rates (Fowler, 2019), and positive student perceptions of their learning experiences (Peterson et al., 2018). This blending has been considered as a happy medium where there is flexibility through the asynchronous methods and immediacy through the synchronous sessions (Zotti, 2017). A recent meta-analysis confirms student learning performance favors online courses blending both modalities as opposed to using asynchronous learning in isolation (Martin et al., 2021). Yet, we know little about how to blend synchronous and asynchronous activities to create bichronous experiences that engage students while leading to effective learning outcomes. While the research literature base in online learning continues to grow, we believe that the notion of bichronous online learning is an untapped resource and opportunity to explore the boundaries of effective online learning.

Challenges of Bichronous Online Learning

While research on bichronous online learning is new, one of the intuitive challenges that course designers and instructors face is determining the percentage of course content and the specific course content that should be included in synchronous sessions or asynchronous work (Martin et al., 2023; Yamagata-Lynch, 2014). Using an instructional model similar to in-person flipped instruction, some course designers and instructors have learners view videos or read texts prior to synchronous sessions and then learners collaboratively discuss content or complete activities with other learners during the synchronous sessions (Strelan et al., 2020). However, this model of teaching is dependent on learners engaging with content prior to the synchronous sessions, which could create polarizing outcomes with a large performance gap between learners who thoroughly engage with content during asynchronous activities and those who do not (Stohr et al., 2020; Tang et al., 2020).

Additionally, course designers and instructors must reconcile the fact that learning preferences tend to fall to either completely asynchronous or completely synchronous course formats (Strelan et al., 2020). Some learners prefer completely asynchronous course activities due to the flexibility of when assignments can be completed, while others prefer having live interaction with classmates and the course instructor (Lehman & Heaviland, 2023). In synchronous sessions, specifically most learners in one study preferred having cameras off and just wanted to use text chat with their instructor (Lehman & Heaviland, 2023). In a study that examined the use of video chat, researchers found that while all learners reported positive interactions, graduate students preferred video chat with other colleagues as opposed to live teaching from the course instructor (Gosmire et al., 2009). Lastly, in their large-scale synthesis of research on online learning Tallent-Runnels and colleagues (2006) recommended to the field that multiple types of research methods be used in the future to examine the benefits and challenges of different types of online learning. To this end, the authors sought to examine best practices in bichronous online courses.

Purpose Statement and Research Questions

The purpose of this research study is to systematically explore the best practices, benefits, and challenges for bichronous online learning through the lens of award-winning online instructors. In this study, we sought to address the following two research questions:

1. What best practices are used by award-winning online instructors in bichronous online courses?
2. What are some benefits and challenges of bichronous online courses?

Methods

This study employed a qualitative research methodology by interviewing 12 award-winning online instructors from across the United States and Canada. This research project was executed in two phases. First, the conceptual model for bichronous online learning was adopted and an interview guide based on the conceptual framework was developed. Second, award-winning online instructors from institutions in the United States and Canada were identified and interviewed.

Instrument

Based on the conceptual framework used by Martin et al. (2019), we developed a semi-structured interview protocol with ten questions to collect in-depth qualitative information about participants' experiences with bichronous online courses. The interview team met twice to carefully review the questions for clarity and intent. The questions were all open-ended and included opportunities for follow-up questions as needed to ask for elaboration or clarification. The questionnaire included in Appendix A was emailed to the award-winning online instructors ahead of time for them to review. The definition of bichronous online learning was shared in the questionnaire as well as at the beginning of the interviews.

Participants

Participant (Pseudonym)	Subjects taught	Teaching Experience (in years)	Online Teaching Experience (in years)	Learning Management System(s) used	Synchronous Tools used
1 (Ivy)	Education	20	10	Blackboard	Zoom
2 (Chris)	Computer Science	7	7	Canvas	BlueJeans, Microsoft Teams
3 (Emma)	Respiratory Care/Therapy	28	2	Sakai; Blackboard, WebCT, Canvas	Zoom, Jamboard, polling tools
4 (Mark)	History	7	7	Canvas; Blackboard	Zoom
5 (Ana)	Industrial Engineering	7	5	Blackboard	Zoom, Microsoft Teams

6 (Ben)	Spanish	15+	8	Canvas	Zoom
7 (Ruth)	Accounting	14	14	Blackboard	Zoom
8 (Ella)	Communica-tion	10	8	Canvas	Zoom
9 (Lily)	Student Success	14	12	Canvas, Blackboard, BrainHoney	Microsoft Teams
10 (Kate)	Psychology	21	14	Blackboard, Canvas	Zoom, Big Blue Button
11 (Eve)	Educational/Social Sciences	29	10+	Desire 2 Learn/Brightspace	Webex, Zoom
12 (Mia)	Public Health	22	15	Canvas, Engage, Blackboard	Zoom

A list of 56 instructors who had won awards for online teaching at their institutions was first compiled. An email was sent inviting each of them to participate in the interviews and this was followed by an email reminder. Twelve instructors agreed to participate in the hour-long interviews resulting in a purposeful sample. Three instructors were male while the remaining nine were female. The online instructors were from varied disciplines and had varied online teaching experience ranging from 5 to 20 years. Ten of the online instructors were white with one faculty being Asian American and another being Hispanic. The instructors used a variety of Learning Management Systems (LMSs) and synchronous technologies to teach in bichronous online learning settings. Five of the instructors had optional synchronous sessions, whereas four of them had required synchronous sessions in their bichronous courses. One instructor had a combination of required and optional synchronous sessions; another instructor had optional synchronous sessions but had the students complete an assignment if they did not attend it; and a third instructor required synchronous sessions but provided students multiple options with times and dates to attend.

Table 1

Participants' Teaching Experience and Technology Use

Data Collection and Analysis

Twelve award-winning online instructors were interviewed via the Zoom online conferencing application. Each interview ranged from 45 minutes to an hour. At least two members of the research team participated in each interview. While consent to participate in the interview was requested early on, this was reinforced before the recording began. For the ease of online interviews, the questions were displayed on a PowerPoint and shared using the screen sharing option during the interview process. The interviews were transcribed by machine-based Otter transcription, and then further cleaned manually by members of the research team. The transcripts were then de-identified by assigning IDs to participants. A table with details of participant names and assigned IDs was created.

The interview responses for each question were compiled for inductive analysis. Two cycles of coding were used where two researchers read the responses to each question, coded them independently, and then met to discuss the codes to each question. The codes were then combined in NVIVO and similar codes were categorized using the constant comparative method (Patton, 2014) to explain the phenomenon, bichronous online learning, based on the large amount of interview data. All the categories and codes were again discussed by the coders, and themes were identified. After the themes were finalized, at the time of writing, pseudonyms were assigned to the participants.

Results

The themes related to each of the research questions on best practices in bichronous online courses, and benefits and challenges of bichronous online learning are presented in this section. When sharing best practices for bichronous online courses, the instructors in our study explained how they combined best practices in asynchronous and synchronous online learning to succeed in their courses. We begin by illustrating a single case to exemplify how an award-winning instructor blended the components of asynchronous and synchronous online learning to best design and facilitate a bichronous online course. We then present the best practices for asynchronous and synchronous components within bichronous online courses shared by the instructors.

Blending Asynchronous and Synchronous Components in a Bichronous Course

To illustrate how the best practices in asynchronous and synchronous learning can be intentionally blended to formulate a bichronous online course, we provide the case of one of the instructors from our sample of participants. Our case is drawn from an award-winning instructor in the domain of industrial engineering. Our participant with the pseudonym Ana is an Asian American female working as an associate professor with five years of online teaching experience and working with the Blackboard LMS and Zoom and Microsoft Teams synchronous communication tools. Ana combined a number of best practices to create a different and more complex bichronous learning experience for her students.

Ana teaches a cross-listed course, split between undergraduate students and graduate students with additional requirements for the graduate students in the course. Her course requires access to a modern personal computer, a reliable internet connection, and a variety of specialized software packages (e.g., Integrated Development Environment for Python). Ana noted that her course is software and programming heavy, which she believes lends itself to bichronous online learning. Ana created her bichronous online course in weekly modules, each with instructional videos created by her using tools like Camtasia and Kalutura, readings, and smaller, focused quizzes with automated feedback and a range of formative assessment activities (e.g., simulations, data analysis problems, etc.) graded for participation. She noted these resources serve as reusable learning artifacts, but also emphasizes the online instructors must constantly update their online learning resources. Notably, Ana is careful to not record more than an hour and a half of total time spent by her students on the instructional videos in a given weekly module. Although Ana did not employ cumulative examinations in her bichronous online course, she does make use of larger applied projects spanning multiple weeks and modules. Ana makes use of reflective and planning assessment activities to support her students on successfully completing the larger, applied learning project. Ana posts announcements to introduce each weekly module and works to provide feedback on the assessment activities within the first few days of the ensuing module.

Ana schedules weekly, one-hour synchronous sessions, typically later in the week such as a Thursday or Friday, after the students completed the module readings and the instructional videos; and after Ana had the opportunity to grade and provide timely feedback on the previous module assessment activities typically due on Sunday nights. All of the synchronous sessions are recorded for her students in the case of re-review or absence from the actual synchronous session. Her synchronous sessions typically involve a pre-designed PowerPoint slide deck to guide the learning experience when lecturing or presenting content, combined with open question and answer periods addressing current course topics and activities in the weekly module as well as a review of the graded assessment from the previous weekly module. Ana also uses synchronous tools for student presentations that are assessed using a rubric by both her and the other students. She also provides office hours in a synchronous format and on-demand synchronous sessions when and where appropriate.

While Ana does not regularly use all the best practices identified in this research by the other award-winning instructors (e.g., discussion forums or breakout rooms), we can observe how she intentionally blended her asynchronous and synchronous components to create a flexible and engaging bichronous online learning experience for her diverse students. Ana emphasized that facilitation is key to establishing instructor presence online and encouraged new online instructors to adopt an incremental approach to using the range of technologies available to online instructors and to spend the necessary time to learn about the needs and challenges of their students. As Ana expressed, “students nowadays are not the same as 10 years ago, 20 years ago, how they digest information already is different for face-to-face classes, I think it's a whole different situation when it comes to online.”

Best Practices for Asynchronous Components in Bichronous Courses

Within their bichronous online courses, the online instructors in our study explained that the following asynchronous online learning best practices for course design and structure, course resources, instructor presence, discussion forums for student engagement, various types of assessment, and feedback were helpful.

Course Design and Structure

When designing the asynchronous part of their bichronous online courses, online instructors found that consistent format and organization, course orientation and onboarding, working with instructional designers and Quality Matters training were valuable.

Consistent Format and Organization

Award-winning online instructors discussed the importance of consistent format and organization related to the asynchronous parts of their bichronous course, so that students knew what to expect. For example, Ana said, "I try to keep the exact same visual format when I deliver content. So we use Blackboard. So I use the same format on the top course objectives or the week objectives." The term "cadence" was used by Emma to refer to the timing and frequency of communications or interactions or more broadly a rhythmic pattern or pace, that also contribute to the structure of the course. They said:

> I'd say that the most important strategies, I try to employ one I call cadence, which is just creating course designs. So that even though you're not meeting synchronously, you feel an inherent structure to the course. So you feel a pacing, you feel the calendar more than you consult the calendar…in my classes, you will only ever have something due Sunday nights at 11:59pm. anywhere on Earth time. So that's always consistent. If it's not Sunday, you don't have something to do that night.

Course Orientation and Onboarding

To help students get familiar with the asynchronous parts of the bichronous course, the instructors discussed the importance of an asynchronous course orientation. Ben provided an example:

> I have asynchronous onboarding activities…that's where they start…where they have to review tutorials, the syllabus, they have to complete a syllabus quiz, they have to complete some readiness quizzes just to show that they're prepared to interact with the course and how it's set up.

Ana mentioned:

> …. the very first week, I don't usually post any lecture content, it's usually here's a video of how to navigate in Blackboard, here's where you're going to find the weekly modules, here's how to submit an assignment or a link to watch this, this is how you submit an assignment.

Working with Instructional Designers and Quality Matters Training

A best practice recommended by three instructors was working with instructional designers. Chris described it as “the instructional designer sits down with you, when you’re going to create a course, the faculty are the content experts, but the instructional designers, the instructional design expert, so the two come together and create it, to me, the students have had a great experience there, their evaluations and surveys of the courses have been very positive.” Two instructors also emphasized the importance of Quality Matters training to develop engaging online courses.

Course Resources

Instructors also discussed best practices related to course resources, which were flexible, required, and optional resources, use of videos, use of various resources to engage students, and updating files in real-time.

Use Various Resources to Engage Students

Instructors discussed how they try to engage students in the asynchronous part of the course using various resources. Kate shared,

> I use a lot of memes, a lot of gifs, a lot of YouTube clips, I use a lot of narrated PowerPoints, different online games that they can play as review or practice polling discussion, if there’s a tool for it, I can make some kind of use for it.

Ben discussed the online textbook platform that is used to engage the learner, “where they’re provided with the tutorials, Introduction to the content for each unit, they have mechanical type activities, to review and to practice, very independent type work.”

Flexible, Required, and Optional Resources

The instructors discussed the importance of including not only required, but also optional resources such as videos or additional content. Ana explained:

> So, delivering flexible content…, having a very safe and supportive environment, as well as I’m trying to make it interactive. So, I try to keep those pieces in mind. In our college, we have a lot of students that are also working. So, the students who tend to want to take online courses, in particular, enjoy the same asynchronous components are the ones that can digest it in multiple pieces... So, the way they digest the content cannot be a one-hour lecture or a three-hour lecture or anything like that. So, as I’m designing the courses, I have to keep that in mind, like, how can I make it flexible?

Using Videos

Several instructors discussed the use of videos in the asynchronous part of the course as a best practice. They shared that these can help establish instructor presence and help students feel they know their instructors. Instructors discussed hosting videos outside of the learning management system by recording on Camtasia and uploading to YouTube which made it easier for students to access, and recording during synchronous sessions, and then sharing it asynchronously for students to watch later. Ana emphasized the importance of short videos. They said:

> The most common comment I get from students is that they like the small videos, they said, I can't sit through a long one. But you know, 15-minute mark is usually they will say if you post something that's 25 minutes, I might stop at 10 minutes anyway, like, I might not even go through the whole video.

Emma also discussed the importance of reusing artifacts and not having to re-record videos every semester. They said:

> So very often, that's very natural to think of things like lecture material, and I'm going to use the same videos for two or three years, I can invest into making them really good, as opposed to if I'm just going to be using it for this semester, it's a lot easier to just say, I'll do this real quick for the semester, because the impact is limited.

<u>Updating Resources in Real-Time</u>

Ruth discussed the importance of being able to update resources during the course if needed, saying:

> I took all of my files out of the learning management system, and moved everything into a program like Dropbox, so that there are just URLs that the students access. And then if there is a problem or an update, or something that needs to be changed, then you can change it, save it, and you don't miss uploading, or one of the steps there. And that seems to speed things up for students as well. And they seem to like the fact that they're getting things real time.

Instructor Presence

Instructor presence was discussed by online instructors as a best practice in the asynchronous part of bichronous courses, which they established by using email to connect with students, using announcements, and being present in discussion forums.

<u>Email to Connect with Students</u>

Instructors emailed students to check on how they were doing, to connect with them, remind them of missing assignments, and for students to connect with them. Ruth stated, "I have to be involved and interacting with the students as much as I can. So, I set aside time each day to answer emails..." Lily mentioned:

> It is a lot of work to create that online instructor presence. It requires quite a bit of time upfront and constant check-ins with my students. But yes, I feel like they really know me they comment on how like, unlike other online classes, they feel like they really get to know me that I really care about them.

Announcements

Instructors discussed using periodic announcements in the form of written announcements, and video announcements to establish instructor presence. They emphasized the importance of sending weekly announcements to establish instructor presence, and also to not be very verbose. Ana discussed sending video announcements:

> The first video is usually a five-minute video that I actually will record every week. And that 5-10-minute video is announcements or whatever that I'm trying to react to. So if they just had a quiz and I just posted it, then I'll discuss that a little bit.

Discussion Forums

Discussion forums were discussed as a separate best practice but were also mentioned as being used to establish instructor presence through which instructors stay involved.

Discussion Forums for Student Engagement

To help students connect and engage with their peers in the asynchronous component of their bichronous courses, a best practice recommended by online instructors was discussion forums. Some of the best practices they shared included, using discussions for video introductions, using Voicethread for audio visual discussions, facilitating content and resource-based discussions, and using discussions for responding to questions from students. Mark commented:

> One of the key things I've employed…would be online discussions that have a pretty open-ended focus question or series of questions that enable students to really apply the independent analysis skills in a way that's relatively flexible, in which they can gauge with their own interests in relation to what we've covered that week.

Some of the best practice discussion strategies that online instructors shared included, to use them judiciously so that students do not have discussion fatigue, have accountability and monitor student discussions, and provide formative feedback.

Different Types of Assessment

Award-winning online instructors found that different types of assessments including quizzes and exams, reflective assessments, applied learning projects and game-based points were an important best practice in the asynchronous part of their bichronous courses.

Several of the instructors discussed including quizzes, however instructors also discussed open book quizzes and not locked down browsers. Ivy discussed providing opportunities to revise and resubmit quizzes with unlimited tries, stating, "they retake it again. And they can apply that knowledge that they got from getting something wrong. And the next time I take advantage of the question pools so that every time they retake a quiz, they don't get the exact same question." Ivy also required students to complete an activity, receive the code and include it in a quiz to move on to the next section and conducted stealth assessments to check on students without referring to them as quizzes. Instructors used asynchronous exams and also AI for exams.

Instructors also discussed the importance of other types of assessments in their bichronous courses, such as reflective assessments and applied learning projects which provided students the opportunity to engage with a variety of topics. Ben commented:

> So the reflection is a written reflection that they come back to the LMS Canvas to do and it's a five-point reflection of basically summarizing what have I learned this week, what am I struggling with? What am I doing really well with? What could I do to improve and what can my instructor do to help me improve?

Ivy also discussed how students have to collect certain core or cumulative points to move to the next segment, referring to it as a game-based teaching approach.

Feedback

A best practice in the asynchronous part of online instructors' bichronous courses was the provision of different types of feedback and the timeliness of feedback. Automated, manual, written and oral feedback were discussed by online instructors. They provided automated feedback in large enrollment undergrad MOOC type of courses, but in masters' courses they discussed grading manually and including project-based assessments. Ben discussed providing both written and oral feedback using rubrics, based on what feedback the student required. They explained:

> We go in and provide response or feedback to every individual comment by every single student, as well as a quantitative assessment with a rubric that's attached to the assignments that were they're both getting individualized attention from us, where we're providing them, either written feedback, or oral feedback.

Instructors also discussed providing timely feedback and dialogue to help establish instructor presence. Lily commented:

> I generally have like a 24 hour to 48 hour window that I will give responses and I give detailed feedback using their name, and just very specifics about what they written as questions, try and get in a dialogue with them…And I think that's a really important part because I feel like the courses are organized, there's the content, there's assessment and all that kind of stuff, but my presence and my involvement in the course, it's important to me that they see me and that they know that I'm there and that I care about them.

Best Practices for Synchronous Components in Bichronous Courses

The online instructors discussed several best practices for the synchronous aspect of their online bichronous courses. They discussed different types of synchronous sessions activities, going beyond content delivery to connecting students, and flexibility in synchronous sessions.

Synchronous Session Activities

Instructors discussed the need for various types of synchronous activities including lectures and presentations, Q&A sessions, office hours, group discussions, breakout sessions, and integrating multimedia and other functionality.

Lectures and Presentations

Instructors delivered lectures, presentations, and webinars to introduce new content and teach during synchronous sessions. Kate stated, “I’ll have more of a traditional lecture, which I’ll meet with them maybe once a week. And it’s more of a, you’ve had a couple of days on the module. Now I’m going to give you sort of a 3000 feet overview.” Other instructors discussed how they would work through a problem with students during a session, teach them how to follow a specific process or use software (e.g., SPSS), or use the time to “focus on the hardest parts of the course, the things that they might need a little bit more help with” (Ruth).

Group Discussions

Some instructors discussed the importance of having a dialogue, “live conversation,” or “candid conversation” and not only lecturing in synchronous sessions. They used the time to discuss and reflect with the students. Chris mentioned:

> What I found is that, if I could give them many lectures ahead of time, a quiz or a discussion with some questions, so that they could be prepared, and then to call on people or have people volunteer their time to share their responses.

For group discussions, instructors used both moderated discussions, and think-pair-share activities. They also used polls to check for understanding and the text chat where students could post their questions or doubts during discussions.

Breakout Sessions

Instructors found it important for students to interact with one another, for which they broke up students into small groups, or breakout rooms through zoom, and conducted various activities. For instance, Chris had case studies that students discussed, and then presented when they were back in the main room and commented “I felt that that was extremely valuable. The students did give feedback that they enjoyed that very much because they were with small groups.” Lily used think-pair-share activities in breakout rooms:

> So that’s a strategy that I used… have them think about something and then put them in groups. And…this was a career exploration class…I put them in groups according to maybe the college in which they were interested, the career choices, and then having them kind of modeling how they could go into that space and work together. And then always having them at the end, report back.

Q&A Session

Instructors also used the synchronous sessions for Q&A sessions or office hours. Ella said:

> I asked them to submit questions in advance. And they don't typically do that. If students join, they will ask a lot of questions. And that's very helpful for everybody. Because then those questions are asked and answered in a recorded format that can then be posted, and students can watch it asynchronously.

Another instructor offered points for students who attended the session, or watched the recording and completed an assignment, to increase attendance.

<u>Integrating Multimedia and Other Functionality</u>

Instructors emphasized the importance of integrating multimedia during synchronous sessions to inspire and engage different types of learners. Digital presentations were also followed by Kahoot activities to engage learners. One instructor used Google slides during breakout rooms while another instructor used whiteboard activities, specifically Jamboard to make the sessions interactive. Instructors also used screen sharing through which they were able to model processes or share Google earth to show students various regions. Several instructors used the polling features during synchronous sessions to engage learners.

Going Beyond Content Delivery to Connecting Students

Instructors stated that a best practice during synchronous sessions was to go beyond content delivery to aim for community-building and helping students feel comfortable. They used several strategies to help students get to know each other and build community, such as icebreakers, and a student lounge.

Almost all the instructors used the synchronous sessions for getting to know students, helping them connect with peers, and building community. Mia explained:

> I'm there trying to give them the support that they would have gotten from me had we been face to face... using those synchronous times to create community is one of the most important things, and also, for them to get to know me.

Instructors wanted to make students comfortable and highlighted the importance of students getting the chance to have their voices heard and connecting with each other.

Mark and Emma described their strategies as "I try and make it very conversational. That relaxed, approachable way that draws students in," "I create a supportive environment," and "I try and encourage people who haven't said as much to come in."

One strategy that several instructors mentioned were Icebreakers, to draw students in. Some instructors began sessions by checking in with the students to ask how they were doing or feeling. Lily shared:

> I would always start out with a quick question, like an icebreaker type thing like about what was going on in their week, or sharing like, their favorite vacation they went on or just something fun that they could talk about that they cared about. And then I found that that helped them, like, get comfortable, realize they can turn off their camera, realize

> they can unmute, and then also show that I care about them and what's going on with them.

Emma also used synchronous sessions as a "student lounge" or "social gathering place." Students were encouraged to turn on their cameras and interact with each other.

Flexibility in Synchronous Sessions

Another best practice that was discussed by the online instructors was including different types of synchronous sessions (e.g., required, optional) and providing flexibility. Some instructors offered optional synchronous sessions, so that students can watch the recordings later. One of the instructors offered a synchronous recitation option which some students attended during the live time and others watched the recording. Some other instructors provided students with multiple sessions of which students had to attend a required number. For instance, Eve offered synchronous sessions two days in a week so students could attend at least one, especially if they were at work or had other commitments. They explained:

> I've been successful in doing that. Because a lot of times, it's listed right in the course schedule like, you know, weekly synchronous session at 7pm on Tuesdays. But I've been able to by offering them choices, and I've kind of you know, landed on a couple of times that seemed to work, I have yet to have somebody say I can't make either time.

Ruth assigned participation points for attending the synchronous session live. If students were not able to attend live, they had to complete an assignment to earn points. This increased synchronous session attendance and was also helpful in holding the students accountable to watch the synchronous sessions.

Benefits of Bichronous Online Learning

The online instructors discussed a number of benefits for bichronous online courses, such as, increases student access, builds rapport with students, increases student presence, engagement and builds community among students, "the best of both worlds," increases instructor presence, develops student communication and collaboration skills.

<u>Increases Student Access</u>

Instructors discussed how students had more opportunities to have access to their instructors and peers through bichronous online learning. Kate commented, "I think there's something that knowing there's access. And that in and of itself is comforting for them to know that there is a time where they can find an actual human being that they can interact with."

<u>Builds Rapport with Students</u>

Instructors discussed how the increased opportunities for interactions in bichronous online courses help the instructor to build rapport with students. Mark explained,

> Even though I always make myself very much available to my students in asynchronous courses, they don't necessarily take that opportunity to Zoom with me, for example. But when they do they finally benefit from it. So, there's a great benefit always to that direct interaction that I find bichronous courses already have built into them.

Instructors gave various examples of interactions with students, such as conversations with students that took place after synchronous sessions when the instructor decided to "stick around," and conversations in the chat box in Zoom during synchronous sessions that led to further communications asynchronously. One instructor reflected that instructor videos in the asynchronous course had their advantages, but that real-time interaction helped students see the instructor in a different light. Another instructor similarly stated that the combination of asynchronous and synchronous communications helped them see what challenges students faced and get to know their strengths and weaknesses. Mark mentioned, "The biggest benefit is rapport, getting much more of a sense of my students, and getting to know them, and then being able to have, like, a little meeting with some of them."

<u>Increases Student Presence, Engagement, and Builds Community</u>

In bichronous courses, students are able to engage in different formats, both asynchronous and synchronous and therefore they interact more with each other and make more connections, according to instructors. They believed that the opportunity to engage synchronously or asynchronously works well for students who are shy to speak or are more comfortable writing, and for those who prefer to talk and want more interaction. Instructors are also able to see how students apply and dialogue with the instructors on topics they have learned. Ella stated:

> The benefits of having a little bit of both allows the students to feel like they have autonomy, which is why they usually sign up for online learning. But they also feel connected to the institution, to other students to, you know, to have that learning environment that comes with meeting other people.

Bichronous courses also facilitate student presence, interactions among peers, and community-building. Kate shared:

> I had a student who joined early every class period and played guitar for like half an hour like a coffeehouse. It was lovely, until I had to interrupt it to teach, but it was a way for them to have this moment together that they would normally have before I walked into the classroom. And I think everyone needed that sense of connection.

Best of Both Worlds

Instructors considered bichronous online learning as the best of both worlds. Ivy reflected that combining asynchronous and synchronous is valuable because it is the best of both worlds, but instructors have to very deliberately use both, and Ruth stated that, "Having the blend, as opposed to doing one or the other gives the benefits of a live classroom without destroying the benefits of the online environment." Instructors believed it gave them the opportunity to capitalize on the affordances of each environment, with Ivy stating, "I think what it allows you to be very deliberate about what you do in class, and how you take advantage of that in class time." They also discussed how students have the freedom to engage differently in asynchronous and synchronous settings.

Increases Instructor Presence

Bichronous courses provide opportunities to increase instructor presence. Lily commented:

> To build instructor presence in an asynchronous course it takes a lot of work and a lot of time. And I think that having a synchronous component really kind of accelerates that instructor presence just because they're seeing you, they're listening to you. They're connecting with you multiple times per week, and also with their classmates.

Develops Student Communication and Collaboration Skills

Bichronous courses also help develop student communication and collaboration skills in multiple virtual formats. Mia discussed, "that's important for them to learn communication skills, learn to talk to one another."

Challenges of Bichronous Online Learning

The online instructors discussed challenges of bichronous online learning including content design and decision making, requiring and scheduling synchronous sessions, course descriptions not communicating the bichronous modalities, time taken to design and facilitate bichronous due to the two modalities, technology and access, and breakout rooms.

Content Design and Decision Making

Instructors discussed their challenges making decisions about what is delivered asynchronously and what is delivered synchronously online. Ivy stated, "I want to take advantage of the fact that they are in a Zoom room together and able to interact and talk to each other. If it's something that doesn't require them to be together, then I move it offline or asynchronous." Instructors struggled with presenting information in various ways, how to integrate but not duplicate content, and make the design "manageable for grading." One instructor pointed out that online synchronous sessions were not the same as face-to-face teaching, especially with respect to facilitation. Two additional aspects that were discussed for content design were knowing their learners and designing based on the context and course level.

Requiring and Scheduling Synchronous Sessions

Another challenge discussed was how synchronous sessions were scheduled. In some cases, the universities scheduled sessions that were on the student schedule and students had to make it work. In other cases, the instructors scheduled sessions taking the students' availability into consideration, which was challenging as several students worked full time and had different schedules or were on different time zones. Lily mentioned:

> The logistics of that just makes my head hurt, trying to figure out their schedules. but I think like having that set time that they're committed to that they know at the beginning, as they're planning their schedules, I think that's critical if you're going to teach a bichronous course, that they have that specific time set aside.

Additionally, instructors wanted to be flexible, but struggled to find solutions for students who could not attend synchronous sessions due to various reasons.

Course Descriptions Don't Communicate Bichronous Modality

An additional challenge is that when students sign up for bichronous courses, they are not always aware of both the components, so it is important to communicate this in schedules. Ella discussed:

> I don't think that the course description of my course or other courses that have this bichronous component, I don't think that they do enough in the course description, just tell students that this is the expectation, because I'll have students who will come and say like, 'I didn't take this class so that I could try and find the time to meet with these other people.'

Time Taken to Design and Facilitate Bichronous Online Courses, Due to the Two Modalities

The time taken to design both asynchronous and synchronous aspects of the online course was challenging for instructors. Some shared that they had taught asynchronous courses before, but bichronous involved more effort in the design, facilitation, and also the assessments. Ruth stated, "It takes more work to do bichronous than it does to do asynchronous. Synchronous, of course, takes the most time because you're having live sessions." This was particularly true of large bichronous courses, where instructors found it difficult to manage discussions with a large number of students.

Technology and Access

Students may not always have the appropriate technologies to participate and be successful in bichronous courses, which impedes their progress and is challenging for instructors. Some students use an iPad or another mobile device such as their cell phone which may not work adequately, and several can face challenges with cameras, microphones, or internet quality. In one case, Ben discussed the challenges of integrating the textbook within the course learning management system or having functionality in Voicethread to accommodate groups. Instructors also commented on the challenge of students recording synchronous sessions, especially when other students were engaging with the instructor or peers and asking or responding to questions, and how this might get used elsewhere. They felt that it was a student privacy issue, and that they were unaware of university policy on that.

Challenges in Breakout Rooms

When facilitating group activities in synchronous sessions of bichronous online courses instructors faced several challenges. This included silence in the breakout rooms, struggling with no conversations at the beginning of the class when students join the synchronous online room, issues with students logging in and out of the session, and their own challenges with "popping in and out" of breakout rooms but trying to give guidance in a limited time, and gauging the time needed for collaborative activities in breakout rooms.

Discussion

This study examined the best practices, benefits, and challenges of bichronous online learning through award-winning online instructor perspectives. These findings can impact bichronous course quality and decision-making to offer the intentional blending of both asynchronous and synchronous modalities. The authors acknowledge that bichronous online learning is not a new or novel construct. Rather, we aim to provide a coherent definition and framework from which to better explain the intentional blending of asynchronous and synchronous online learning experiences. In doing so, we hope to provide a better vocabulary and rich description of the blending of bichronous online learning experiences.

Bichronous Online Learning Best Practices

The findings from this study reinforced several of the best practices discussed in prior research on asynchronous and synchronous online courses. In this study, with regard to best practices for asynchronous components within bichronous online courses, the online instructors recommended course design and structure, course resources, discussion forums, instructor presence, and timely assessment and feedback. Researchers have discussed the importance of course design and structure so that course material is easy to find, and a course is easy to access (Czerkawski & Lyman, 2016; Shelton & Saltsman, 2011). Our findings were also reinforced using various course resources including required and optional content, videos, reusable artifacts (Lowenthal et al., 2020; Muniasamy, & Alasiry, 2020; Quality Matters, 2023). Research has also emphasized the meaningful integration of asynchronous online discussions (Fehrman & Watson, 2021; Oyarzun & Martin, 2023), establishing instructor presence (Martin et al., 2018; Richardson et al., 2015) and including different types of assessments and feedback. Our findings align with studies that have recommended the integration of a variety of assessment strategies including projects, portfolios, multimedia resources, discussion boards and research papers (Sun et al., 2008) and also providing timely feedback in different formats (Leibold et al., 2015; Peterson, 2016).

With regard to best practices for the synchronous components within bichronous courses, the online instructors recommended various synchronous activities, going beyond content delivery, and types of synchronous sessions for being flexible. Our findings are in alignment with prior researchers who discussed various types of synchronous session activities such as lectures and presentations, question and answer sessions including office hours, group-based discussion, breakout session, and integrating multimedia and other functionality (Gillett-Swan, 2017; Kara, 2021; Lowenthal et al., 2017). This study also extends the findings to go beyond content delivery to community building, icebreaker activities, and the student lounge which researchers have discussed as important to be able to socialize and interact with other learners through the synchronous sessions (Lin & Gao, 2020; Richardson et al., 2017). And finally, this study recommends different types of synchronous sessions including optional, required, and those with required assignments and points (e.g., student presentations).

We illustrated one instructor's approach to manifesting a bichronous online course to meet the unique needs of her content and students. While no two instructors will employ the exact same configuration of bichronous online learning, their descriptions of how to intentionally blend their courses demonstrates that bichronous online learning provides affordances and experiences that go above and beyond asynchronous or synchronous online learning modalities. Instructors carefully select which best practices best align with their student learning outcomes and the unique needs of their students and create more sophisticated and elaborate designs of online learning.

Bichronous Online Learning Benefits and Challenges

The online instructors discussed a number of benefits of bichronous online courses. Several of these benefits support both online instructors and students in designing and facilitating effective online courses. Just as instructors refer to the benefit of blending as best of both worlds and deliberate use of both, in a prior study, Zotti (2017) considers the blending of asynchronous and synchronous sessions to be a happy medium. Also, other benefits such as increased student access to instructors, building of rapport with students, increased instructor presence (Oyarzun et al., 2017), increased student engagement (Martin & Bolliger, 2018), building community among students, and developing student communication and collaboration (Oyarun & Martin, 2023) skills are reinforced in this study.

The online instructors discussed some challenges for bichronous online learning including, content design and decision making, requiring and scheduling synchronous sessions, time taken to design and facilitate bichronous due to the two modalities, course descriptions not communicating the bichronous modalities, technology and access, and breakout rooms. Some of these challenges exist when using one modality, for example synchronous online courses have challenges with requiring and scheduling synchronous sessions, technology and access and breakout rooms. Instructors have to find strategies and support to overcome the challenges so that both them and their students can be successful. The other challenges are unique to bichronous online courses, and arise from the blending of both modalities, content design and decision making, time taken to design and facilitate bichronous due to the two modalities (Yamagata-Lynch, 2014), course descriptions not communicating the bichronous modalities. With the adoption of more bichronous online courses, and research communicating best practices, strategies for content design, and lead time for designing and facilitating bichronous courses will assist online instructors.

Limitations

As this research is an in-depth qualitative exploration of bichronous online learning practices, benefits and challenges based on the experiences of award-winning online instructors, we remind our readers that a generalization of the findings is not the outcome of this work. Rather, we attempted to provide a rich account of bichronous online learning best practices that may or may not be transferable to a different online instructor's domain, student population, or context. Our instructors were selected by their respective institutions for their online teaching practices. The requirements for earning such awards vary across institutions and each institution will have its own expectations and culture surrounding exemplary online learning. Additional steps in the research process could have enhanced the credibility (e.g., member-checking or triangulation) of our research findings. In addition, this study solely relied on interview data. This could be a potential limitation of the study due to the risk of bias and future researchers are recommended to employ triangulation of findings.

Future Research and Practice

Bichronous online learning is a nascent research area with great potential to transform online teaching and learning practices across educational settings (e.g., higher education, K-12, etc.). While our current research has attempted to explore and explain bichronous online learning with in-depth interviews, future research efforts should attempt to pinpoint the configurations and abstractions in bichronous online learning that afford students the most potential for flexible and quality online learning experiences. For instance, online scholars may elect to triangulate data sources, such as a systematic evaluation of a bichronous online course's design, an online instructor's facilitation practices during a live course, or by employing learning analytics approaches to examine behaviors (e.g., log trace data). Further, while exploratory research in bichronous online learning is growing, other traditional quantitative methods using correlational and experimental designs may be appropriate to provide online instructors and researchers more generalizable and casual accounts of bichronous online learning. We encourage online instructors and instructional designers to collaborate to test different designs and configurations in their online teaching practices and to share these experiences within and beyond their communities. Future researchers could also examine the use of various instructional technologies that might blend into both the asynchronous and synchronous modalities.

References

Conrad, D. & Openo, J. (2018). Assessment strategies for online learning: Engagement and authenticity. *Athabasca University Press*.

Czerkawski, B. C., & Lyman, E. W. (2016). An instructional design framework for fostering student engagement in online learning environments. *Tech Trends*, *60*(6), 532-539. https://doi.org/10.1007/s11528-016-0110-z

Farros, J. N., Shawler, L. A., Gatzunis, K. S., & Weiss, M. J. (2020). The effect of synchronous discussion sessions in an asynchronous course. *Journal of Behavioral Education*, 1-13. https://doi.org/10.1007/s10864-020-09421-2

Fehrman, S., & Watson, S. L. (2021). A systematic review of asynchronous online discussions in online higher education. *American Journal of Distance Education*, *35*(3), 200-213.

Fowler, R. C. (2019). The effects of synchronous online course orientation on student attrition. (Doctoral dissertation). https://scholarcommons.sc.edu/etd/5346

Gillett-Swan, J. (2017). The challenges of online learning: Supporting and engaging the isolated learner. *Journal of Learning Design*, *10*(1), 20-30.

Gosmire, D., Morrison, M., & van Osdel, J. (2009). Perceptions of interactions in online courses. *MERLOT Journal of Online Learning and Teaching*, *5*(4), 609-617.

Guerrero-Roldán, A.E., & Noguera, I. (2018). A model for aligning assessment with competencies and learning activities in online courses. *The Internet and Higher Education*, *38*, 36-46.

Kara, N. (2021). Enablers and barriers of online learning during the COVID-19 pandemic: A case study of an online university course. *Journal of University Teaching and Learning Practice*, *18*(4). https://doi.org/10.53761/1.18.4.11

Lehman, C., & Heaviland, L. (2023). Student preferences of student-teacher communication during synchronous online classes. *International Journal of English Education*, *8*(1), 1-14. http://dorl.net/dor/20.1001.1.25384015.2023.8.1.1.7

Lin, X., & Gao, L. (2020). Students' sense of community and perspectives of taking synchronous and asynchronous online courses. *Asian Journal of Distance Education*, *15*(1), 169-179.

Lowenthal, P., Dunlap, J., & Snelson, C. (2017). Live synchronous web meetings in asynchronous online courses: Reconceptualizing virtual office hours. *Online Learning Journal*, *21*(4).

Lowenthal, P. R. (2022). Exploring student perceptions of asynchronous video in online courses. *Distance Education*, *43*(3), 369-387.

Lumabi, B. M. & Tabajen, R. C. (2021). College students' experience in online asynchronous peer feedback in writing. *TESOL and Technology Studies, 2*(2), 41-54. https://doi.org/10.48185/tts.v2i2.250

Martin, F. & Bolliger, D.U. (2018). Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment. *Online Learning, 22*(1), 205-222. http://dx.doi.org/10.24059/olj.v22i1.1092

Martin, F., Kumar, S., Ritzhaupt, A., & Polly, D. (2023). Bichronous online learning: Award-winning online instructor practices of blending asynchronous and synchronous online modalities. *The Internet and Higher Education, 56,* 100879. http://dx.doi.org/10.1016/j.iheduc.2022.100879

Martin, F., Polly, D., & Rithzaupt, A.D. (2020). Bichronous online learning: Blending asynchronous and synchronous online learning. *Educause Review.* https://er.educause.edu/articles/2020/9/bichronous-online-learning-blending-asynchronous-and-synchronous-online-learning

Martin, F., Sun, T., Turk, M., & Ritzhaupt, A. (2021). A meta-analysis on the effects of synchronous online learning on cognitive and affective educational outcomes. *International Review of Research on Open and Distributed Learning, 22(3), 205-242. http://dx.doi.org/10.19173/irrodl.v22i3.5263*

Martin, F., Wang, C., & Sadaf, A. (2018). Student perception of helpfulness of facilitation strategies that enhance instructor presence, connectedness, engagement and learning in online courses. *The Internet and Higher Education, 37,* 52-65. http://dx.doi.org/10.1016/j.iheduc.2018.01.003

Muniasamy, A., & Alasiry, A. (2020). Deep learning: The impact on future elearning. *International Journal of Emerging Technologies in Learning (Online)*, *15*(1), 188.

National Center for Education Statistics (2022). Postbaccalaureate enrollment: Condition of education. U.S. Department of Education, Institute of Education Sciences. https:/nces.ed.gov/programs/coe/indicator/chb

Oyarzun, B. A., Conklin, S. A., & Barreto, D. (2017). Instructor presence. In P. Vu, S. Fredrickson, & C. Moore (Eds.), *Handbook of research on innovative pedagogies and technologies for online learning in higher education* (pp. 106-126). https://doi.org/10.4018/978-1-5225-1851-8.ch006

Oyarzun, B, & Martin, F. (2023). A systematic review of research on online learner collaboration from 2012 –2021: Collaboration technologies, design, facilitation, and outcomes. *Online Learning, 27*(1), 71-106. https://doi.org/10.24059/olj.v27i1.3407

Patton, M. Q. (2014). *Qualitative research and evaluation methods: Integrating theory and practice*. Sage.

Peterson, J. L. (2016). Formative evaluations in online classes. *Journal of Educators Online*, *13*(1), 1-24.

Peterson, A. T., Beymer, P. N., Putnam, R. T. (2018). Synchronous and asynchronous discussions: Effects on cooperation, belonging, and affect. *Online Learning Journal*, *22*(4), 7-25. http://dx.doi.org/10.24059/olj.v22i4.1517

Richardson, J. C., Koehler, A. A., Besser, E. D., Caskurlu, S., Lim, J., & Mueller, C. M. (2015). Conceptualizing and investigating instructor presence in online learning environments. *The International Review of Research in Open and Distributed Learning*, *16*(3).

Richardson, J. C., Maeda, Y., Lv, J., & Caskulru, S. (2017). Social presence in relation to students' satisfaction and learning in the online environment: A meta-analysis. *Computers in Human Behavior, 71*, 402-417. https://doi.org/10.1016/j.chb.2017.02.001

Shelton, K. & Saltsman, G. (2011). Applying the ADDIE model to online instruction. *Instructional Design: Concepts, Methodologies, Tools, and Applications* (pp. 566-582). IGI Global. https://doi.org/10.4018/978-1-60960-503-2.ch305

Stohr, C., Demazière, C., Adawi, T. (202). The polarizing effect of the online flipped classroom. *Computers & Education, 147*, https://doi.org/10.1016/j.compedu.2019.103789

Strelan, P., Osborn, A. & Palmer, E. (2020). The flipped classroom: A meta-analysis of effects on student performance across disciplines and education levels. *Educational Research Review*, *36*(3), 295-314. https://doi.org/10.1016/j.edurev.2020.100314

Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). What drives successful e-learning? An empirical investigation of the critical factors influencing learning satisfaction. *Computers & Education*, *50*(4), 1183-1202. https://doi:10.1016/j.compedu.2006.11.007

Tallent-Runnels, M. K et al. (2006). Teaching courses online: A review of the research. *Review of Educational Research, 76*(1) 93-125.

Tang, T., Abuhmaid, A. M., Olaimat, M., Oudat, D. M., Aldhaeebi, M., & Bamanger, E. (2020). Efficiency of flipped classroom with online-based teaching under COVID-19. *Interactive Learning Environments,* 1–12.

Wang, Y. M. & Chen, D. T. (2017). Assessing online discussions: A holistic approach. *Journal of Educational Technology Systems, 46*(2), 178-190. https://doi.org/10.1177/0047239517717036

Yamagata-Lynch, L. C. (2014). Blending online asynchronous and synchronous learning. *The International Review of Research in Open and Distributed Learning*, *15*(2). https://doi.org/10.19173/irrodl.v15i2.1778

Zotti, R. (2017). The implementation of web conferencing technologies in online graduate classes. (Doctoral dissertation). https://eric.ed.gov/?id=ED577484

Appendix A

Bichronous Online Learning – Award-winning online instructor interview questionnaire

Bichronous online learning: Blending of both asynchronous and synchronous online learning, where students can participate in anytime, anywhere learning during the asynchronous parts of the course but then participate in real-time activities for the synchronous sessions.

1. Before we get into the bichronous or blending of asynchronous and synchronous online instruction, can you describe some of the strategies and best practices you use in the asynchronous aspect of your online course?

2. Can you next elaborate on the strategies and best practices you use in the synchronous aspect of your online course?

3. So that we can get a bit of context, please tell us about the bichronous courses you teach?

4. 4. When you designed your online course, describe how you blended synchronous and asynchronous components in your online courses?

5. How did you facilitate the synchronous and asynchronous components of your online course?

6. How did you assess your online students in the bichronous course?

7. Reflecting on your bichronous course, what are some best practices/strategies that worked well for you on blending asynchronous and synchronous online learning?

8. What are some benefits to bichronous online courses?

9. What are some challenges that surface in bichronous online courses?

10. Is there anything else related to teaching a bichronous online course that you would like to tell us about?

A Framework for Evaluating Online Degree Programs Through Student Satisfaction

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Abstract

Student satisfaction is a key performance indicator in evaluating any degree program's performance. In light of the vast difference between online and traditional degree programs, factors that may significantly affect student satisfaction and thus contribute to the success of online degree programs still need to be explored. Previous literature on student satisfaction either focused on the course level or researched the factors for traditional face-to-face degree programs. This study shifts the focus to online degree programs by integrating the existing literature and proposing a new conceptual framework for evaluating online degree programs. The proposed conceptual framework includes six big categories of factors and three outcome variables related to student satisfaction. The theoretical underpinning of the conceptual framework was supported by a comprehensive literature review regarding each of the six factors. Data were collected from two online engineering degree programs in a large public university to assess the underlying relationships and identify the key factors affecting student satisfaction. This research contributes to the existing literature in the following four aspects: 1) it integrates the existing literature and proposes a new framework for evaluating online degree programs; 2) it identifies critical factors for evaluating online degree programs through student satisfaction; 3) it extends the definition and construct of student satisfaction, and assesses the construct from three dimensions; and 4) it provides suggestions to the policymakers such as school administrators and accreditation bodies.

Keywords: Online degree program, student satisfaction, key factors, perceived learning, program recommendation

Zhou, Z. & Rouse, S. (2024). Evaluating Online Degree Programs Through Student Satisfaction. *Online Learning*, *28*(2), (202-238). DOI: https://doi.org/10.24059/olj.v28i2.3983

The outbreak and spread of COVID-19 changed many people's lifestyles, significantly affecting traditional face-to-face education (Dhawan, 2020). More and more universities have shifted to the online teaching format to accommodate this changing educational environment, and the number of fully online degree programs is expected to experience rapid growth in the coming years (Crawford et al., 2020). Online educational platforms such as Canvas and Blackboard and video conferencing solutions such as Zoom and Webex have been widely adopted to facilitate online teaching and communication (Chaka, 2020). Technology companies have significantly improved online educational platforms and video conferencing solutions over the past few years to embrace this trend.

The online degree program differs considerably from traditional face-to-face education in many ways, including but not limited to 1) interactions, 2) course structure and organization, 3) use of technologies, and 4) student motivation. First, it is different in terms of how students interact with the instructors and how they interact with each other (Alqurashi, 2019; Kuo et al., 2014). For instance, students interact directly with instructors and other students in traditional classroom settings, while less communication and fewer interactions may be observed in an online learning environment.

Second, how online courses are organized and structured (Gray & DiLoreto, 2016) differs from traditional face-to-face education. For instance, the classes may be designed and delivered weekly in traditional education settings, while in an online learning environment, lectures may be prepared and posted early and made available to all at once, and students may be allowed to study at their own pace.

Third, online education differs from traditional face-to-face education in terms of the use of technologies (Freeman & Urbaczewski, 2019). For instance, students must use specific learning management systems (LMS) or video conferencing software to take classes in an online learning environment, whereas the use of specific technologies might not be a requirement in a traditional classroom setting. The use of technologies may lead to particular issues, such as whether the LMS and software are helpful or easy to use.

Finally, how students are motivated in online instruction differs from traditional face-to-face education (Suhre et al., 2007; Tseng et al., 2019). In a traditional educational setting, students are usually surrounded by their instructors and classmates. They are more likely to be motivated by such an immersive environment and be pushed to pursue their learning objectives, while in online education, students are often required to be more self-regulated and self-motivated (Wong et al., 2019).

Considering the significant differences between the online degree program and traditional face-to-face education, and in light of the ongoing trend of online learning, it is imperative to understand what key implications may be addressed and what factors may significantly contribute to the success of online degree programs.

Significance of This Study

Previous literature either focused on the factors at the course level or researched the factors for the traditional face-to-face degree programs. This study shifts the focus to online degree programs by integrating the existing literature and proposing a new theoretical framework for evaluating them. We review the factors affecting student satisfaction at the course and traditional degree program levels. A new conceptual framework will be proposed, and a comprehensive literature review on each factor will be conducted.

Student satisfaction is a key performance indicator for the success of any online degree program (e.g., Alqurashi, 2019; Blau et al., 2019; Gray & DiLoreto, 2016). In light of the vast difference between online and traditional degree programs, how student satisfaction is evaluated and what factors may significantly affect student satisfaction and thus contribute to the success of online degree programs are still underexplored (Freeman & Urbaczewski, 2019).

This study has been developed to answer the following research questions (RQs):
RQ1: What conceptual framework can be used to evaluate online degree programs?
RQ2: What critical factors may affect student satisfaction in online degree programs?
RQ3: How is student satisfaction defined and assessed?

By responding to the above research questions, this research contributes to the existing literature in the following four aspects: 1) it integrates the existing literature and proposes a new framework for evaluating online degree programs; 2) it identifies critical factors in evaluating online degree programs through student satisfaction; 3) it extends the definition and construct of student satisfaction by evaluating it from three dimensions; and 4) it provides suggestions to policymakers such as school administrators and accreditation bodies.

Literature Review

Previous Literature Focused on the Factors at the Course Level

Previous research on distance learning or online education often focused on the factors at the course level. For instance, Wei and Chou (2020) investigated a general-education undergraduate online course; they suggested the positive effects of computer/internet self-efficacy (CIS) and motivation for learning (ML) on student satisfaction and online learning performance. Alqurashi (2019) studied the impact of online learning self-efficacy (OLSE), learner-content interaction (LCI), learner-instructor interaction (LII), and learner-learner interaction (LLI) on student satisfaction and perceived learning at the course level.

Gray and DiLoreto (2016) summarized the factors into four categories that may affect student satisfaction and perceived learning in online classes, including 1) course organization, 2) student engagement, 3) learner interaction, and 4) instructor presence. Bolliger (2004) suggested the use of an online survey (OCSS) to evaluate student satisfaction with online course delivery, which included six distinct factors: 1) instructor, 2) technology, 3) course management, 4) course website, 5) interactivity, and 6) general issues.

Previous Literature Studied the Factors for the Traditional Degree Programs

On the other hand, previous research also studied the factors that affect student satisfaction in traditional face-to-face degree programs. For instance, Letcher and Neves (2010) adopted eight factors from the Undergraduate Business Exit Assessment (UBEA) to evaluate student satisfaction in a traditional face-to-face business degree program. Those factors are 1) self-confidence, 2) curriculum, instruction, and classes, 3) satisfaction with teaching in subject matter, 4) extra-curricular activities and career opportunities, (5) advising, (6) quality of teaching and feedback, (7) computing resources, and (8) fellow students.

Sears et al. (2017) identified ten factors as predictors of student satisfaction in a traditional face-to-face psychology undergraduate program. The ten factors are 1) quality of teaching in lectures, 2) quality of teaching in labs, 3) student-faculty interaction, 4) level of academic challenge, 5) opportunities for research experience, 6) variety of courses available, 7) opportunities for class discussions, 8) opportunities to write about views and ideas, 9) program advising, and 10) career information.

Blau et al. (2019) conducted the research in a traditional face-to-face business degree program, in which they classified the factors that affect student satisfaction into three categories: 1) background variables, 2) curriculum-related variables, and 3) professional development variables. The traditional classroom offers opportunities—often unavailable online—for students to engage with the instructor and their classmates. It allows a different set of predictors to evaluate student satisfaction.

A Shift to Focus on the Online Degree Programs

As suggested in the review above, previous literature on student satisfaction either focused on online course level factors or researched the factors for the traditional face-to-face degree programs. Fewer studies have integrated these two perspectives and targeted the factors influencing online degree programs. The growing trend in online education requires that the focus of research shift from traditional face-to-face programs to online degree programs. In this study, we summarize and propose a new conceptual framework containing the factors tailored to online degree programs based on existing literature.

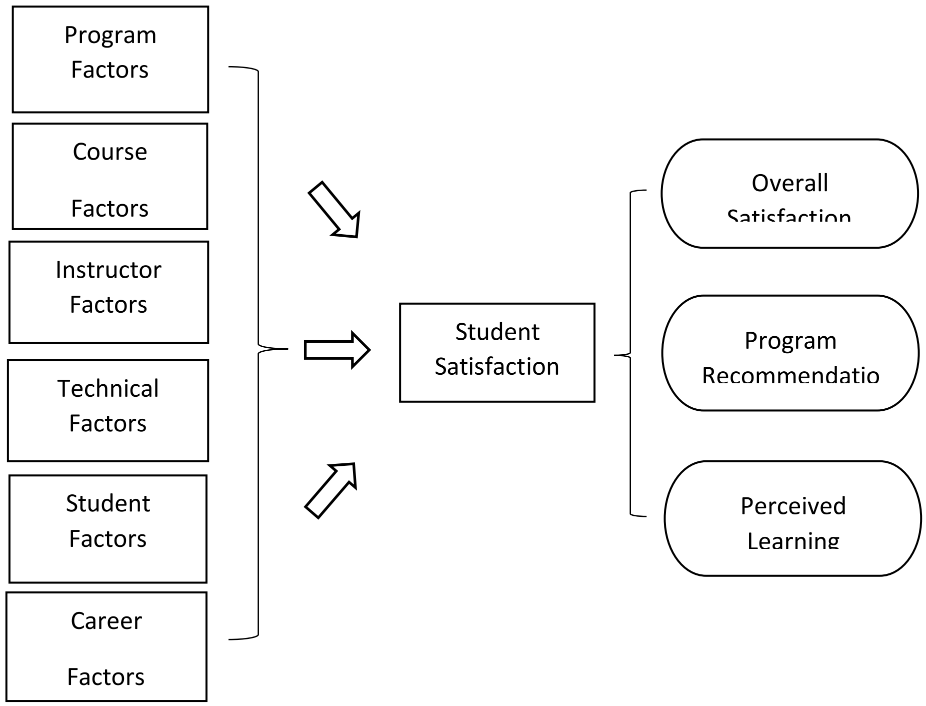
A New Conceptual Framework

Several studies have investigated the factors affecting student satisfaction with online degree programs. For instance, Freeman and Urbaczewski (2019) evaluated seven factors that affect student satisfaction with an online business degree program, including 1) course quality, 2) interactivity, 3) faculty, 4) learning style, 5) learning management systems (LMS), 6) course availability, and 7) advising. Kucuk and Richardson (2019) suggested that teaching presence, cognitive presence, emotional engagement, behavioral engagement, and cognitive engagement positively predicted student online learning satisfaction. Malik (2010) proposed a conceptual framework for student online learning satisfaction that identified five factors: 1) student factors, 2) instructor factors, 3) design factors, 4) course factors, and 5) technical factors.

In this study, we integrate and expand on the research listed above and propose a conceptual framework that consists of six categories, including 1) program factors, 2) course factors, 3) instructor factors, 4) technical factors, 5) student factors, and 6) job factors (Figure 1). These proposed factors and variables under each category are tailored explicitly to online degree programs and their importance and relevance will be reviewed in the following sections.

Figure 1

A Framework for Evaluating Online Degree Programs

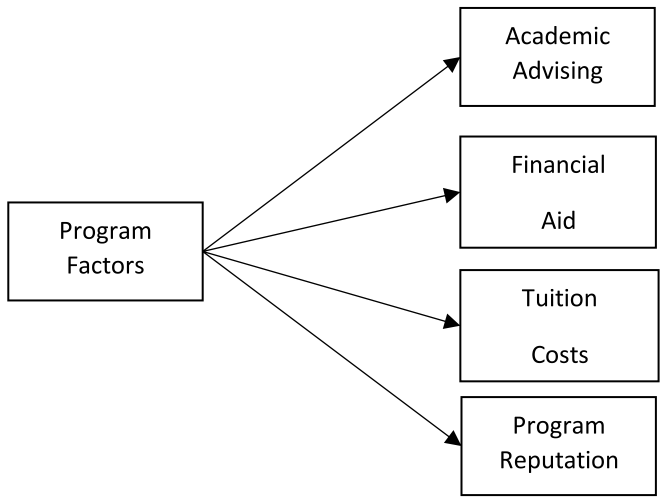


Program Factors

Program factors affect student satisfaction at the program level, such as academic advising, financial aid, tuition costs, and program reputation (Figure 2). These program-level factors are important because they provide fundamental support to online students from a broader perspective to help them achieve their academic goals or learning objectives during their studies (Farahmandian et al., 2013; Sears et al., 2017).

Figure 2

Program Factors



Previous research has studied these variables' effects on student satisfaction and provided evidence of the relationships between various program-related factors and student satisfaction. For instance, Sears et al. (2017) suggested that program advising was one of the predictors of student satisfaction in a large psychology undergraduate program. Freeman and Urbaczewski (2019) studied seven critical success factors for online program satisfaction, and advising was one of the seven factors. Farahmandian et al. (2013) found that advisory services, financial assistance, and tuition costs positively and significantly impacted student satisfaction. In another study, Khosravi et al. (2013) identified academic advising and financial aid effectiveness as two of the seven factors affecting higher education student satisfaction.

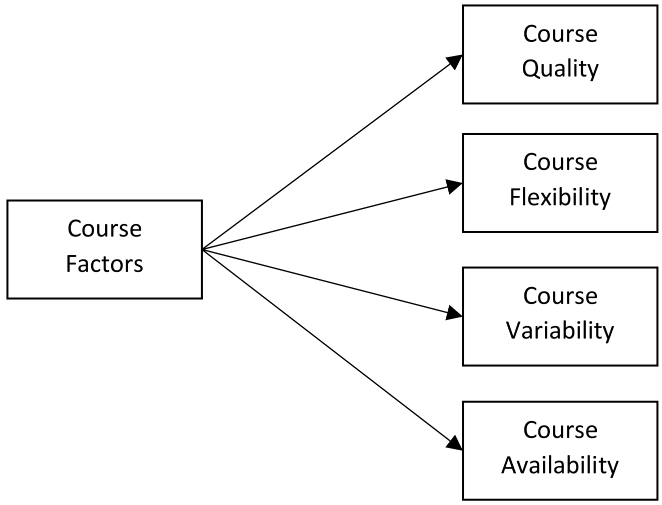
Additionally, Parahoo et al. (2016) found that university reputation was the most determinant predictor of student satisfaction in online learning. Al Hassani and Wilkins (2022) suggested that an institution's reputation significantly affects student satisfaction. Other factors, such as the facilities (Farahmandian et al., 2013) and campus life (Khosravi et al., 2013), may be attributed to the category of program factors as well but were eliminated from the investigation in this study because facilities and campus life may not apply to the online degree programs.

Course Factors

Course factors evaluate students' perceptions of course delivery, including course quality, flexibility, variability, and availability (Figure 3). Ensuring the quality of the course delivery is an important long-term strategy for higher education institutions and the key to the success of any online degree programs (Kucuk & Richardson, 2019), while making the online courses flexible, variable, and available may positively affect student satisfaction (Freeman & Urbaczewski, 2019; Letcher & Neves, 2010).

Figure 3

Course Factors



Several studies have provided evidence to support the classification of course factors. For instance, Letcher and Neves (2010) included course quality, variability, and availability within two of the eight factors in evaluating online student satisfaction. Freeman and Urbaczewski (2019) assessed the effects of course quality and availability on student satisfaction with the online degree program. Malik (2010) proposed that student satisfaction with online learning was positively influenced by course flexibility and course quality.

Past research often studied course factors in terms of various course interactions in individual online courses, such as learner-content interaction (LCI), learner-instructor interaction (LII), and learner-learner interaction (LLI) (Alqurashi, 2019; Kuo et al., 2014). This research focuses on online degree programs rather than individual online courses. We define course factors as those course-related variables positively affecting student satisfaction with the online degree program, such as course quality, flexibility, variability, and availability.

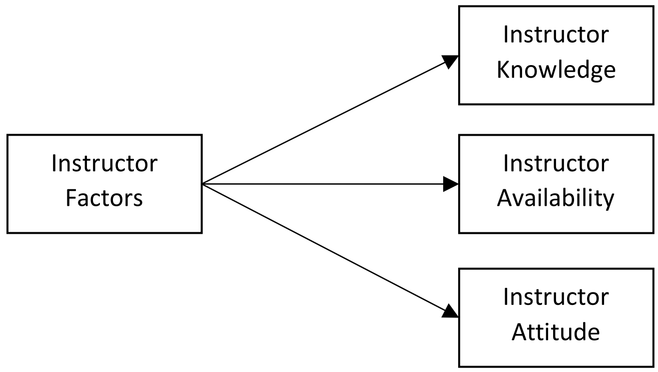
Specifically, course quality refers to students' overall perceptions regarding the quality of the courses, while course flexibility pertains to students' perceptions of the time flexibility of the courses offered. Course variability assesses students' perceptions regarding the breadth or variability of the courses offered, and course availability evaluates students' perceptions concerning the depth or the level of difficulties of the courses provided.

<u>Instructor Factors</u>

The instructor is often considered one of the critical factors in the success of online teaching activities (Roddy et al., 2017) because they can affect students' attitudes and motivation toward their learning behaviors (Cole et al., 2017; Gares et al., 2020). This study investigated three instructor-related factors that may affect student satisfaction with online degree programs, including instructor knowledge, instructor availability, and instructor attitude (Figure 4).

Figure 4

Instructor Factors



Instructor knowledge refers to the extent to which the instructor is knowledgeable of the subject matter and capable of coordinating the online students' learning activities using technology. It is believed to positively affect student satisfaction in traditional face-to-face and online education (Bolliger, 2004).

Instructor availability refers to how the instructor is available to provide assistance and timely response to the students when needed. It is critical because direct interaction between instructors and students is usually uncommon in an online learning environment (Freeman & Urbaczewski, 2019; Letcher & Neves, 2010).

Finally, instructor attitude refers to the instructors' friendly behaviors and understandability when dealing with potential issues with online students. It was suggested that instructors with a positive attitude were more likely to motivate the students, get along with them well, and positively influence student satisfaction (Gares et al., 2020).

<u>Technical Factors</u>

Compared to traditional degree programs, online education relies heavily on technology. Bolliger (2004) suggested that technology was vital in determining student satisfaction with online learning. Thus, it is crucial to study the effects of those technical factors on the success of online degree programs.

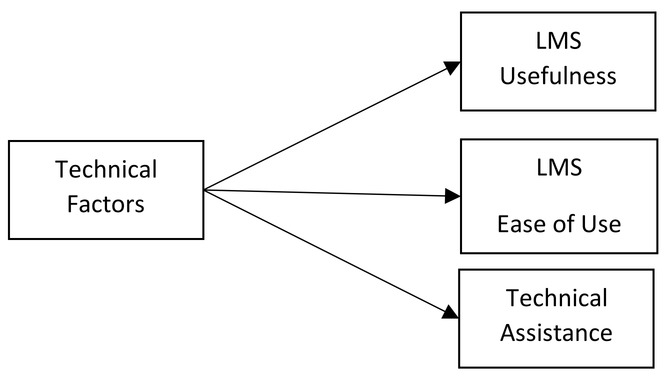
Learning management systems (LMS) are widely used in an online learning environment. LMS refers to the software applications used for the administration, documentation, tracking, reporting, automation, and delivery of online courses or learning programs (Ellis, 2009). Examples of LMS include educational platforms such as Canvas and Blackboard and video conferencing solutions such as Zoom and WebEx (Chaka, 2020).

Some previous studies have investigated the importance of technology for student satisfaction. For instance, Freeman and Urbaczewski (2019) evaluated the effects of LMS on student satisfaction from six different aspects, including dashboard, software, uploading, downloading, discussions, and assessments. Avcı and Ergün (2019) argued that online students more actively participating in LMS would improve academic performance. Malik (2010) proposed that the availability of technical assistance played an important role when online students encountered technical issues, and it may positively affect student satisfaction.

In this study, we incorporate the technology acceptance model (TAM) (Davis et al., 2020) and the variables suggested in previous literature to evaluate technical factors' effects on student satisfaction. The technological factors assessed in this research consist of three factors: LMS usefulness, LMS ease of use, and technical assistance (Figure 5). LMS usefulness evaluates students' perceptions regarding the efficiency and usefulness of the LMS in delivering online courses. LMS ease of use refers to the extent to which students feel the LMS is easy to use, and technical assistance assesses whether it is convenient to get technical help when having issues with the LMS.

Figure 5

Technical Factors



Student Factors

Online learning usually requires students to be more self-motivated and self-regulated and take more responsibilities and autonomy in learning activities than traditional face-to-face education, especially for students who take asynchronous online classes (Wong et al., 2019; Zhou & Wang, 2023). Thus, it is important to understand how student-related factors, such as students' personalities and experiences, affect student satisfaction in an online learning environment.

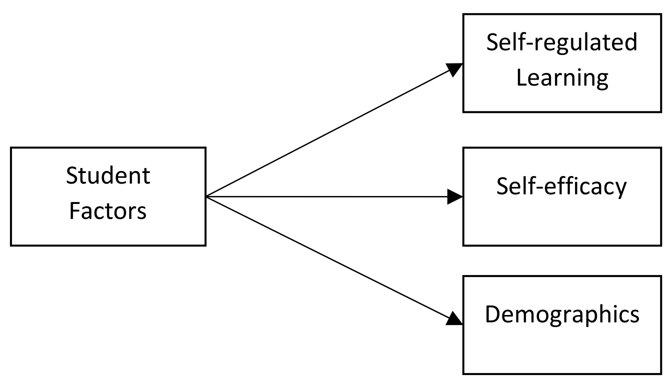
Many previous studies suggested that factors related to online students' personalities and experiences might affect student satisfaction positively. For instance, self-regulated learning and self-efficacy were two key factors frequently investigated in online learning literature (e.g., Alqurashi, 2019; Kuo et al., 2014).

Self-regulated learning refers to activities guided by metacognition, strategic action, and learning motivation. Self-regulated students are more likely to be self-motivated, set up plans and goals, and take strategic actions to monitor and evaluate their learning progress (Moller &

Huett, 2012).On the other hand, self-efficacy refers to a student's confidence level when they need to fulfill the requirements or achieve goals (Alqurashi, 2016). Students with a higher level of self-efficacy are more likely to make efforts and take the necessary steps to overcome challenges and obstacles, leading to better learning outcomes and higher satisfaction in the online learning environment (Alqurashi, 2019). Besides the abovementioned factors, students' experience or educational background may also affect their satisfaction with online degree programs (Li, 2019). This study defines students' demographic information as one of the student factors (Figure 6).

Figure 6

Student Factors



Career Factors

Career factors are those factors related to students' job searching, job placement, and career development. It is crucial to study the effects of career factors because students may seek job placements or potential promotion opportunities after graduation, and factors related to students' future careers may significantly impact their satisfaction with online degree programs (Letcher & Neves, 2010; Weerasinghe & Fernando, 2017).

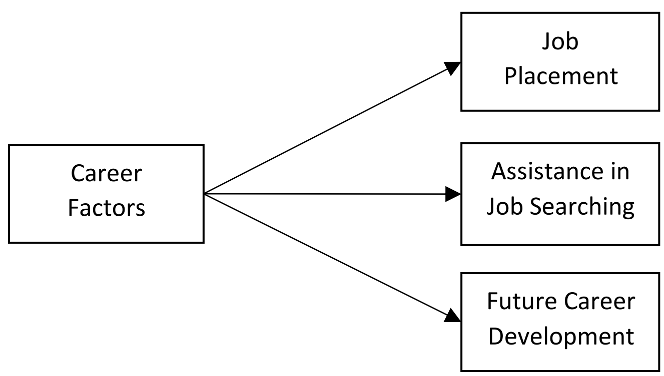
Previous literature has investigated various career-related factors. For instance, Hanssen and Solvoll (2015) suggested that job prospects greatly influenced student satisfaction in countries with relatively low employment rates. Letcher and Neves (2010) found that career opportunities positively affected student satisfaction in an online business degree program. Sigala et al. (2006) proposed that student satisfaction heavily depended on job placement chances after graduation in Italian universities. Sears et al. (2017) included career information as one of the key predictors for student satisfaction in a large psychology undergraduate program.

Blau et al. (2019) found that degree program satisfaction was positively associated with assistance in job searching, such as resume critiques, job search strategies, business etiquette, mock employer interviews, and internship opportunities. DeShields et al. (2005) suggested that career development was one of the determinants of business students' satisfaction. This determinant is especially true for students with jobs while attending online degree programs because they might look for career development opportunities rather than job placement. In this case, students' perceptions of career development may significantly impact their online degree program satisfaction.

Based on the previous literature, we propose three career factors: job placement expectation, assistance in job searching, and future career development (Figure 7). Job placement expectation refers to whether the students feel optimistic or pessimistic about their future job placement. Assistance in job searching evaluates if the students can obtain enough help while searching for jobs during their studies. Future career development assesses whether the students feel optimistic or pessimistic about future career development opportunities (such as job changes or promotion opportunities) after they graduate from the programs.

Figure 7

Career Factors

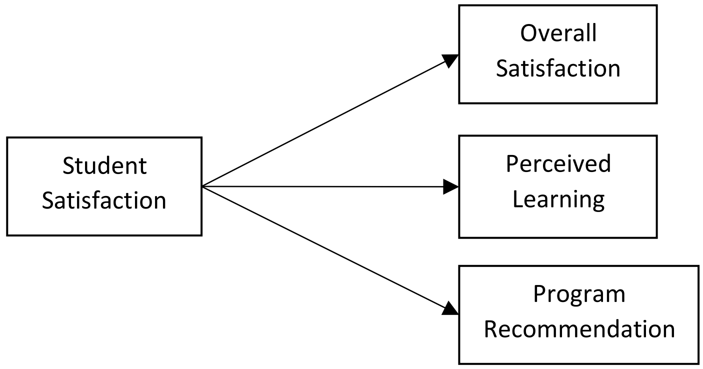


Student Satisfaction

Student satisfaction may be evaluated from different angles. For instance, Sears et al. (2017) suggested using two items to evaluate student satisfaction with the program. One measures overall satisfaction, and the other assesses the likelihood of recommending the program to others. Students may feel satisfied with the online degree program but unwilling to recommend it to others. On the other hand, students may indicate a good level of perceived learning but a lower level of satisfaction with the program. In this sense, perceived learning and program recommendation may be included as the additional dimensions under the construct of student satisfaction (Alqurashi, 2019; Blau et al., 2019; Sears et al., 2017). This study proposes three dimensions in evaluating student satisfaction: overall satisfaction, perceived learning, and program recommendation (Figure 8).

Figure 8

Student Satisfaction



Method

Design and Recruitment Procedures

Drawing upon the literature review and the proposed conceptual framework (Figure 1) in evaluating the online degree programs, the survey was developed regarding each of the six factors and student satisfaction. Qualtrics Online Survey Platform was used to house and deliver the survey to the potential respondents. To improve the quality of the responses, we also incorporated three attention-check questions in the survey.

The potential respondents were online students enrolled in two industrial engineering online degree programs (either graduate or undergraduate) at a 4-year public university in the southern region of the United States. The online degree programs have an average enrolment of 250 undergraduate and 25 graduate students over the past three years.

The research design and survey were developed and submitted to the Institutional Review Board (IRB). Upon the approval of the IRB, an email announcement was sent to all the online students enrolled in these two programs; it briefly described the purpose and procedure and the potential benefits and risks of the study to the students. All the online students were encouraged to participate in the survey to earn extra credits for their classes as a potential reward for their participation. The survey took about 15-20 minutes to complete, and the survey link from the Qualtrics Online Survey Platform was included in the email announcement.

<u>Participants</u>

A total of 229 responses were received, of which 158 were valid answers after screening the incomplete responses and the three attention-check questions. Of these 158 students, 40 were females, and 115 were males; the other three preferred not to answer. Most of the students came from the undergraduate online degree program (81.6%), aged between 25 to 44 years old (71.5%), and identified their culture as English-speaking (69%) and ethnicity as Caucasian (65.2%). Concerning the student type, 93 were transfer students, 38 were returning students, and 27 were in the "other" category. The prior online learning experience across these 158 students varied, with 22.2% indicating no experience and 25.9% suggesting over ten online courses completed before entering the program. Only a small number of students earned bachelor's degrees or above (18.4%) and had a GPA below 3.0 (12%). A detailed summary of demographic information is presented in Table 1.

Table 1

Demographic Information

Characteristics		N	%
Variables	Category		
Gender	Female	40	25.3
	Male	115	72.8
	Prefer not to answer	3	1.9
Age	15-24	29	18.4
	25-34	57	36.1
	35-44	56	35.4
	45-54	11	7.0
	55+	3	1.9
	Prefer not to answer	2	1.3
Ethnicity	Caucasian	103	65.2
	African American	29	18.4
	Latino or Hispanic	6	3.8
	Asian	6	3.8
	Native American	1	0.6
	Two or More	7	4.4
	Other/Unknown	1	0.6
	Prefer not to answer	5	3.2
Culture	African-Islamic	3	1.9
	Baltic	2	1.3
	Catholic Europe	11	7.0
	English Speaking	109	69.0
	Latin America	3	1.9
	Orthodox Protestant Europe	5	3.2
	South Asia	3	1.9
	Other/Unknown	12	7.6
	Prefer not to answer	10	6.3
Degree Program	Undergraduate Program	129	81.6
	Graduate Program	6	3.8
	Other Undergraduate Programs	23	14.6
Semester Enrolled	First Semester	30	19.0
	Second Semester	12	7.6
	Third Semester	19	12.0
	Fourth Semester	15	9.5
	Fifth Semester	12	7.6
	Sixth Semester	19	12.0
	More than Six Semesters	51	32.3
Student Type	Transfer Student	93	58.9
	Returning Student	38	24.1
	Other	27	17.1
Online Learning Experience	Completed less than 5 online courses before joining the program	50	31.6
	Completed 5 - 10 online courses before joining the program	32	20.3
	Completed more than 10 online courses before joining the program	41	25.9

	No online courses were taken before joining the program	35	22.2
Degree Earned Before Joining the Program	Some college credit, no degree	43	27.2
	Associate’s degree	73	46.2
	Bachelor's degree	21	13.3
	Master's degree	8	5.1
	Other	13	8.2
Current GPA	Above 3.5	87	55.1
	Between 3.0 to 3.5	52	32.9
	Below 3.0	19	12.0
Total		158	100.0

Measures

Dependent Variables

In this study, we proposed three dimensions (dependent variables) to assess student satisfaction with online degree programs, including overall satisfaction, perceived learning, and program recommendation. The survey question for overall satisfaction was “Please rate your overall satisfaction with your experience in the program using a 5-point scale ranging from extremely satisfied to extremely dissatisfied.” The one for program recommendation was “How likely are you to recommend the program to others using a 5-point scale ranging from extremely likely to extremely unlikely”. Perceived learning was measured through one item revised based on Sebastianelli et al. (2015) research, “Please indicate your perceived learning from the degree program using a 5-point scale ranging from far exceeds expectations to far short of expectations.”

Independent Variables

The independent variables were divided into two categories: demographic and non-demographic. The demographic variables were categorical variables regarding students’ background information as described in the previous section, including age, ethnicity, culture, degree program, semester enrolled, student type, online learning experience, degree earned before joining the program, and current GPA (Li, 2019). The demographic information was classified as one of the student factors in our research framework (Figure 6).

The non-demographic variables referred to the continuous variables included in each of the six categories: 1) program factors, 2) course factors, 3) instructor factors, 4) technical factors, 5) student factors, and 6) job factors.

Program factors included academic advising, financial aid, tuition costs, and program reputation. Based on previous literature, we adopted one item to evaluate each of the four program factors (Farahmandian et al., 2013; Khosravi et al., 2013). The sample item was “Please rate your satisfaction with the academic advising of the program using a 5-point scale ranging from extremely satisfied to extremely dissatisfied.”

Course factors consisted of course quality, course flexibility, course variability, and course availability. Like the program factors, we used one item to measure each course factor (Freeman & Urbaczewski, 2019; Letcher & Neves, 2010). One sample item was “Please rate your satisfaction with the overall quality of the courses offered using a 5-point scale ranging from extremely satisfied to extremely dissatisfied."

Instructor factors included instructor knowledge, instructor availability, and instructor attitude. We applied one item from Bolliger (2004) to measure instructor knowledge, two items from Freeman and Urbaczewski (2019) to assess instructor availability, and two items from Volery and Lord (2000) to evaluate instructor attitude. One sample survey item was "Please indicate the level of agreement with the following statement using a 5-point scale ranging from strongly agree to strongly disagree: Instructors are knowledgeable about their respective disciplines."

Technical factors included LMS usefulness, ease of use, and technical assistance. One item was used to assess each technical factor (Freeman & Urbaczewski, 2019). A sample item was written as "Please indicate the level of agreement with the following statement using a 5-point scale ranging from strongly agree to strongly disagree: Overall, the learning management system (Canvas) is easy to use."

Student factors included self-regulated learning, self-efficacy, and students' demographic data. We adopted two separate measures to evaluate self-regulated learning and self-efficacy, respectively. First, one survey question was employed based on the previous literature (Alqurashi, 2019; Kuo et al., 2014). The sample question for self-regulated learning was "Please indicate the level of agreement with the following statement using a 5-point scale ranging from strongly agree to strongly disagree. I am a self-motivated and self-regulated learner for online classes." Secondly, we implemented a 24-item QSLQ survey developed by Barnard et al. (2009) and an 8-item OLSE survey suggested by Alqurashi (2019) to validate self-regulated learning (QSLQ) and online learning self-efficacy (OLSE). The results of QSLQ and OLSE were highly correlated to that of the first measure. Thus, we took the average of these two measures for self-regulated learning and self-efficacy ratings.

Career factors comprised job placement expectation, assistance in job searching, and future career development. One survey item was used to measure each of the three career factors, respectively (Blau et al., 2019; DeShields et al., 2005; Sigala et al., 2006). A sample item was "Please rate your satisfaction with the job placement after you finish the program using a 5-point scale ranging from extremely satisfied to extremely dissatisfied."

In addition to the 5-point Likert scale, we added one "not applicable" option to each survey question because some factors, such as financial aid and technical assistance, may not apply to all students. For instance, those who have never considered financial aid or technical assistance may select "not applicable" to this question. Whenever "not applicable" was chosen, it was coded as three, the same as "neither agree nor disagree" on the 5-point Likert scale. Please refer to the Appendix for a complete list of survey questions.

Statistical Analysis

The proposed conceptual framework included six factors: program factors, course factors, instructor factors, technical factors, student factors, and career factors. Different variables were listed within each of these six factors, and the measurement for each of the variables was developed (see Appendix). In general, there were ten demographic variables (categorical variables) such as gender, age, ethnicity, culture, etc. (Table 1) and 19 non-demographic variables (continuous variables) such as academic advising, course quality, instructor knowledge, etc.

Demographic and non-demographic variables' effects on student satisfaction (overall satisfaction, perceived learning, and program recommendation) were evaluated separately. To test the effects of 19 non-demographic variables on student satisfaction, structural equation modeling and path analysis were initially used for the data analysis (Kline, 2015). However, the confirmatory factor analysis (CFA) results did not indicate a good fit for the measurement model, suggesting that using structural equation modeling and path analysis might not be appropriate. Thus, multiple linear regression analysis was employed to evaluate the effects of non-demographic variables on student satisfaction.

To evaluate the effects of demographic variables on student satisfaction, we applied univariate analysis. In addition, we dummy-coded demographic variables into the multiple linear regression models to test the collective effects of both demographic and non-demographic variables. Finally, paired-comparison t-tests were performed to evaluate the difference among three dependent variables regarding student satisfaction (Denis, 2018). IBM SPSS 28 was used for the data analysis.

Results

Zero-Order Correlation Matrix and Measurement Model

We first constructed the zero-order correlation matrix between the non-demographic (continuous) variables and three dependent variables (overall satisfaction, perceived learning, and program recommendation). The results suggested that all 19 non-demographic variables were significantly correlated with three dependent variables, indicating that each may significantly contribute to the variations in overall satisfaction, perceived learning, and program recommendation (Table 2).

Table 2

Zero-Order Correlation Matrix

Variables	Mean	S.D.	Overall Satisfaction	Perceived Learning	Program Recommend	Academic Advising	Financial Aid	Tuition Costs	Program Reputation	Course Quality	Course Flexibility
Overall Satisfaction	4.39	.812	1								
Perceived Learning	3.63	.855	.637**	1							
Program Recommend	4.39	.895	.702**	.614**	1						
Academic Advising	4.55	.692	.458**	.409**	.462**	1					
Financial Aid	3.78	1.073	.330**	.275**	.208**	.341**	1				
Tuition Costs	3.44	1.085	.426**	.307**	.312**	.292**	.504**	1			
Program Reputation	4.24	.825	.697**	.614**	.613**	.347**	.455**	.456**	1		
Course Quality	4.23	.904	.718**	.606**	.610**	.393**	.368**	.432**	.633**	1	
Course Flexibility	4.57	.726	.457**	.349**	.370**	.437**	.224*	.244**	.408**	.426**	1
Course Variability	4.27	.849	.530**	.472**	.521**	.481**	.428**	.310**	.569**	.538**	.542**
Course Availability	4.20	.927	.652**	.590**	.644**	.407**	.318**	.299**	.646**	.659**	.514**

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Sample Size N = 158

Table 2

Zero-Order Correlation Matrix (continued)

Variables	Mean	S.D.	Overall Satisfaction	Perceived Learning	Program Recommend	Instructor Knowledge	Instructor Availability	Instructor Attitude	LMS Ease of Use	LMS Usefulness	Technical Assistance
Overall Satisfaction	4.39	.812	1								
Perceived Learning	3.63	.855	.637**	1							
Program Recommend	4.39	.895	.702**	.614**	1						
Instructor Knowledge	4.45	.921	.661**	.535**	.596**	1					
Instructor Availability	4.38	.885	.542**	.435**	.480**	.643**	1				
Instructor Attitude	4.45	.790	.592**	.439**	.546**	.500**	.708**	1			
LMS Ease of Use	4.68	.587	.271**	.325**	.274**	.335**	.253**	.281**	1		
LMS Usefulness	4.67	.535	.339**	.375**	.352**	.367**	.328**	.352**	.741**	1	
Technical Assistance	3.92	1.013	.307**	.446**	.370**	.296**	.256**	.262**	.291**	.342**	1

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Sample Size N = 158

Table 2

Zero-Order Correlation Matrix (continued)

Variables	Mean	S.D.	Overall Satisfaction	Perceived Learning	Recommend Program	Self-Regulated Learning	Self-Efficacy	Job Search Assistance	Job Placement	Career Development
Overall Satisfaction	4.39	.812	1							
Perceived Learning	3.63	.855	.637**	1						
Program Recommend	4.39	.895	.702**	.614**	1					
Self-Regulated Learning	4.22	.545	.315**	.375**	.346**	1				
Self-Efficacy	4.57	.567	.209**	.183*	.202*	.669**	1			
Job Search Assistance	3.42	.883	.245**	.323**	.275**	.198*	-.031	1		
Job Placement Expectation	3.99	.987	.305**	.314**	.342**	.220**	.162*	.398**	1	
Future Career Development	4.20	.949	.460**	.390**	.498**	.252**	.166*	.377**	.742**	1

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Sample Size N = 158

Next, confirmatory factor analysis (CFA) was used to evaluate the measurement model in our research framework. There were six factors in the measurement model, including program, course, instructor, technical, student, and career factors. The model fit indices showed that the value of CMIN/DF was less than 3.0, and both TLI and CFI values were above .90, indicating an acceptable fit between the hypothetical model and sample data. In addition, the RMSEA value was less than .08, and the PCLOSE value was greater than .05, further providing evidence of a close model fit (Kline, 2015).

Concerning the standardized regression weights, all factor loadings were positive and statistically significant. Research suggested that a factor loading above .70 was ideal, but an item can still be retained with a loading of .40 or above as long as the average variance explained was greater than .50 (Hair Jr et al., 2021). A summary of the model fit indices and the factor loading values are presented in Table 3.

The results of the factor loadings suggested that the latent variables loaded well on the course and instructor factors. In contrast, technical and career factors had poorly loaded items, such as technical assistance (.39) and job placement expectation (.44). Due to these poorly loaded items, treating 19 non-demographic variables as latent variables for each of the six categories may not be appropriate. As a result, structural equation modeling and path analysis were not used for further data analysis. Instead, multiple regression analysis was employed to evaluate the effects of non-demographic variables on three dependent variables.

Table 3

Confirmatory Factor Analysis for the Measurement Model

Model fit indices						
	CMIN/DF	TLI	CFI	RMSEA	PCLOSE	
	1.571	.931	.946	.060	.139	
Factor loadings						
Factors	Program factors	Course factors	Instructor factors	Technical factors	Student factors	Career factors
Academic advising	.65					
Financial aid	.53					
Tuition costs	.51					
Program reputation	.85					
Course quality		.80				
Course flexibility		.61				
Course variability		.81				
Course availability		.82				
Instructor knowledge			.85			
Instructor availability			.78			
Instructor attitude			.90			
LMS usefulness				.80		
LMS ease of use				.92		
Technical assistance				.39		
Self-regulated learning					1.00	
Self-efficacy					.62	
Job placement expectation						.44

Job searching assistance	.81
Career development	.91

The Effects of Demographic Variables on Three Dependent Variables

Demographic variables were considered part of the student factors in our research framework. The effects of demographic variables on three dependent variables were evaluated separately from non-demographic (continuous) variables because they were categorical data. We applied univariate analysis in SPSS to test the effects of each demographic variable on three dependent variables individually (Table 4). Because some categories had a small sample size, we regrouped and recoded the data for those demographic variables. For instance, there were only five respondents in the last two "age" categories, and we regrouped "age" into four categories instead of six. In addition, 69% of the respondents identified their "culture" as "English-speaking," and thus, "culture" was recoded into two groups as "English-speaking" and "other." Most respondents identified themselves as "Caucasian" or "African American," and the variable of "ethnicity" was therefore regrouped into three categories.

Table 4

The Effects of Demographic Variables on Three Dependent Variables

Dependent Variables	Demographic Variables	Category	N	Mean	S.D.	F statistics	P value
Overall Satisfaction	Program Enrolled	Undergraduate Program	129	4.44	.770	1.900	.153
		Graduate Program	6	4.33	.816		
		Other Undergraduate Programs	23	4.09	.996		
Perceived Learning		Undergraduate Program	129	3.67	.849	1.609	.203
		Graduate Program	6	3.83	.983		
		Other Undergraduate Programs	23	3.35	.832		
Program Recommendation		Undergraduate Program	129	4.54	.729	12.408	<.001**
		Graduate Program	6	4.17	.983		
		Other Undergraduate Programs	23	3.61	1.270		
	Degree	No degree	43	4.42	.731	6.098	<.001**

	Earned	Associate	73	4.44	.707		
Overall Satisfaction		Bachelor	21	4.43	.676		
		Master	8	3.13	1.553		
		Other	13	4.69	.630		
Perceived Learning		No degree	43	3.67	.919	3.821	.005*
		Associate	73	3.60	.740		
		Bachelor	21	3.86	.793		
		Master	8	2.63	1.408		
		Other	13	3.92	.494		
Program Recommendation		No degree	43	4.23	1.065	5.191	<.001**
		Associate	73	4.48	.648		
		Bachelor	21	4.62	.590		
		Master	8	3.25	1.753		
		Other	13	4.77	.599		

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Sample Size N = 158

The results were presented in Table 4, suggesting that most demographic variables did not significantly affect three outcome variables, except for "program enrolled" and "degree earned." Specifically, the students enrolled in our undergraduate and graduate programs indicated a relatively strong preference in recommending the program to other people (Mean = 4.54, SD = .729 and Mean = 4.17, SD = .983) compared to the students from other undergraduate programs (Mean = 3.61, SD = 1.270) who took the courses as their electives (F =12.408, p < .001). In addition, those who earned master's degrees before enrollment provided significantly lower ratings in terms of all three outcome variables, including overall satisfaction (Mean = 3.13, SD = 1.553 vs. Mean = 4.39, SD = .812, p < .001), perceived learning (Mean = 2.63, SD = 1.408 vs. Mean = 3.63, SD = .855, p < .05), and program recommendation (Mean = 3.25, SD = 1.753 vs. Mean = 4.39, SD = .895, p < .05).

To further control the impacts of non-demographic variables, we incorporated those variables as covariates into the univariate model and retested the effects of "program enrolled" and "degree earned" on three dependent variables. The results from the adjusted estimates suggested that after controlling for the non-demographic variables, the students in our undergraduate programs still indicated a relatively strong preference in recommending the program (Mean = 4.49, SD = .048) compared to those from other undergraduate programs (Mean = 3.90, SD = .123) who took the courses as their electives (F = 9.505, p < .001).

However, this was not the case for the students in our graduate program (Mean = 4.28, SD =.233). For "degree earned," students with master's degrees before entering our program indicated significantly lower ratings for overall satisfaction (Mean = 3.95, SD = .189 vs. Mean = 4.34, SD = .052, p < .05) and program recommendation (Mean = 3.99, SD = .229 vs. Mean = 4.37, SD = .063, p < .05), but not for perceived learning (Mean = 3.38, SD = .248 vs. Mean = 3.63, SD = .068, p >.10).

The Effects of Non-Demographic Variables on Three Dependent Variables

Non-demographic variables were measured on a 5-point Likert scale and considered continuous variables. Our research framework included 19 non-demographic variables: four in program and course factors, three in instructor, technical, and career factors, and two in student factors. The zero-order correlation matrix suggested that all 19 non-demographic variables were significantly correlated with three dependent variables, indicating that each may individually contribute to overall satisfaction, perceived learning, and program recommendation.

We used multiple linear regression to evaluate the collective impacts and identify the significant factors within these 19 variables. Three separate multiple linear regressions were performed on three dependent variables. In the first model, overall satisfaction was the dependent variable, while the other 19 non-demographic variables were the independent variables. At the same time, perceived learning and program recommendation were the dependent variables for models 2 and 3 (Table 5).

Table 5

The Effects of Non-Demographic Variables on Three Dependent Variables

Model	Dependent Variable	Independent Variables	R square	Adjusted R square	F statistics	P value	
Model 1	Overall Satisfaction	All Non-Demographic Variables	.714	.675	18.151	<.001**	
		Parameter Estimates with Robust Standard Errors					
		Significant IVs	Coefficient	Robust Std. Error	t statistics	P value	Partial Eta Squared
		Program Reputation	.297	.096	3.109	.002*	.065
		Course Quality	.221	.094	2.359	.020*	.039
		Instructor Knowledge	.226	.118	1.914	.058	.026
Model 2	Perceived Learning	All Non-Demographic Variables	.562	.502	9.331	<.001**	
		Parameter Estimates with Robust Standard Errors					
		Significant IVs	Coefficient	Robust Std. Error	t statistics	P value	Partial Eta Squared
		Technical	.144	.065	2.220	.028*	.034

		Assistance					
		Course Quality	.221	.106	2.072	.040*	.030
		Program Reputation	.214	.107	1.998	.048*	.028
Model 3	Program Recommendation	All Non-Demographic Variables	.643	.594	13.099	<.001**	
		Parameter Estimates with Robust Standard Errors					
		Significant IVs	Coefficient	Robust Std. Error	t statistics	P value	Partial Eta Squared
		Financial Aid	-.178	.052	-3.411	<.001**	.078
		Course Depth	.238	.099	2.397	.018*	.040
		Career Development	.206	.098	2.101	.037*	.031

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Sample Size N = 158

Testing the potential collinearity issues and the four linear regression analysis assumptions is essential for multiple linear regression analysis. The assumptions include linearity, homoskedasticity, independence, and normality (Darlington & Hayes, 2016). The results from the collinearity test showed that all VIF values were less than 3, suggesting no evidence for the collinearity issue. In addition, the histogram and normal P-P plot indicated no clear evidence of fairly extreme non-normality in the residuals. Further investigation in studentized residual plots indicated that the linearity assumption was not violated (Pituch & Stevens, 2015). Moreover, the assumption of independence might not be an issue since the dependent variables in this study were not measured on one or more cases over time (Fidell & Tabachnick, 2018).

The modified Breusch-Pegan test and White's test were performed to evaluate the homoskedasticity assumption for the multiple linear regression. The results of the modified Breusch-Pegan test for the first and third models were significant, suggesting that there might be evidence of heteroskedastic residuals. To overcome the issue of heteroskedasticity, we retested the multiple linear regression models using the parameter estimates with robust standard errors, which were considered heteroskedasticity-consistent standard errors (Astivia & Zumbo, 2019). The results indicated that program reputation (β = .297, p =.002) and course quality (β = .221, p =.020) were the significant factors affecting overall satisfaction, while instructor knowledge (β = .226, p =.058) was marginally significant in model 1. In model 3, financial aid (β = -.178, p =

.001), course depth (β = .238, p = .018), and career development (β = .206, p = .037) significantly affected program recommendation.

For model 2, the modified Breusch-Pegan and White's test results were insignificant, suggesting no evidence of heteroskedastic residuals. Both the parameter estimates with and without robust standard errors indicated that program reputation (β = .214, p = .048), course quality (β = .221, p = .040), and technical assistance (β = .144, p = .028) had significant effects on perceived learning. The adjusted R^2 for the three models were .675, .502, and .594, respectively. A summary of the results is shown in Table 5.

The Effects of Both Demographic and Non-Demographic Variables on Three Dependent Variables

To test the collective effects of demographic and non-demographic variables, we dummy coded two demographic variables (degree earned and program enrolled) identified as significant in previous analysis and incorporated these two categorical variables into three multiple linear regression models. After entering these two dummy variables, program reputation (β = .273, p = .011) and course quality (β = .200, p = .049) were still the significant factors for overall satisfaction in model 1.

However, instructor knowledge was not marginally significant (β = .205, p = .104). In model 2, technical assistance (β = .157, p = .027) was still significant, but program reputation (β = .210, p = .080) and course quality (β = .181, p = .112) did not significantly affect perceived learning. For model 3, financial aid (β = -.125, p = .015), course availability (β = .228, p = .015), and career development (β = .171, p = .026) still significantly affected program recommendation after incorporating these two dummy variables. In all three multiple regression models, two dummy coded variables (degree earned and program enrolled) were not statistically significant on three dependent variables.

The Significant Difference Among Dependent Variables

Paired-comparison t-tests were performed to evaluate the difference among three dependent variables. The results suggested that the average rating of perceived learning was significantly lower than that of overall satisfaction or program recommendation (Table 6). To explore the potential causes leading to the lower average rating of perceived learning, we created two new dependent variables, d_1 and d_2, where d_1 represented the difference between overall satisfaction and perceived learning, and d_2 referred to the difference between program recommendation and perceived learning. The multiple linear regression models were used to assess the effects of both demographic and non-demographic variables on d_1 and d_2. The results suggested that self-regulated learning was the significant factor for both d_1 (β = -.427, p = .020) and d_2 (β = -.375, p = .045).

Table 6

Paired Comparison t-Tests Among Three Dependent Variables

Dependent Variable	N	Mean	S.D.	Paired comparison t-tests	Mean difference	S.D.	t statistics	P value
Overall Satisfaction	158	4.39	.812	Overall Satisfaction vs. Perceived Learning	.753	.711	13.315	<.001**
Perceived Learning	158	3.63	.855	Overall Satisfaction vs. Program Recommendation	.006	.663	.120	.905
Program Recommendation	158	4.39	.895	Program Recommendation vs. Perceived Learning	.759	.769	12.413	<.001**

**Correlation is significant at the 0.01 level (2-tailed).

Discussion

Implication One: Propose a Conceptual Framework for Evaluating Online Degree Program

The first goal of this study is to propose a conceptual framework for evaluating the online degree program. We proposed a conceptual framework comprising six categories based on the existing literature to achieve this objective. The six categories included program factors, course factors, instructor factors, technical factors, student factors, and job factors. Following a thorough literature review, various sub-factors were identified within each of the six categories. Aside from ten demographic variables, 19 non-demographic variables were suggested for evaluating the online degree program. The measurement for each demographic and non-demographic variable was also proposed based on previous literature.

In addition to the six-category framework, we proposed three outcome variables as the dependent variables for evaluating the online degree program from students' perspectives, including overall satisfaction, perceived learning, and program recommendation. The results from the zero-order correlation matrix suggested that all 19 non-demographic factors were significantly correlated with three dependent variables, supporting the use of our proposed framework to evaluate online degree programs.

To further evaluate the measurement model proposed, a confirmatory factor analysis (CFA) was conducted to extract the factor loadings on six different categories. The overall model fit indices suggested that the measurement model was acceptable regarding the relationship between the hypothetical model and sample data. However, the factor loadings results showed that most categories did not have decent loadings across different latent variables. The measurement model may need further improvement, and we used multiple regression models to assess the effects of demographic and non-demographic variables. In summary, the proposed framework may provide a valuable portfolio for evaluating online degree programs from students' perspectives.

Implication Two: Identify Key Factors in Evaluating Online Degree Programs Through Student Satisfaction

The second goal of this study is to identify the critical factors in evaluating online degree programs through student satisfaction. Based on our proposed framework, we collected the responses from the college students in two engineering online programs and used multiple regression models to test the effects of various demographic and non-demographic variables on three outcome variables (overall satisfaction, perceived learning, and program recommendation). The following discussion lists key variables identified from the data analysis.

<u>Program Enrolled</u>

Concerning the demographic variables, only “program enrolled” and “degree earned” significantly impacted three outcome variables. Specifically, the students enrolled in our undergraduate program seemed more inclined to recommend the program to others than those from other programs for elective courses. The possible explanation was that the students enrolled in our program were generally satisfied, given the relatively high ratings (4.39 out of 5) for overall satisfaction and program recommendation. However, since there was no significant difference in overall satisfaction and perceived learning among the students enrolled in different programs, this implication should be treated cautiously. The actual effect of “program enrolled” may be limited.

<u>Degree Earned</u>

Aside from “program enrolled,” the students who earned master’s degrees before joining the online degree program suggested a fairly consistent lower overall satisfaction and program recommendation ratings. The plausible explanation was that those who had already obtained a high-level degree might be more likely to have higher expectations and less likely to feel satisfied and recommend the program to others. However, considering the small number of students who earned master’s degrees in our sample, further validation is needed for this implication.

<u>Program Reputation</u>

Key non-demographic variables were identified in three dependent variables besides the demographic variables listed above. Specifically, program reputation and course quality were the main contributors to the variations in overall satisfaction, whereas technical assistance was the significant factor for perceived learning. The most critical factors affecting the program recommendation were financial aid, course depth, and career development. Though the above results were generated based on the sample collected in two specific online degree programs, they may still have meaningful implications.

Online students usually perceive the program’s reputation as one of the keys because it may affect their initial expectations or future job applications. For instance, the students were asked if they had any additional comments at the end of the survey. One student stated, “This was my first degree. I am extremely satisfied with the program. I like the fact that the program is ABET certified.” The other one suggested, “Being an online student in the program, I am afraid that I will have to transfer out due to the school losing its ABET accreditation for the program.” In this regard, it would be beneficial if efforts could be made to promote the reputation of online degree programs, such as obtaining the program certification from prestigious accreditations.

Course Quality

Course quality refers to students' overall perceptions regarding the quality of the courses, which is often considered the key to any online degree program. One student suggested in her additional comments, "The quality of my courses has varied greatly. Some classes have been exceptional, while others have been atrocious. Some standardization for the courses within the program would be very beneficial." Another one mentioned, "I have been incredibly disappointed with the quality of education in this program. I have really only 1 or 2 quality classes."

Improving the overall quality of courses is usually challenging because different instructors may teach the classes differently. Especially in asynchronous online programs, most of the lectures are pre-recorded, and some instructors may fail to update the lecture videos in a timely manner. Therefore, it is crucial to implement specific standards for online courses. For instance, introducing and incorporating the standards suggested by Quality Matters (QM) or the Association of College and University Educators (ACUE) may be a good option.

Technical Assistance

Technical assistance refers to whether it is convenient for online students to get the proper assistance when having trouble with the learning management system (LMS). It is crucial for those new to the online program and unfamiliar with LMS. Many students indicated an excellent learning experience using the Canvas LMS during their studies. For instance, one student suggested, "I feel that Canvas is a simple and easy program or platform to use, much simpler and more user-friendly than other platforms I have seen compared to other students from other universities." Another stated, "I feel that the Canvas system overall is designed perfectly for the user to be as successful as possible."

However, the data analysis results suggested that technical assistance was the key contributor to the variation of perceived learning among online students. Likely, students needing help with LMS did not receive proper assistance, which may result in poor learning experiences among those students. In dealing with this issue, proper training for using LMS may be provided, and resources regarding technical assistance should be announced once the students are enrolled in the online degree program.

Financial Aid

One of the interesting implications of the data analysis was the effect of financial aid on program recommendation. The results suggested that financial aid significantly contributed to the variation in program recommendation. In addition, it affected program recommendation in a reverse way ($\beta = -.178$, $p < .001$). It was probably because most students in our program did not receive financial aid and provided low ratings on this item. In other words, though they might not be satisfied with the financial aid provided, they were still willing to recommend the program to others, contrary to our expectations. Financial aid might be essential when students apply for the online degree program. However, when students entered the program, this might not significantly affect their overall satisfaction, perceived learning, and willingness to recommend the program.

Course Availability

Course availability refers to the depth or the level of difficulties of the courses offered. When the course lacks challenges, it is likely that the students are not satisfied with the learning outcomes. On the other hand, if the course is too challenging, the students may feel overwhelmed with learning.

For instance, one student suggested, "The online Calculus II class is by far the most difficult course I have ever taken, and it is my understanding that there is only one professor who teaches that course online. I think it would be helpful to online students if there were more professor options. Not everyone will learn Calculus II the way that the professor teaches." Another student mentioned, "There are two classes specifically that I have found extremely challenging: the computer science class with lab and the Calculus II class. They are extremely difficult, and the failure rate seems far too high for the number of students putting forth legitimate effort."

The results of the data analysis indicated that the students who were more satisfied with the level of difficulty of the courses were more likely to recommend the program to others. It was an important finding that setting the proper difficulty level for course design and development was crucial and imperative. Therefore, we recommend that the courses' depth be tailored to the average level of students enrolled in the online degree program.

Future Career Development

Future career development refers to the students' expectations regarding future career opportunities, such as job change and promotion opportunities. We proposed three career factors: job placement, job searching assistance, and future career development. The results suggested that students might value future career development rather than the other two factors. It was probably because most students in online programs were non-traditional students. One of the primary reasons students choose to study in an online program is that they may have more flexibility in making time arrangements to accommodate their daily job responsibilities.

Most students enrolled in our program were working professionals who not only expected to receive a higher-level degree but also expanded their knowledge base in their professional field and sought opportunities for their future career development. In this sense, assistance in job searching or job placement expectation might be a minor consideration for these non-traditional students. In addition, traditional higher education might focus more on teaching fundamental theories in various domains rather than emphasizing the importance of practices and applications. We suggest online degree programs focus more on practical knowledge when designing and developing the curriculum. It may better align the course delivery with the students' expectations for future career development.

Implication Three: Propose Three Dimensions of Student Satisfaction and Assess the Differences Among Them

Another potential contribution of this study is to propose three dimensions of student satisfaction and assess the differences among them. Evaluating student satisfaction from different perspectives and identifying the causes that may lead to potential inconsistencies is crucial. In this study, we proposed three dimensions of student satisfaction in our research framework: overall satisfaction, perceived learning, and program recommendation. In addition, the differences among these three dimensions were assessed, and the key factor affecting the differences was identified.

Self-Regulated Learning

The results from the data analysis suggested that the average rating of perceived learning was significantly lower than that of overall satisfaction or program recommendation. After further investigations, we found that the significant differences were likely attributed to the variations in students' self-regulated learning behaviours. Specifically, self-regulated learning was negatively associated with the difference between overall satisfaction and perceived learning ($\beta = -.427$, $p = .020$) or between program recommendation and perceived learning ($\beta = -.375$, $p = .045$).

In other words, the results suggested that students with lower self-regulated learning behaviours were more likely to provide inconsistent ratings among three outcome variables. Self-regulated learning is a key determinant in online education because online learning usually requires more self-autonomy, self-motivation, and self-regulation (Zhou & Zhang, 2023). In a traditional classroom, students may receive more pressure from the surrounding environment, while in online learning, students usually have more freedom and flexibility in making study arrangements. Therefore, promoting self-regulated learning behaviors in online students through proper training would be beneficial. The online degree program may provide training workshops to the students enrolled before they start to take the online courses.

Implication Four: Implications to School Administrators and Accreditation Bodies

One of the critical implications of this study is to provide valuable references to school administrators or accreditation bodies. During the past decade, universities have continuously devoted their efforts to developing online programs, and online learning has become a significant portion of higher education worldwide (Seaman et al., 2018). Statistics show that distance education enrollments in universities across the United States have consistently increased over the past twenty years (Muljana & Luo, 2019). According to the National Center for Education Statistics, the percentage of undergraduate students taking at least one online course increased from 15.6% to 74%, and taking distance education courses exclusively increased from 4.9% to 45.5% from the year 2003 to the year 2020 (*Digest of education statistics*, 2021). To adapt to this trend, school administrators may use the proposed framework to evaluate their online degree programs. In addition, revisions can be made to tailor the evaluation framework to their needs. The ultimate goal is to make continuous improvements in the delivery of online degree programs based on the data collected from the students.

On the other hand, this study may also provide meaningful implications for accreditation bodies. Accreditation bodies accredit programs by setting standards worldwide to assure that a college or university program meets the quality standards of the profession for which that program prepares graduates. The results of this study may offer students' perspectives in evaluating the online degree programs and thus provide references for standard setting carried out by accreditation bodies such as the Association to Advance Collegiate Schools of Business (AACSB) and Accreditation Board for Engineering and Technology (ABET).

Limitations and Future Research

This study proposed a framework for evaluating online degree programs. Data was collected from an existing online program in higher education to assess the underlying relationships and identify the key factors. In addition, several implications were suggested based on the data analysis. Apart from the potential contributions, a few limitations associated with this study are worth mentioning. First, the sample was collected from a 4-year public university in the southern region of the United States. The key factors identified and the conclusions addressed may not apply to other online degree programs with different circumstances. Different key factors may be specified in a diverse sample. The underlying goal of this study was to provide a framework and an example for evaluating the online degree program. Secondly, the framework proposed was an initiative in the field, which consists of six big categories of factors and three dimensions regarding student satisfaction. The overall framework needs to be improved, and more elements may be added to both sides to expand on this proposed initiative.

Additionally, this study was developed to evaluate the online degree program only from the students' perspectives. Higher education is considered a part of the service industry, and students are the customers whose opinions are the key to success (Canning, 2017). However, looking at the issue from only one angle may be limited, while seeing the problem from different perspectives (e.g., faculty or administrators) may broaden the horizons. Finally, most of the students who completed the survey were undergraduates, while the sample collected from the graduate students was tiny. As a result, we could not test the framework in evaluating the online degree program at the graduate level.

Future research may focus on various aspects to expand on this study. First, the proposed framework may be implemented in various online degree programs (e.g., business, education, or health programs) with different circumstances. Based on the various samples collected, we may better understand the key factors affecting online degree program satisfaction in other conditions. Secondly, key factors identified in this study may be used as control variables to investigate the effects of these factors in future intervention studies. Thirdly, evaluating online degree programs from different perspectives is essential. Research frameworks may be developed from faculty or school administrators' perspectives in assessing online degree programs.

Additionally, samples targeting diverse populations may be collected, and comparisons can be made across samples. For instance, future research may compare the effects of students from different cultures or educational backgrounds. Finally, more factors may be added to the six big categories, and additional dimensions under student satisfaction can be identified. It is expected to modify and expand the existing conceptual framework to improve the evaluation of online degree programs from students' perspective.

Ethical Approval

This study was approved by the Institutional Review Boards (IRB) at the University of Southern Mississippi, Mississippi, United States, and the protocol number is 22-208.

Disclosure Statement

The author reported no potential conflict of interest.

References

Al Hassani, A. A., & Wilkins, S. (2022). Student retention in higher education: the influences of organizational identification and institution reputation on student satisfaction and behaviors. *International Journal of Educational Management*, *36*(6), 1046-1064. https://doi.org/10.1108/ijem-03-2022-0123

Alqurashi, E. (2016). Self-efficacy in online learning environments: A literature review. *Contemporary Issues in Education Research (CIER)*, *9*(1), 45-52. https://doi.org/10.19030/cier.v9i1.9549

Alqurashi, E. (2019). Predicting student satisfaction and perceived learning within online learning environments. *Distance Education*, *40*(1), 133-148. https://doi.org/10.1080/01587919.2018.1553562

Astivia, O. L. O., & Zumbo, B. D. (2019). Heteroskedasticity in Multiple Regression Analysis: What it is, How to Detect it and How to Solve it with Applications in R and SPSS. *Practical Assessment, Research, and Evaluation*, *24*(1), 1. https://doi.org/10.7275/q5xr-fr95

Avcı, Ü., & Ergün, E. (2019). Online students’ LMS activities and their effect on engagement, information literacy and academic performance. *Interactive Learning Environments*, 1-14. https://doi.org/10.1080/10494820.2019.1636088

Barnard, L., Lan, W. Y., To, Y. M., Paton, V. O., & Lai, S. L. (2009). Measuring self-regulation in online and blended learning environments. *Internet and Higher Education*, *12*(1), 1-6. https://doi.org/10.1016/j.iheduc.2008.10.005

Blau, G., Williams, W., Jarrell, S., & Nash, D. (2019). Exploring common correlates of business undergraduate satisfaction with their degree program versus expected employment. *Journal of Education for Business*, *94*(1), 31-39. https://doi.org/10.1080/08832323.2018.1502144

Bolliger, D. U. (2004). Key factors for determining student satisfaction in online courses. *International Journal on E-learning*, *3*(1), 61-67. https://www.learntechlib.org/primary/p/2226/

Canning, J. (2017). Conceptualising student voice in UK higher education: four theoretical lenses. *Teaching in Higher Education*, *22*(5), 519-531. https://doi.org/10.1080/13562517.2016.1273207

Chaka, C. (2020). Higher education institutions and the use of online instruction and online tools and resources during the COVID-19 outbreak-An online review of selected US and SA's universities. https://doi.org/10.21203/rs.3.rs-61482/v1

Cole, A., Anderson, C., Bunton, T., Cherney, M., Fisher, V. C., Featherston, M., Motel, L., Nicolini, K., Peck, B., & Allen, M. (2017). Student predisposition to instructor feedback and perceptions of teaching presence predict motivation toward online courses. *Online Learning Journal*, *21*(4). https://doi.org/10.24059/olj.v21i4.966

Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., Magni, P., & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, *3*(1), 1-20. https://doi.org/10.37074/jalt.2020.3.1.7

Darlington, R. B., & Hayes, A. F. (2016). *Regression analysis and linear models: Concepts, applications, and implementation*. Guilford Publications.

Davis, F. D., Marangunic, A., & Granic, A. (2020). *Technology acceptance model: 30 Years of Tam*. Springer.

Denis, D. J. (2018). *SPSS data analysis for univariate, bivariate, and multivariate statistics*. John Wiley & Sons.

DeShields, O. W., Kara, A., & Kaynak, E. (2005). Determinants of business student satisfaction and retention in higher education: applying Herzberg's two-factor theory. *International Journal of Educational Management*, *19*(2), 128-139. https://doi.org/10.1108/09513540510582426

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, *49*(1), 5-22. https://doi.org/http://dx.doi.org/10.1177/0047239520934018

National Center for Education Statistics. (2021). *Digest of education statistics*. https://nces.ed.gov/programs/digest/d21/tables/dt21_311.15.asp

Ellis, R. K. (2009). *Field guide to learning management systems*. ASTD Learning Circuits. https://home.csulb.edu/~arezaei/ETEC551/web/LMS_fieldguide_20091.pdf

Farahmandian, S., Minavand, H., & Afshardost, M. (2013). Perceived service quality and student satisfaction in higher education. *Journal of Business and Management*, *12*(4), 65-74. https://doi.org/10.9790/487X-1246574

Fidell, L. S., & Tabachnick, B., G. (2018). *Using Multivariate Statistics* (7th ed.). Pearson.

Freeman, L., & Urbaczewski, A. (2019). Critical success factors for online education: longitudinal results on program satisfaction. *Communications of the Association for Information Systems*, *44*(1), 630-645. https://doi.org/10.17705/1cais.04430

Gares, S. L., Kariuki, J. K., & Rempel, B. P. (2020). Community matters: Student instructor relationships foster student motivation and engagement in an emergency remote teaching environment. *Journal of Chemical Education*, *97*(9), 3332-3335. https://doi.org/10.1021/acs.jchemed.0c00635

Gray, J. A., & DiLoreto, M. (2016). The effects of student engagement, student satisfaction, and perceived learning in online learning environments. *International Journal of Educational Leadership Preparation*, *11*(1), n1. https://files.eric.ed.gov/fulltext/EJ1103654.pdf

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2021). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage.

Hanssen, T.-E. S., & Solvoll, G. (2015). The importance of university facilities for student satisfaction at a Norwegian University. *Facilities*, *33*(13/14), 744-759. https://doi.org/10.1108/F-11-2014-0081

Khosravi, A. A., Poushaneh, K., Roozegar, A., & Sohrabifard, N. (2013). Determination of factors affecting student satisfaction of Islamic Azad University. *Procedia-Social and Behavioral Sciences*, *84*, 579-583. https://doi.org/10.1016/j.sbspro.2013.06.607

Kline, R. B. (2015). *Principles and practice of structural equation modeling*. Guilford Publications.

Kucuk, S., & Richardson, J. C. (2019). A structural equation model of predictors of online learners' engagement and satisfaction. *Online Learning*, *23*(2), 196-216. https://doi.org/10.24059/olj.v23i2.1455

Kuo, Y. C., Walker, A. E., Schroder, K. E. E., & Belland, B. R. (2014). Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *Internet and Higher Education*, *20*, 35-50. https://doi.org/10.1016/j.iheduc.2013.10.001

Letcher, D. W., & Neves, J. S. (2010). Determinants of undergraduate business student satisfaction. *Research in Higher Education Journal*, *6*, 1. https://api.semanticscholar.org/CorpusID:2373494

Li, K. (2019). MOOC learners' demographics, self-regulated learning strategy, perceived learning and satisfaction: A structural equation modeling approach. *Computers & Education*, *132*, 16-30. https://doi.org/10.1016/j.compedu.2019.01.003

Malik, M. W. (2010). Factor effecting learner’s satisfaction towards e-Learning: A conceptual framework. *OIDA International Journal of Sustainable Development*, *2*(3), 77-82. https://ssrn.com/abstract=1711989

Moller, L., & Huett, J. B. (2012). *The next generation of distance education: Unconstrained learning*. Springer Science & Business Media.

Muljana, P. S., & Luo, T. (2019). Factors contributing to student retention in online learning and recommended strategies for improvement: A systematic literature review. *Journal of Information Technology Education-Research*, *18*, 19-57. https://doi.org/10.28945/4182

Parahoo, S. K., Santally, M. I., Rajabalee, Y., & Harvey, H. L. (2016). Designing a predictive model of student satisfaction in online learning. *Journal of Marketing for Higher Education*, *26*(1), 1-19. https://doi.org/10.1080/08841241.2015.1083511

Pituch, K. A., & Stevens, J. P. (2015). *Applied multivariate statistics for the social sciences: Analyses with SAS and IBM's SPSS*. Routledge.

Roddy, C., Amiet, D. L., Chung, J., Holt, C., Shaw, L., McKenzie, S., Garivaldis, F., Lodge, J. M., & Mundy, M. E. (2017). Applying best practice online learning, teaching, and support to intensive online environments: An integrative review. Frontiers in Education. http://dx.doi.org/10.3389/feduc.2017.00059

Seaman, J. E., Allen, I. E., & Seaman, J. (2018). *Grade increase: Tracking distance education in the United States*. Babson Survey Research Group. https://files.eric.ed.gov/fulltext/ED580852.pdf

Sears, C. R., Boyce, M. A., Boon, S. D., Goghari, V. M., Irwin, K., & Boyes, M. (2017). Predictors of student satisfaction in a large psychology undergraduate program. *Canadian Psychology-Psychologie Canadienne*, *58*(2), 148-160. https://doi.org/10.1037/cap0000082

Sebastianelli, R., Swift, C., & Tamimi, N. (2015). Factors affecting perceived learning, satisfaction, and quality in the online MBA: A structural equation modeling approach. *Journal of Education for Business*, *90*(6), 296-305. https://doi.org/10.1080/08832323.2015.1038979

Sigala, M., Christou, E., Petruzzellis, L., D'Uggento, A. M., & Romanazzi, S. (2006). Student satisfaction and quality of service in Italian universities. *Managing Service Quality: An International Journal*. https://doi.org/10.1108/09604520610675694

Suhre, C. J. M., Jansen, E. P. W. A., & Harskamp, E. G. (2007). Impact of degree program satisfaction on the persistence of college students. *Higher Education*, *54*(2), 207-226. https://doi.org/10.1007/s10734-005-2376-5

Tseng, H. W., Yi, X., & Yeh, H. T. (2019). Learning-related soft skills among online business students in higher education: Grade level and managerial role differences in self-regulation, motivation, and social skill. *Computers in Human Behavior*, *95*, 179-186. https://doi.org/10.1016/j.chb.2018.11.035

Volery, T., & Lord, D. (2000). Critical success factors in online education. *International Journal of Educational Management*, *14*(5), 216-223. https://doi.org/10.1108/09513540010344731

Weerasinghe, I. S., & Fernando, R. (2017). Student' satisfaction in higher education. *American Journal of Educational Research*, *5*(5), 533-539. https://ssrn.com/abstract=2976013

Wei, H.-C., & Chou, C. (2020). Online learning performance and satisfaction: Do perceptions and readiness matter? *Distance Education*, *41*(1), 48-69. https://doi.org/10.1080/01587919.2020.1724768

Wong, J., Baars, M., Davis, D., Van der Zee, T., Houben, G. J., & Paas, F. (2019). Supporting self-regulated learning in online learning environments and moocs: A systematic review. *International Journal of Human-Computer Interaction*, *35*(4-5), 356-373. https://doi.org/10.1080/10447318.2018.1543084

Zhou, Z., & Wang, S. (2023). Strategies for Online Student Engagement. Society for Information Technology & Teacher Education International Conference. https://www.learntechlib.org/primary/p/221884/

Zhou, Z. K., & Zhang, Y. Y. (2023). Intrinsic and extrinsic motivation in distance education: a self-determination perspective. *American Journal of Distance Education*, 1-14. https://doi.org/10.1080/08923647.2023.2177032

Appendix

Survey Items

Factors	Variables	Items on survey
Program Factors	Academic advising	Please rate your satisfaction with the academic advising of the program.
	Financial aid	Please rate your satisfaction with the financial aid of the program.
	Tuition costs	Please rate your satisfaction with the tuition costs of the program.
	Program reputation	Please rate your satisfaction with the reputation of the program.
Course Factors	Course quality	Please rate your satisfaction with the overall quality of the courses offered.
	Course flexibility	Please rate your satisfaction with the time flexibility of the courses offered.
	Course variability	Please rate your satisfaction with the breadth of the courses offered (a variety of courses).
	Course availability	Please rate your satisfaction with the depth of the courses offered (the level of difficulty).
Instructor Factors	Instructor knowledge	Instructors are knowledgeable about their respective disciplines.
		Instructors have been available for questions and assistance.

	Instructor availability	Instructors have responded to my emails in a timely manner.
	Instructor attitude	Instructors have been friendly toward the students. Students felt welcome to seek advice or help.
Technical Factors	LMS ease of use	Overall, the learning management system (Canvas) is easy to use.
	LMS usefulness	Overall, the learning management system (Canvas) is efficient and useful in delivering online classes.
	Technical assistance	It is convenient to get technical assistance when you have issues with the learning management system (Canvas).
Student Factors	Self-regulated learning	I am a self-motivated and self-regulated learner of online classes.
	Self-efficacy	I can overcome most of the challenges and obstacles in online classes.
Career Factors	Job placement expectation	Please indicate whether you feel optimistic or pessimistic about the future job.
	Assistance in job searching	Please rate your satisfaction with the assistance in job searching during your study in the program placement opportunities after you finish the program.
	Future career development	Please indicate whether you feel optimistic or pessimistic about future career development opportunities (such as job changes or promotion opportunities) after you finish the program.
Outcome Variables	Overall satisfaction	Please rate your overall satisfaction with your experience in the program.
	Program recommendation	How likely are you to recommend the Program to others?
	Perceived learning	Please indicate your perceived learning from the degree program.
QSLQ	24-item	Barnard et al. (2009)
OLSE	8-item	Alqurashi (2019)

Students' Expectations and Experiences About Engagement Strategies in Online Courses: A Mixed Methods Study

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Abstract
Engagement strategies play a crucial role in ensuring engaged and high-quality online learning experiences. In this mixed methods study, we examined online students' expectations and explored their experiences regarding online strategies of peer, instructor, self-directed, and multimodal engagement, using a survey and qualitative interviews. Our quantitative results indicated that instructor engagement strategies were perceived as the most important strategies to be employed in online courses, while peer engagement strategies were viewed as the least important. Qualitative findings suggested that although all four dimensions were perceived to be important and necessary, actual experiences of each contextually varied. In support of prior research, our study demonstrates the importance of the instructor in online courses and offers theoretical implications for online student engagement and practical implications for instructors, instructional designers, and other stakeholders in online education.

Keywords: Engagement strategies, higher education, online courses, mixed methods research

Turk, M. Turk, S.T., Muftuoglu, A.C., Karakaya, O., Karakaya, K. (2024**).** Students' expectations and experiences about engagement strategies in online courses: A mixed methods study. *Online Learning, Volume 28*(2), (239-26). DOI: 10.24059/olj.v28i2.3937

Online learning has become an integral component of higher education over the years with the growing number of college students taking at least one online course (Hsu et al., 2019; Martin et al., 2020; Seaman et al., 2018). The popularity of online learning is mainly due to convenience, accessibility, and flexibility of education (Bolliger & Martin, 2018; Picciano, 2019). Despite the steady growth of online learning within the context of higher education, lack of student engagement remains an important challenge and concern in online education (Bolliger & Martin, 2018; Martin et al., 2021). Student engagement is a multifaceted construct that has been defined and studied by researchers within traditional and online learning environments (Dixson, 2015; Fredricks et al., 2004). Student engagement is particularly important to consider in online education because online students are physically separated from their peers and course instructors; therefore, such students have fewer opportunities to interact and engage with them (Martin & Bolliger, 2018; Martin et al., 2020). It is crucial for course instructors and instructional designers to design and implement a wide range of opportunities for online students to engage with their peers, instructors, and their own learning process (Martin & Bolliger, 2018).

To design and implement interactive learning opportunities that foster and maintain student engagement and to help create better online learning experiences and outcomes, there is a need to learn about what is found to be engaging (or not) by online students. Acquiring empirical knowledge about online students' expectations and experiences regarding engagement strategies may help online instructors and instructional designers better address—if not eliminate—lack of student engagement in online learning environments. Although the corpus of literature focuses on student engagement in different contexts, including students' self-reports of their online engagement (e.g., Kucuk & Richardson, 2019; Park & Yun, 2019; Sun & Rueda, 2012), few studies have examined what strategies and activities are perceived to be important and necessary by online students in regard to their own engagement in online courses (e.g., Bolliger & Martin, 2018; Dixson, 2010; Martin & Bolliger, 2018). The problem is that successful online learning experiences are hard to achieve without active student engagement in the learning process. Therefore, the purpose of this mixed methods research study was to examine students' expectations and explore their experiences regarding engagement strategies used in online courses of higher education. Three specific research questions were addressed in this study:

1) What are the expectations of online students regarding engagement strategies in their online courses?
2) How do online students describe their engagement experiences in the online courses?
3) How do online students' engagement experiences in their online courses help explain quantitative differences in their expectations of online engagement strategies?

Student Engagement in Online Learning Environments

Online student engagement is a complex construct that has been conceptualized and studied in many ways, using different terms and lenses (e.g., presence, collaboration) (Martin et al., 2020). In this study, we conceptualized online student engagement through the lens of interaction in online learning environments. We used the definition of online student engagement as "students' involvement in the online environment connected with the instructor, with peers, with oneself in a self-directed manner and with the multimodal online instructional content to achieve the online course learning outcomes" (Bolliger & Martin, 2021, p. 412).

Following Bolliger and Martin's (2021) framework of online student engagement, we adopted and used Moore's (1989) three types of interaction to conceptualize and measure online student engagement strategies: (a) learner-learner interactions, (b) learner-instructor interactions, and (c) learner-content interactions. According to researchers (Bolliger & Martin, 2018; Martin & Bolliger, 2018), learner-learner interaction refers to online students' interactions with other online learners in the same learning environment through sharing knowledge and collaborative activities. Learner-instructor interaction refers to the course instructor's interactions with their students through different means and channels of communication in the online learning environment. Learner-content interaction refers to online students' intellectual interactions with the instructional content of the course including tasks, activities, and assignments.

Bolliger and Martin's (2021) four-factor model of online student engagement strategies is comprised of peer engagement, instructor engagement, multimodal engagement, and self-directed engagement. In this model, peer engagement refers to online students' interactions and engagement with their peers in the online learning environment and corresponds to Moore's (1989) learner-learner interaction. Instructor engagement refers to online course instructors' interactions and engagement with their students in the online course and corresponds to Moore's (1989) learner-instructor interaction. Self-directed engagement refers to online students' engagement with different learning resources and opportunities to interact with the instructional content and corresponds to Moore's (1989) learner-content interaction. Multimodal engagement refers to both online students' and course instructors' engagement with multimodal content and their use of various forms of technology tools and it also corresponds to Moore's (1989) learner-content interaction. This four-factor theoretical model of student engagement in online learning environments proposed and validated by Bolliger and Martin (2021) informed our examination and exploration of online students' expectations and experiences regarding engagement strategies used in online courses of higher education.

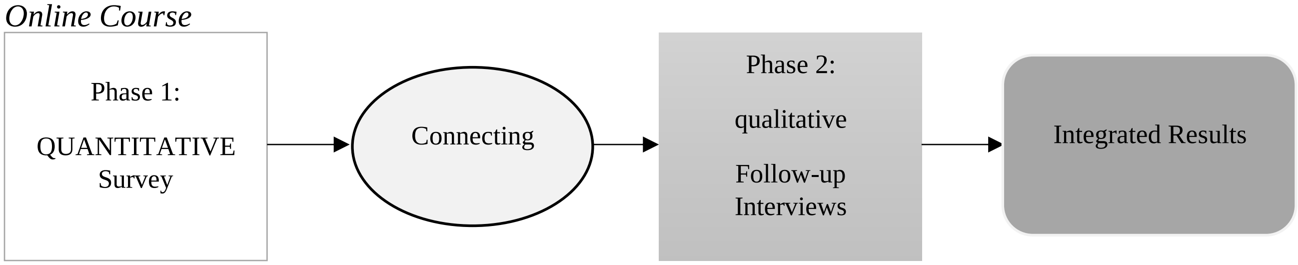
Student engagement has been traditionally conceptualized by educational psychology scholars focusing on several dimensions, mainly behavioral, emotional, and cognitive engagement in traditional in-person learning environments (e.g., Appleton et al., 2006; Fredricks, 2011; Sinatra et al., 2015) but online learning environments have unique affordances and environmental features, such as online presences (Garrison et al., 1999; Shea et al, 2022), interactions (Moore, 1989), and collaboration (Redmond et al., 2018) that significantly influence these different dimensions of the learner engagement itself. The interactions of these engagement dimensions with those unique online environment affordances should also be considered for a complete understanding of the learner engagement in online learning environments (Martin & Borup, 2022). Bolliger and Martin's (2021) four-factor model of online student engagement that has guided this study encompasses those "specific conditions in the online environment in which the engagement is taking place" (Martin & Borup, 2022, p.2).

Methods

The purpose of this study called for the use of mixed methods research approach, which is a methodology that involves intentional collection, analysis, and integration of qualitative and quantitative data (Creswell & Plano Clark, 2018; Tashakkori et al., 2021). In an explanatory sequential mixed methods design, the quantitative phase is implemented first and followed by a qualitative phase to explain the quantitative results (Creswell & Plano Clark, 2018). In this study, we put an emphasis on the quantitative phase (QUAN → qual) (Morse, 2003) that informed purposeful participant selection and the development of data collection for the qualitative phase. The rationales of using this mixed methods research design were *illustration* and *context*. Illustration refers to enriching "dry" quantitative findings, and context refers to gaining a contextual understanding of a phenomenon that is uncovered through a survey (Bryman, 2008, p. 92). Consistent with the logic of the study design (Figure 1) and rationales, this article first presents the methods and results of the quantitative phase. Then, it describes the procedures for connecting quantitative and qualitative phases with participant selection and the development of the interview protocol followed by the methods and results of the qualitative phase. It concludes with integration of both phases in the final discussion.

Figure 1

Procedural Diagram of Students' Expectations and Experiences About Engagement Strategies in Online Course



Quantitative Phase: Methods

The aim of the first, quantitative phase was to examine the expectations of online students regarding engagement strategies in their online courses. This section describes methods of the quantitative phase of the study.

<u>Participants</u>

Convenience and purposive sampling were used to recruit participants who were enrolled in at least one online course in Spring 2021. The survey was administered through the Qualtrics® platform in three different online courses offered by the Learning Sciences and Educational Technology departments within two R1 institutions. One of the institutions was in the Southwest and the other institution was in the Midwest in the United States.

<u>Measures</u>

Our guiding framework drove the selection of the measure in this study. We adapted and administered an online survey developed by Bolliger and Martin (2021) that focuses on four dimensions: (a) peer engagement, (b) instructor engagement, (c) self-directed engagement, and (d) multimodal engagement. Peer engagement and instructor engagement dimensions involve seven items for each, and self-directed engagement and multimodal engagement involve six items for each dimension with a total of 26 items in the online survey. Participants responded to the survey using a 5-point Likert-type scale of "1=Strongly disagree" to "5=Strongly agree" to indicate their level of agreement or disagreement with the importance of an online engagement strategy employed in an online course. A higher score on an item indicates the higher degree of an online student's expectation regarding an online engagement strategy.

Permission to modify the original survey items to fit the purpose of the current study was granted by the developers of the original survey. We slightly modified each of the items in wording to fit the specific purpose of our study. We split the original self-directed engagement item S-4 "*Students research an approved topic and present their findings in a delivery method of their choice (e.g. discussions forum, chat, web conference, multimedia presentation)*" into two separate items. We did not include the multimodal engagement item M-7 "*Students complete an integrated profile on the learning management system that is accessible in all courses*" because it was not applicable in the context of offered online courses in this study. The modified items were first submitted to expert review since expert opinion is highly recommended to be used at least as a minimum analysis of new or modified items for face and content validity (Hardesty & Bearden, 2004; Morgado, 2017). In addition, we included two open-ended questions in the modified survey to capture students' perspectives about the most and least important factors that played important roles in their engagement as well as other strategies that could be beneficial to their engagement in an online course. The developers of the original scale served as our expert judges, reviewed our modified items, and offered feedback. We made revisions regarding item content, item clarity, and wording accordingly and finalized the survey (Appendix A). The survey with 26 Likert-type items had a good internal consistency reliability, $\alpha = 0.89$, and its subscales: peer engagement ($\alpha = 0.78$), instructor engagement ($\alpha = 0.77$), self-directed engagement ($\alpha = 0.75$), and multimodal engagement ($\alpha = 0.77$). Table 1 presents the original reliability statistics with the reliability statistics obtained in this study.

Table 1

Reliability Statistics of the Engagement Survey

Dimension	Original α	α in This Study	*n*
Peer Engagement	0.75	0.78	52
Instructor Engagement	0.66	0.77	52
Self-directed Engagement	0.65	0.75	52
Multimodal Engagement	0.75	0.77	51
Overall Scale	0.84	0.89	51

Demographic information collected included age, sex, race/ethnicity, major, first-generation student status, year in college (i.e., freshman, junior, senior, sophomore), and institution as the survey data were collected anonymously. Participants were asked whether they would be willing to be interviewed, and if so, to provide an email address.

<u>Procedures</u>

Prior to the data collection, the approvals of the institutional review board were obtained for the first three authors' affiliate institutions. After providing informed consent, participants answered the online survey, typically completed in 15-20 minutes. Quantitative data were analyzed using descriptive statistics (i.e., mean, standard deviation, frequencies). The first and third authors were involved in data collection and analysis with participant identifiers available. The second author was involved in the data analysis process after the first author de-identified the data. The fourth and fifth authors were not involved in the data collection and analysis.

Quantitative Phase: Results

A total of 52 students took the survey. Participants ranged in age from 18 to 26 (M=20.87, SD=1.21). Most of the participants were female (n=42, 80.8%), White/Caucasian (n=42, 80.8%), and not first-generation students (n=40, 76.9%). More than one half of the participants were junior (n=32, 61.5%) majoring in elementary education (n=29, 55.8%). Table 2 provides information about participant characteristics.

Table 2

Demographic Information About the Study Participants (N=52)

	n	%
Sex		
Female	42	80.8
Male	9	17.3
Prefer not to answer	1	1.9
Race/Ethnicity		
White/Caucasian	42	80.8
American Indian or Alaskan Native	4	7.7
Asian	3	5.8
Hispanic/Latino	2	3.8
African-American/Black	1	1.9
Year in College		
Freshman	2	3.8
Sophomore	3	5.8
Junior	32	61.5
Senior	15	28.8
First Generation		
Yes	12	23.1
No	40	76.9
Major		
Elementary Education	29	55.8
Music Education	10	19.2
Early Childhood Education	2	3.8
Social Studies Education	2	3.8
Vocal Music Education	2	3.8
English Education	1	1.9
Instrumental Music Education	1	1.9
Language Arts Education	1	1.9
Mathematics Education	1	1.9
Mathematics	1	1.9
Professional Writing	1	1.9
Special Education	1	1.9

To address the first, quantitative research question, we used descriptive statistics. Table 3 provides the number of respondents, mean, and standard deviation for each item in four dimensions. As seen in Table 3, overall the participants perceived online engagement strategies to be important and necessary to be utilized in an online learning environment. All four subscales of engagement strategies had a mean score above 3 (neither agree nor disagree) and two subscales had a mean score above 4 (agree). In addition, eighteen items on the scale had a mean score above 4 and the remaining eight items had a mean score above 3. Of the four dimensions of online engagement strategies, peer engagement had the lowest overall mean (*M*=3.70) and instructor engagement had the highest overall mean (*M*=4.47). Participants perceived multimodal engagement strategies (*M*=3.90) as slightly more important than peer engagement strategies (*M*=3.70) and viewed instructor engagement strategies as slightly more important than self-directed engagement strategies (*M*=4.34). The instructor engagement item "The instructor should send or post regular email reminders or announcements" had the highest mean score (*M*=4.69), while the peer engagement item "Students should be asked to rate each other's performance on collaborative projects" had the lowest mean score (*M*=3.06) on the entire scale of 26 items.

Table 3

Online Students' Expectations About Engagement Strategies by Total Number of Responses, Mean, and Standard Deviation

Engagement Strategies	*n*	Mean	SD
Dimension 1: Peer Engagement		**3.70**	**0.63**
Students should introduce themselves to peers using icebreaker activities (e.g., self-introduction discussions, icebreaker games).	52	4.00	0.82
Students should work collaboratively using online communication tools to complete assignments.	52	3.77	0.94
Students should interact with peers through real-time or asynchronous student presentations.	52	3.73	0.97
Students should peer-review classmates' work.	52	3.35	1.06
Students should have opportunities to reflect on the course content together with peers.	52	4.19	0.60
Students should facilitate online discussions together with their peers.	52	3.83	0.94
Students should be asked to rate each other's performance on collaborative projects.	52	3.06	1.24
Dimension 2: Instructor Engagement		**4.47**	**0.43**
The instructor should send or post regular email reminders or announcements.	52	4.69	0.51
The instructor should create a common space for students to contact him/her with questions about the course.	52	4.60	0.57
The instructor should provide an online course orientation for students.	52	4.19	0.74
The instructor should post grading rubrics for all assignments.	52	4.60	0.63
The instructor should post a due date checklist at the end of each unit or module.	52	4.58	0.70
The instructor should structure online discussions with questions and/or prompts for deeper student understanding of the content.	52	4.25	0.68
The instructor should refer to students by name in online discussions.	52	4.37	0.77
Dimension 3: Self-directed Engagement		**4.34**	**0.41**

I should have the opportunity to search for and select applicable materials based on my interests.	52	4.31	0.64
I should have the opportunity to use optional online resources to explore topics in more depth.	52	4.33	0.51
I should have choices in the selection of readings (articles, book chapters) that drive discussion group formation.	52	4.31	0.67
I should have the opportunity to research a topic of my interest after instructor approval.	52	4.48	0.58
I should have the opportunity to present my research findings using a delivery method of my choice (e.g., multimedia, web conference, asynchronous discussion).	52	4.21	0.70
I should have the opportunity to work on realistic scenarios or cases to apply the course content (e.g., case studies, client projects).	52	4.40	0.60
Dimension 4: Multimodal Engagement		**3.90**	**0.63**
Students should experience live/synchronous web conferences for class events and/or guest talks.	52	3.92	0.76
Instructors should use various features of synchronous communication to interact with students (e.g., polls, whiteboard, chat).	52	4.25	0.71
Instructors should create short videos to enhance their instructor presence in the course.	51	4.14	0.85
Instructors should use various tools/technologies to provide feedback (e.g., text, audio, video).	52	4.12	0.90
Students should post audio and/or video files in discussion threads instead of text only.	52	3.15	1.27
Students should interact with course content in different formats (e.g., text, video, audio, simulations).	52	3.83	0.92

Notes: In the calculation of mean and standard deviation (SD), assigned values: Strongly agree=5, Agree=4, Neither agree nor disagree=3, Disagree=2, Strongly disagree=1.

Among the peer engagement strategies, the participants perceived having opportunities to reflect on the course content together with their peers as the most important strategy (*M*=4.19). Among the instructor engagement strategies, instructor providing an online course orientation for students was found to be the least (*M*=4.19) scored item. Among the self-directed engagement strategies, participants viewed having the opportunity to research a topic of their interest as the most necessary strategy (*M*=4.48) and having the opportunity to present their research findings using a delivery method of their choice as relatively the least important strategy (*M*=4.21). Among the multimodal engagement strategies, online students perceived instructors' using various features of synchronous communication as the most important strategy (*M*=4.25), although they viewed students' posting audio and/or video files in discussion threads instead of text only as the least necessary engagement strategy (*M*=3.15).

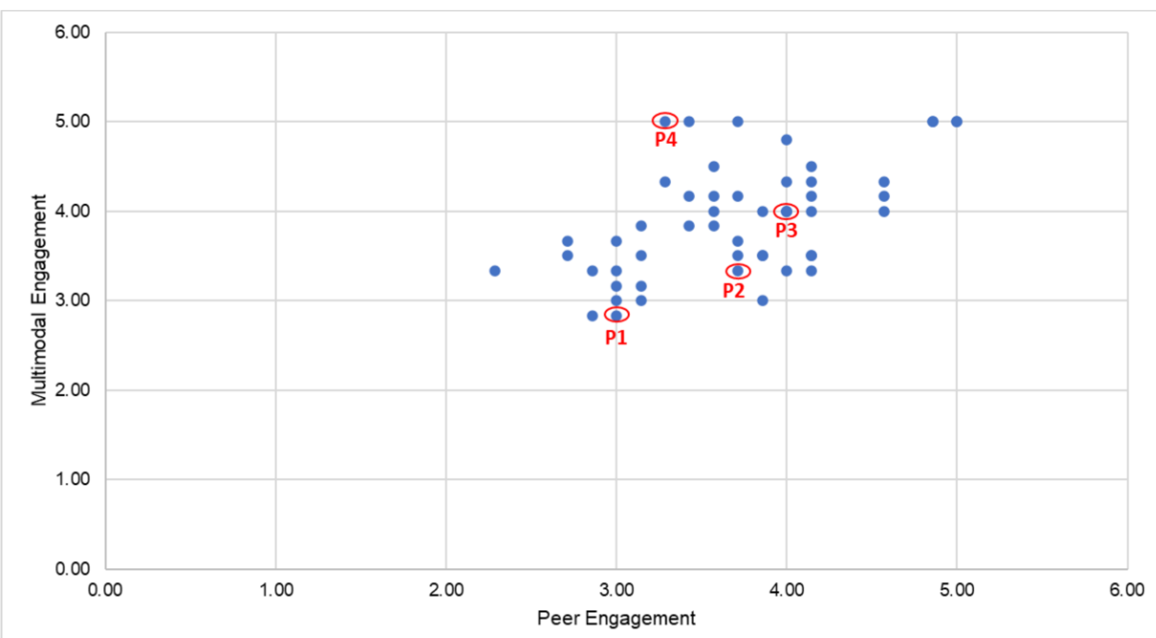
Connection from Quantitative Phase to Qualitative Phase

Quantitative results indicated that there was a variation among the engagement strategies in the survey and some dimensions had higher overall mean scores than others (i.e., instructor engagement and self-directed engagement had overall higher mean scores compared to peer engagement and multimodal engagement). Therefore, the qualitative phase became important in explaining variations in students' engagement experiences in the online courses. After the quantitative data were analyzed, the results were connected with the development and refinement of the qualitative phase, which is called the point of interface in mixed methods research (Creswell & Plano Clark, 2018). The conceptual framework and quantitative results were used to design the qualitative phase, to guide the selection of participants for the qualitative phase, and to determine interview questions.

Based on the overall scores of each participant from each dimension of the survey, we employed maximum variation sampling technique, which is used to select diverse variations to identify patterns (Teddlie & Yu, 2007), to contextually explain different student experiences regarding engagement strategies used in an online course. Accordingly, we determined online students who scored low, medium, or high within one or more dimensions in the survey results. Due to feasibility purposes, we first screened participants who shared their willingness to participate in an interview and provided their email address. Then, we reached out to 12 potential interview participants based on maximum variation in their survey results and invited them for an interview. Four agreed to be interviewed. The interview questions were designed to align with the online student engagement framework by focusing on the lens of interaction in online learning environments (Appendix B). Identified participants who participated in an interview are marked with red circle in Figure 2 for multimodal engagement and peer engagement dimensions to provide an example of participant identification for the interviews.

Figure 2

Identified Interviewees (N=4) Based on the Quantitative Findings



Note: "P" represents participant.

Qualitative Phase: Methods

The aim of the second, qualitative phase was to provide contextual explanation of online students' experiences and expectations about engagement strategies. Because instructor engagement and self-directed engagement mean scores were found to be higher in the survey, the secondary objective of the qualitative phase was to explore in what contexts and how students' experiences and expectations about engagement strategies varied.

Participants

Data were collected from students who scored low, medium, or high within one or more dimensions in the survey results. In the second, qualitative phase of the study, a total of 12 students were invited for an interview based on the quantitative results. A total of four students (two students from each institution) responded to the invite and agreed to participate in an interview. Each interviewee received a $20 Amazon gift card for their participation in the interview. Participants were described using P followed by a number. For example, P1 means first qualitative participant.

Data Collection and Analysis

Guided by the online student engagement framework, we designed the interview protocol by focusing on the lens of interaction in online learning environments. The interview protocol consisted of seven open-ended questions as well as probes and follow-up questions. The interviews lasted about 30-35 minutes and each interview was conducted via Zoom and audio and video-recorded with the permission of each interviewee. The interviews were transcribed verbatim and checked by the first and third authors for accuracy and consistency. Data retrieved from open-ended survey responses and interviews were analyzed inductively using thematic analysis technique (Braun & Clarke, 2006) to identify patterns and deductively using a theoretical framework (Miles et al., 2014) to explain the patterns based on the online student engagement framework used in this study. Memoing and triangulation were used for the validation of the qualitative data. MAXQDA 2020 qualitative and mixed methods research software was used for quantitative, qualitative, and mixed methods integrated analyses (VERBI Software, 2019).

Qualitative Phase: Findings

To address our second, qualitative research question, we present themes that emerged from data analysis in two major sections: (a) findings from the open-ended survey responses and (b) findings from the interviews.

Findings from the Open-Ended Responses

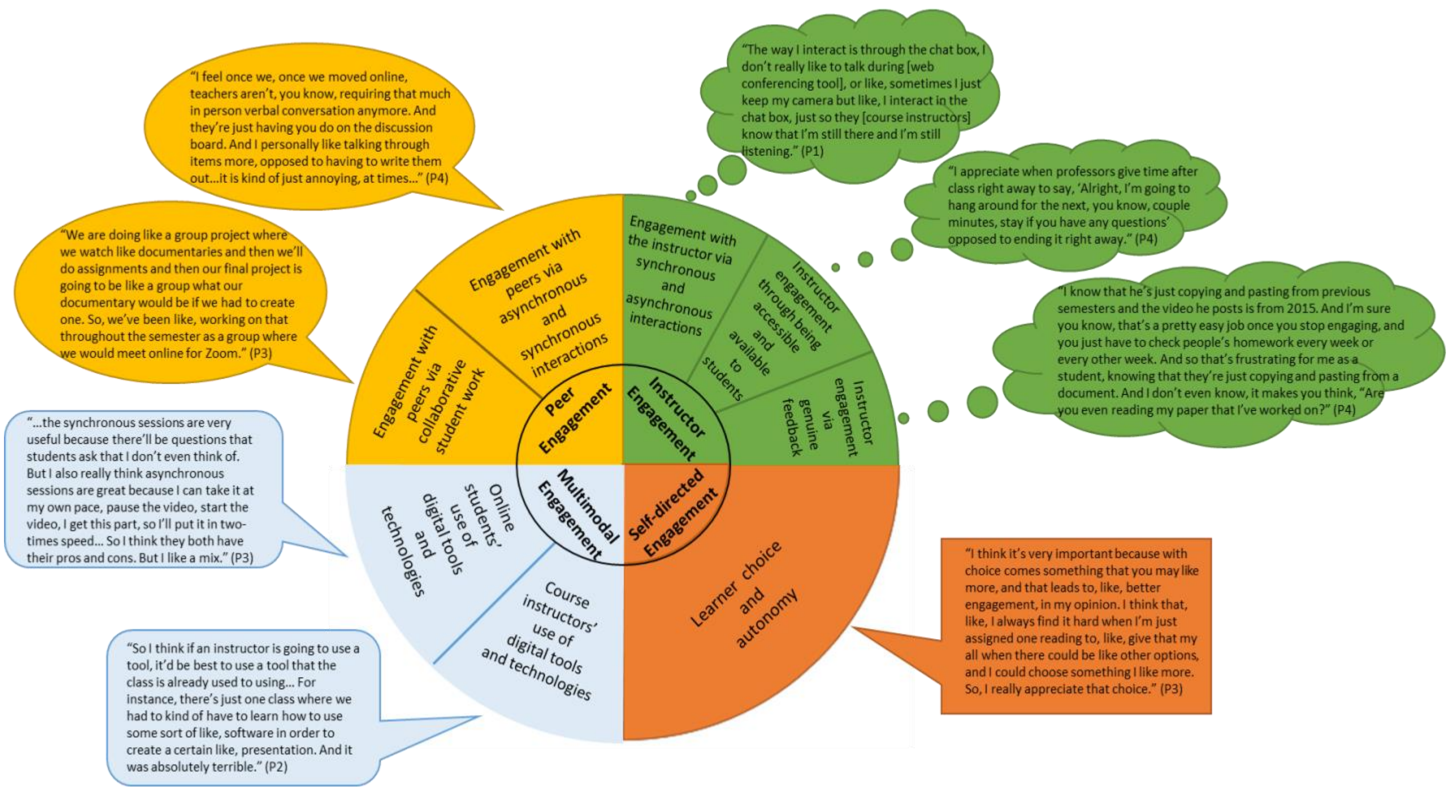
In the open-ended questions in the survey, participants were asked about the most and the least important things that played a role in their engagement in an online course. The results showed that the interviewees in general agreed upon some main expectations for their engagement in online course environment. The common points of agreement in the most important things for online engagement were "communication and interaction with professor and peers," "a balanced distribution of autonomy and structure," "clear and simple class schedule," "multimodal engagement with the content," and "constant instructor engagement and intrinsic motivation to teach." In addition, interviewees viewed online learning environments as different from in-person experiences and found efforts of instructors to make online courses like in-person course format unnecessary. This can be seen from the common points emerged from their responses to the least important things for their engagement in online learning courses. Some students complained about the lack of flexibility and instructors forcing students to stick to fixed rules like they do in-person classes. There were different forms of flexibility expectations such as meeting at a different time and date, turning their cameras off or being allowed to eat or drink during the class.

Findings from the Interviews

Findings from the interviews are presented in four major themes in line with the engagement framework used in the conceptualization of this study: (a) peer engagement, (b) instructor engagement, (c) self-directed engagement, and (d) multimodal engagement. Sub-themes emerged within each of these major themes. Figure 3 depicts the four major themes and subthemes along with the relevant quotes.

Figure 3

Visual Representation of Themes, Sub-themes, and Quotes



Peer Engagement

Under the major theme of peer engagement, two sub-themes emerged. These sub-themes characterize different manifestations of peer engagement as perceived and experienced by the interviewees.

Engagement with Peers via Asynchronous and Synchronous Interactions.

One of the manifestations of peer engagement was engagement with peers via asynchronous online discussions. P1 explicitly stated "I feel like we must engage in discussions," indicating the perceived importance of online discussions as an important instructional strategy. She added, "There's like review games here and there, like in one of my courses, but mostly it's discussions."

Lack of peer engagement on the asynchronous discussion board was also mentioned by three participants. P1 who stated that once she posted her initial response, she did not go back and look at other people's responses, thereby making it impossible to participate in content-related dialogues with the peers and truly get engaged in learning. When asked about using other digital tools such as a video response tool to increase peer engagement, she answered, "I think it's fun to watch others…I would rather do that [video respond] then post to a discussion board, I find it more enjoyable for myself to respond to peers on [video tool] than I do typing to them."

Peer engagement was also experienced through synchronous meetings (e.g., Zoom) in which the students interacted with their peers and their course instructor in different ways, such as breakout room discussions and activities. As P2 described, "I think doing group activities and breakout rooms has been pretty successful, I guess, in like, creating more engagement, and some courses and some courses could probably start to do that more." The quality of peer engagement through synchronous meetings was also influenced by the nature of the course and the instructor's teaching style. For example, P4 mentioned that she had different amounts of peer engagement in different online courses depending on how the course was structured and implemented by the course instructor. She explained that some of her online courses were student-centered, whereas others were mostly instructor-dominated.

The quality of peer engagement through synchronous meetings was also perceived and experienced as being influenced by peers themselves. Depending on how willing the peers were, P4 reported having experienced peer engagement at different levels of quality. Having to interact and engage with peers through virtual means rather than face-to-face was still considered a challenge to achieving optimal student engagement in online courses. For example, P2 believed it would be much easier for her to get to know her peers if the course was not online, attributing her more shallow engagement with her peers to the online nature of the class. Similarly, she mentioned not being able to see all the reactions from her peers during synchronous activities or presentations since in some online courses students simply have their cameras turned off, which in turn considerably reduces peer engagement. In support of this, P2 stated, "Engagement in an online class will always be lower than in an in-person class."

Engagement with Peers via Collaborative Student Work

Another manifestation of peer engagement was experienced through collaborative student work, such as group assignments or final projects for which the students were expected to collaborate with each other during the semester.

Another form of peer engagement was embedded in those collaborative assignments and projects in the form of peer evaluations by means of which the students evaluated each other's contribution to those collaborative projects. Such peer evaluations were also perceived as further contribution to peer engagement as each student felt more motivated and obliged to actively and meaningfully engage with their peers to produce the joint work. As P3 pointed out, "Based on the questions that, like, my peers are going to evaluate me on, I think that makes me try harder…" However, the amount of peer evaluation work the students were expected to do was also important to their motivation to evaluate their peers. As P4 explained, "If I don't do over six of them, I do enjoy it. And it depends on the survey, and how often I had this…" Regarding student collaboration, P4 made an important point that "There's typically no collaboration when it comes to homework assignments," adding that she still had collaborative work experience with her peers in in-class activities or final projects, just like the other interviewees indicated.

Instructor Engagement

Under the second major theme of instructor engagement, three sub-themes emerged. These sub-themes characterize different manifestations of instructor engagement as perceived and experienced by the interviewees.

Engagement with the Instructor via Synchronous and Asynchronous Interactions

One of the manifestations of instructor engagement was engagement with the online course instructor via synchronous interactions. Communication through the web video conferencing tools was commonly expressed by the interviewees as a means of engaging with the online course instructor. In terms of the challenging job of online course instructors to keep their students engaged and on task during online learning, P2 mentioned "There's always going to be like a phone nearby, or like another computer screen" as potential obstacles to true engagement online.

The existence of several potential distractors in online students' physical study spaces seemed to pose a serious challenge to student engagement, which would actually call for more systematic and structured instructor engagement so that the instructor could reach out to the students in different ways (e.g., emails, reminders, announcements, meetings) just to make sure that they were on track and following the course in a truly engaged manner. As an example of this systematic and structured instructor engagement with the online students, P3 mentioned regular meetings organized by her online course instructor for student-instructor engagement throughout the semester. P3 also seemed to be satisfied with the level of her professors' instructor engagement in online courses. The online course instructor's regular communication about the expectations and requirements during the semester was also perceived to be very important by the interviewees. For example, P3 pointed out, "And I think that is very helpful, because, like, it's very clear what's expected with like, through each week." On the other hand, P4 did not experience such regular communication with the online course instructor but rather such communication was used to make specific reminders only when necessary during synchronous class times.

In terms of instructor engagement via asynchronous interactions, online discussions were also reported to be another venue where instructor engagement was experienced by the interviewees. For example, P4 mentioned experiencing different structures of online discussions in terms of the questions and prompts given by the course instructors and she seemed to perceive those structured online discussions as helping to keep herself engaged and on track in terms of the course content to be covered.

Two interviewees, P3 and P4, reported experiencing some sort of a course orientation provided by the instructor. P3 mentioned having an orientation module where the online course instructor gave personal information about themselves and the course components and the syllabus, always via a video in which the course would be navigated by the course instructor for the students. P4 explained that their course orientation was done in her online courses through a welcome email asking the students to get themselves acquainted with the learning management system of the course and the course components.

Instructor Engagement Through Being Accessible and Available to Students

Instructor engagement was also perceived and experienced through the online course instructors being accessible to their students. For example, P2 mentioned that there was almost no engagement with the online course instructor at all, especially during the transition period of COVID-related emergency remote instruction. She stated that there would not be any way to ask questions without sending an email to the course instructor. Instructor engagement through being available and accessible to the students was also perceived to be valuable by P4 as reflected in Figure 3.

Instructor Engagement via Genuine Feedback

Another manifestation of instructor engagement was the quality of instructor feedback. P4 mentioned that in one specific online course she took, the feedback she received from the course instructor was exactly the same across all assignments, which frustrated her deeply. She seemed to imply that lack of genuine feedback about her work was detrimental to her engagement as an online student.

Self-Directed Engagement

Under the major theme of self-directed engagement, we only have one sub-theme since self-direction, autonomy, and choice were not commonly expressed by all the interviewees.

Learner Choice and Autonomy

The interviewees stated that they usually had all the readings and learning materials predetermined and provided by their online course instructors. However, having choice and autonomy while, for instance, deciding to read an article or selecting a digital tool to present something was perceived to be important by the interviewees. Having choice in the selection of learning materials also seemed to influence P3's motivation to study in the course and to foster their overall course engagement since they had the opportunity to choose and study something that they wished to. Self-direction was also expressed to be supported by the very nature of online learning itself. For example, P3 stated that online learning developed her self-directed and self-regulated learning skills including time management.

Multimodal Engagement

Under the major theme of multimodal engagement involving both online students and online course instructors' use of tools and technologies for learning and instructional purposes, we have two subthemes.

Online Students' Use of Digital Tools and Technologies

The interviewees reported using a wide variety of presentation software and digital tools to work on and present their course work including their final projects. For instance, P3 stated that a lot of times, she used the studio software embedded in their learning management system and prepared slides with voiceover to present her final projects asynchronously, although she did not experience giving a live presentation for an online class.

Online students' use of different digital tools and technologies also seemed to improve their engagement with the course content and improve their learning experience overall. For instance, P4 mentioned using a video response tool and finding it more enjoyable to watch their peers' responses and respond to their videos rather than typing to them in a discussion board, indicating the engaging power of such digital tools in online courses which seemed also to help better engagement with the course content. As she described, "I'd say it's more engaging, not that their content is less boring, but I do enjoy viewing it with a video."

Course Instructors' Use of Digital Tools and Technologies

The interviewees usually indicated that their online course instructors used different digital tools and technologies, as much as they could, to foster both their own instructor engagement and presence and student interaction and engagement with the course content. We also found that the course instructors' multimodal engagement through their use of various features of synchronous communication such as breakout rooms, opinion polls, and chats in video conferencing sessions promoted and supported the online students' engagement with the content and the course overall.

One interesting point regarding the relationship between online students' multimodal engagement and course instructors' multimodal engagement was raised by P2. She drew attention to the importance of asking the students to use the tools that are more likely to be known and familiar among the students. Another similar connection between instructor multimodal engagement and student multimodal engagement was pointed out by P4, who indicated that some of her online course instructors were more willing to allow video responses than others to be used in the discussion threads instead of text only. The instructor's encouragement of multimodal responses to the discussion boards seemed to influence the multimodal engagement of the online students as well. As P4 stated, "I'm not definitely opposed to typing. That's what I use the majority of the time, but I do enjoy making an audio recording and then submitting that or a video as well."

Integration

To address our third, mixed methods research question, we explain integration strategies used in this study and provide meta-inferences to facilitate the interpretation of both phases. Fetters et al. (2013) describe three levels of integration in a mixed methods study: (a) design, (b) methods, and (c) interpretation and reporting. At the design level, we used one of the three core designs, namely explanatory sequential mixed methods design, in this study. At the methods level, integration occurs through linking data collection and analysis of quantitative and quantitative methods using different approaches (Creswell & Plano Clark, 2018). We used a *connecting* approach as we sampled participants of the qualitative phase and developed our interview protocol based on the quantitative results. We also used *merging* as we brought quantitative and qualitative results together for analysis. At the interpretation and reporting level, we used a *joint display* approach, which allows researchers to draw out new insights using visual tools (Fetters et al., 2013). Table 4 is organized by research questions and presents the quantitative and qualitative findings as well as integrated results.

Table 4

Joint Display of Students' Expectations and Experiences about Engagement Strategies in Online Courses

Note: P_ID=Participant ID; I=MPE= Modified Peer Engagement; MIE= Modified Instructor Engagement; MSDE= Modified Self-Directed Engagement; MME=Modified Multimodal Engagement. Below average, at average, and above average categories are defined by mean ± standard deviation.

=Below average; = At average; =Above average.

	Quantitative Results					Qualitative Findings	Mixed Methods Integrated Findings
P_ID	MPE	MIE	MSDE	MME	Overall Survey	Themes	Meta-Inferences
P1	3.00 ↓	4.14 ↑	4.00 →	2.83 ↓	3.50 →	P1 emphasized the importance of *engagement with peers and instructor* through online asynchronous and synchronous interactions.	Instructor and self-directed engagement were primarily expected for effective engagement in online learning.
P2	3.71 →	4.43 ↑	3.67 →	3.33 →	3. 81 →	P2 expressed the critical role of *instructor engagement* and lack thereof regarding the other dimensions of engagement.	Instructor is a critical factor influencing, if not determining, the level and quality of student engagement.
P3	4.00 → →	3.86 → ↑	4.00 → ↑	4.00 → ↑	3.96 → ↑	P3 highlighted the value of self-directed and multimodal engagement particularly enriching her online learning interactions and experiences.	Choice and personal interest indicating self-directed engagement and use of different technologies indicating multimodal engagement contribute to high-quality online student engagement.
P4	3.29	5.00	4.17	5.00	4.35	P4 emphasized the challenge of maintaining engagement with peers and underlined the value of genuine instructor feedback.	Instructor engagement experienced by online students through genuine scholarly interactions and student work is critical to student engagement, while peer engagement could be more volatile.

Discussion

The purpose of this study was to gain a better understanding of students' expectations and experiences regarding engagement strategies used in online courses. The quantitative results of the study indicate that the participants overall perceived online engagement strategies regarding peer engagement, instructor engagement, self-directed engagement, and multimodal engagement to be important and necessary to be utilized in an online learning environment. The qualitative findings suggest that the participants' actual experiences of engagement strategies varied contextually. Integrated results confirmed the importance of all four dimensions of engagement strategies.

Instructor engagement was identified in this study by various strategies to be used by online course instructors such as sending or posting regular email reminders or announcements, and creating a common space for students to contact the instructor (Bolliger & Martin, 2021). Our findings are consistent with the previous literature suggesting the importance of instructor being available and responsive to students and having regular and open communication with students for online student success (Gaytan & McEwen, 2007; Watson et al., 2017). Our findings are also consistent with Martin and Bolliger (2018) and Bolliger and Martin (2021) who similarly found the instructors' sending regular emails or announcements being rated among the most important engagement strategies for instructor engagement. Our finding about the perceived importance of instructor's posting rubrics for all graded assignments is in line with the previous literature suggesting that well-defined and well-organized rubrics are considered by students to be an integral component of effective online assessments (Gaytan & McEwen, 2007; Watson et al,, 2017) and that assessment rubrics are effective tools that can be used to ensure objective online assessment (Hsiao et al., 2014; Wang, 2015). Our finding regarding the high rating of grading rubrics is also consistent with Bolliger and Martin's (2021) findings. Posting a due date checklist was another instructor engagement strategy perceived very important, which is also consistent with the previous literature indicating that clear course design and organization is highly expected and appreciated by online students (Watson et al., 2017). This finding is valuable in the context of previous literature, suggesting that clearly communicating important due dates as part of online teaching presence helps achieve desirable outcomes, such as basic psychological needs satisfaction (Author et al., 2022) and perceived learning and student satisfaction in online learning environments (Caskurlu et al., 2020). Referring to students by name in online discussions, structuring online discussions with questions and/or prompts, and providing course orientation for students were also perceived important in this category.

This pattern of quantitative findings was further supported by the qualitative results indicating the importance of engagement with the instructor via synchronous and asynchronous interactions. For example, the participants found instructor engagement through being accessible and available to students essential for their own engagement. In our view, the most compelling explanation for the perceived importance of genuine instructor feedback is that students may feel that their work and performance are not being acknowledged by their instructors in the absence of genuine feedback, thereby diminishing their sense of connection and engagement with their course instructor. This idea is supported by the previous literature indicating that prompt, substantive, and meaningful feedback provided by course instructors is highly expected, strongly needed, and appreciated by students (Watson et al., 2017). Feedback enables online students to have a stronger sense of community, which needs to be developed so that students are engaged in online learning environments (Li et al., 2020). Taken together, our findings indicate that instructor engagement needs to be perceived and experienced and is strongly expected by students taking online courses in higher education settings.

Self-directed engagement was identified in this study by various strategies such as students having the opportunity to search for and select materials based on their interests and to work on realistic scenarios or cases to apply course content to real-world situations or problems (Bolliger & Martin, 2021). Having the opportunity to research a topic of their interest and to work on realistic scenarios/cases to apply the course content were perceived highly important in this category. Applying course content to real-world scenarios is particularly relevant and valuable in the context of online learning because such real-world applications of course knowledge are important to achieve high-order learning outcomes including cognitive presence, problem solving, and critical thinking (Sadaf et al., 2021).

Our findings indicating students' self-directed online learning experiences characterized by choice and self-interest are directly relevant to promoting autonomy as the core psychological need necessary for high-quality motivation and engagement (Ryan & Deci, 2017). Promoting autonomy via such self-directed engagement strategies as perceived and experienced by students is particularly relevant and valuable in the context of online learning in which autonomy "is an important construct of motivation in self-regulated, online learning environments" (Lee et al., 2015, p. 55). The overall pattern of findings indicating the high perceived importance of all self-directed engagement strategies is also valuable in light of previous research demonstrating the positive relationships between autonomy or internal locus of control and desirable learning outcomes including student satisfaction and persistence in online learning environments (Joo et al., 2013). Given the particular importance of autonomy and self-direction in online learning environments (Lee et al., 2015), our findings strongly suggest that online course instructors should create and support such self-directed engagement opportunities for their students. Taken together, our findings indicate that self-directed engagement strategies promoting and supporting students' self-direction and autonomy are highly valued and strongly expected by the students taking online courses.

Multimodal engagement was identified in this study by various strategies such as students experiencing synchronous web conferences and instructors using various features of synchronous communication for interactions with students (Bolliger & Martin, 2021). Instructors using different forms of synchronous communication to interact with their students (e.g., polls, whiteboard, chat box), creating short videos for better instructor presence, and using digital tools to provide audio and/or video feedback in addition to text were all perceived highly important and necessary in this category. Students experiencing synchronous web conferences, interacting with course content in different formats (e.g., text, video, audio, simulations), and posting audio and/or video files in discussion threads instead of text only were less important to the participants in this study.

Our findings indicating the high ratings of online course instructors using digital tools and technologies to consolidate their presence and improve their interaction and engagement with the students are consistent with previous research suggesting that online students expect and value different forms of synchronous communication and interaction with the course instructor and the instructors' use of technological tools (Watson et al., 2017). These findings are also directly relevant and valuable in the context of online learning literature, suggesting that emerging technologies and tools can help improve online interactions and contribute to a sense of community (Borup et al., 2012; Thomas et al., 2017).

One particularly interesting finding was that students posting audio and/or video files in discussion threads instead of text only was rated the lowest by the students in this study, which is actually consistent with the existing research evidence indicating such negative student experiences with audio and video discussion responses as distress, time, and technology issues (Denson & Shurts, 2021). This definitely needs further investigation given that there is very limited research about online students' expectations regarding this engagement strategy.

As for our findings regarding the participants' experiences with their online course instructors' use of different technologies for different purposes, the participants' responses were more consistent with the high quantitative ratings of instructor-related multimodal engagement strategies. One particularly interesting qualitative finding was that the instructors' multimodal engagement choices and expectations seemed to influence the students' multimodal engagement. Some instructors might not be as willing and encouraging as others in terms of the students' use of digital tools and technologies. This is another area to be further explored in terms of this potential reciprocal relationship between instructors' multimodal engagement and students' multimodal engagement.

Peer engagement was the least expected engagement strategy and identified in this study by various strategies such as students introducing themselves to their peers using icebreaker activities and working collaboratively using online communication tools to complete assignments (Bolliger & Martin, 2021). Having opportunities to reflect on the course content together with peers was the most expected strategy for peer engagement, followed by students introducing themselves to peers using icebreaker activities. Asynchronous online discussions designed and implemented in line with the principles of collaborative reflection, shared group cognition, and community of inquiry are common online spaces where students experience peer engagement through discussing and thinking about the course content with their peers and co-constructing knowledge (Garrison et al., 2000, 2001; Zydney et al., 2012). This finding is particularly important and valuable emphasizing positive outcomes of online collaborative reflections and communities of inquiry such as higher-order thinking and cognitive presence in social-constructivist online learning environments (Sadaf & Olesova, 2017).

Our finding regarding the high expectations of students introducing themselves to peers using icebreaker activities is also important given that icebreaking activities can help online students get to know each other (Bolliger & Martin, 2021), which in turn gives online students a sense of belonging through their sense of social presence (Richardson et al., 2017). The other engagement strategies not so strongly expected were facilitating online discussions together with peers, working collaboratively using online communication tools to complete assignments, and interacting with peers through student presentations. This pattern of findings is consistent with prior literature indicating that although peer moderation or facilitation of online discussions can support higher-order thinking, cognitive engagement, sense of community, and meaningful interactions in online discussions (Seo, 2007; Xie & Ke, 2011), students need to feel motivated, especially intrinsically motivated, to more actively participate in online discussions (Xie et al., 2006). This finding may be explained by the idea that the students were not intrinsically motivated enough to perceive this strategy to be important for peer engagement. Our finding indicating fewer expectations about collaborative work online may be explained by the idea that some students simply may not prefer or like collaboration online (Martin & Bolliger, 2018). Another interpretation is that online collaboration can be challenging due to problems associated with time management and planning of shared work (Hadwin et al., 2018).

Our findings regarding students' reviewing and rating each other's work and performance are consistent with the previous literature that some students may not take their peers' comments or evaluative feedback as valid or trustworthy and students might be too lenient and so misleading in their overly positive comments about their peers' work (Ertmer et al., 2010). The participants in this study might have had negative experiences and might have accordingly rated these two items lower. Such negative experiences were actually implied by one of the interviewed participants indicating that the amount of peer evaluation work that the students were expected to do was important to their motivation to evaluate their peers. The repetitive nature of online discussions could also be a challenge or limitation to their ability to promote peer engagement despite the overall importance of online discussions for peer interactions. Our findings also suggested that the quality of peer engagement through online interactions including online discussions could also be influenced by instructors' teaching styles, nature of course content, and peers' attitudes towards such interactions. Taken together, our findings indicate that peer engagement strategies might need to be promoted and supported intentionally by course instructors so that the students can see the relevance, importance, and value of such engagement strategies to their high-quality online learning experiences. This could be achieved through systematic and strategic manifestations of teaching presence in the form of both design and organization through clear course goals, learning objectives, and clear instructions and facilitation through providing guidance and intellectual support when needed in online learning environments (Anderson et al., 2001; Caskurlu et al., 2020; Author et al., 2021).

Implications

This study has shown that students taking online courses as part of their higher education consider all four dimensions of engagement strategies (i.e., instructor, peer, self-directed, and multimodal engagement) important and necessary, although instructor engagement was the most expected engagement strategy in this study. We offer some implications for researchers, practitioners, and other stakeholders for whom student engagement in online courses is an important issue to take into serious consideration for high-quality online learning experiences (Kucuk & Richardson, 2019; Robinson & Hullinger, 2008). This study adds to the literature that these four engagement dimensions based on Moore's (1989) three types of interaction proposed and validated by Bolliger and Martin (2021) are empirically important facets of online student engagement in terms of strategies perceived to be necessary and expected by students.

The findings from this study offer several different strategies for online course instructors to improve their students' engagement from diverse perspectives. These engagement strategies also provide insights for instructional designers of online courses. It is noteworthy that instructor engagement strategies were found to be the most expected engagement strategies, which should indicate the vital role of course instructors in engaging and involving their students in the online learning process (Martin & Bolliger, 2018). The second highly expected strategies of self-directed engagement should also indicate to the online course instructors that autonomy through having choices and opportunities to self-endorse their learning experiences is an important psychological need to be satisfied (Turk et al., 2022). Instructors should also seek innovative ways to promote and maintain their students' multimodal engagement to enrich their interactions with the course content. In addition, instructors should diversify their instructional strategies to promote high levels of peer engagement in their online courses. This study also has an important methodological implication to the field of online education. To the best of our knowledge, this study is one of the exemplar studies that used a joint display as an integration strategy in the empirical mixed methods literature of online education.

Limitations and Future Research

Despite the significant findings of this mixed methods study, this study still has its limitations. First, the sample size of the quantitative portion of the study was relatively small. However, the sample was drawn from two different R1 institutions in the United States to represent varying perspectives and different online course contexts. Second, engagement strategies measured and explored in this study were based on four dimensions developed by Bolliger and Martin (2021), but these strategies are not intended to represent an exhaustive list of all possible engagement strategies in the context of online learning. It should still be noted, though, that all the engagement strategies used in this study are in alignment with Moore's (1989) well-established interaction framework. Third, we did not control for any course-specific variations such as instructor's teaching style, course content, or other contextual factors that might have influenced the participants' higher and lower expectations and positive or negative experiences of the engagement strategies. Therefore, the findings should be interpreted with caution due to the relatively limited generalizability across different online contexts and settings. In fact, we aimed to overcome this limitation through the use of mixed methods research in the study design. Future researchers should consider examining other possible engagement strategies not included in this study. Future studies should also consider collecting quantitative data from a larger sample for better representativeness and generalizability of the findings. Contextual factors including instructor's teaching style, online delivery mode, course content and discipline, and demographic variables should also be studied by future research.

Conclusion

Our integrated findings confirmed the importance and necessity of the engagement strategies at varying degrees across four dimensions: instructor, self-directed, multimodal, and peer engagement. Based on these findings, online course instructors and instructional designers should aim to design, develop, and implement engaging online courses. The course instructor as the facilitator and the course design itself may need to provide opportunities for students to effectively engage with the learning content, instructor, and peers using their own volition and choice opportunities and multiple means of online communication.

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

At the time of the data collection and analysis, the second author was affiliated with University of Cincinnati.

Declarations

Competing interests

The authors declare that they have no competing interests.

References

Anderson, T., Rourke, L., Garrison, D. R., & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks*, *5*(2), 1–17.

Appleton, J. J., Christenson, S. L., Kim, D., & Reschly, A. L. (2006). Measuring cognitive and psychological engagement: Validation of the student engagement instrument. *Journal of School Psychology*, *44*(5), 427–445. https://doi.org/10.1016/j.jsp.2006.04.002

Bolliger, D. U., & Martin, F. (2018). Instructor and student perceptions of online student engagement strategies. *Distance Education*, *39*(4), 568–583. https://doi.org/10.1080/01587919.2018.1520041

Bolliger, D. U., & Martin, F. (2021). Factors underlying the perceived importance of online student engagement strategies. *Journal of Applied Research in Higher Education*, *13*(2), 404–419. https://doi.org/10.1108/JARHE-02-2020-0045

Borup, J., West, R. E., & Graham, C. R. (2012). Improving online social presence through asynchronous video. *Internet and Higher Education, 15*(3), 195–203. https://doi.org/10.1016/j.iheduc.2011.11.001

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Bryman, A. (2008). Why do researchers integrate/combine/mesh/blend/mix/merge/fuse quantitative and qualitative research? In M. M. Bergman (Ed.), *Advances in mixed methods research* (pp. 87–100). Sage.

Caskurlu, S., Maeda, Y., Richardson, J. C., & Lv, J. (2020). A meta-analysis addressing the relationship between teaching presence and students' satisfaction and learning. *Computers & Education*, *157*, 1–16. https://doi.org/10.1016/j.compedu.2020.103966

Chen, P.-S. D., Lambert, A. D., & Guidry, K. R. (2010). Engaging online learners: The impact of web-based learning technology on college student engagement. *Computers & Education*, *54*(4), 1222–1232. https://doi.org/10.1016/j.compedu.2009.11.008

Denson, V. L., & Shurts, L. M. (2021). RN to BSN students' experiences with asynchronous audio-video discussion responses. *Nursing Education Perspectives*, *42*(4), 238–240. https://doi.org/10.1097/01.NEP.0000000000000671

Dixson, M. D. (2010). Creating effective student engagement in online courses: What do students find engaging? *Journal of the Scholarship of Teaching and Learning*, *10*(2), 1–13. https://www.learntechlib.org/p/54817/

Dixson, M. D. (2015). Measuring student engagement in the online course: The Online Student Engagement scale (OSE). *Online Learning*, *19*(4), 1–15. https://doi.org/10.24059/olj.v19i4.561

Ertmer, P. A., Richardson, J. C., Lehman, J. D., Newby, T. J., Xi Cheng, Mong, C., & Sadaf, A. (2010). Peer feedback in a large undergraduate blended course: Perceptions of value and learning. *Journal of Educational Computing Research*, *43*(1), 67–88. https://doi.org/10.2190/EC.43.1.e

Fredricks, J. A. (2011). Engagement in school and out-of-school contexts: A multidimensional view of engagement. *Theory into Practice, 50*(4), 327–335. https://doi.org/10.1080/00405841.2011.607401

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, *74*(1), 59–109. https://doi.org/10.3102/00346543074001059

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs – principles and practices. *Health Services Research, 48*(6), 2134-2156. https://doi.org/10.l l l l/1475-6773.12117

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, *74*(1), 59–109. https://doi.org/10.3102/00346543074001059

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, *2*(2), 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education*, *15*(1), 7–23. https://doi.org/10.1080/08923640109527071

Gaytan, J., & McEwen, B. C. (2007). Effective online instructional and assessment strategies. *American Journal of Distance Education*, *21*(3), 117–132. https://doi.org/10.1080/08923640701341653

Hadwin, A. F., Bakhtiar, A., & Miller, M. (2018). Challenges in online collaboration: Effects of scripting shared task perceptions. *International Journal of Computer-Supported Collaborative Learning*, *13*(3), 301–329. https://doi.org/10.1007/s11412-018-9279-9

Henrie, C. R., Halverson, L. R., & Graham, C. R. (2015). Measuring student engagement in technology-mediated learning: A review. *Computers & Education*, *90*, 36–53. https://doi.org/10.1016/j.compedu.2015.09.005

Hsiao, W.-Y., Chen, M., & Hu, H.-W. (2014). Assessing online discussions: Adoption of critical thinking as a grading criterion. *International Journal of Technology, Knowledge & Society: Annual Review*, *9*(3), 15–25. https://doi.org/10.18848/1832-3669/CGP/v09i03/56370

Hsu, H.-C. K., Wang, C. V., & Levesque-Bristol, C. (2019). Reexamining the impact of self-determination theory on learning outcomes in the online learning environment. *Education and Information Technologies*, *24*(3), 2159–2174. https://doi.org/10.1007/s10639-019-09863-w

Huang, C., Wu, X., Wang, X., He, T., Jiang, F., & Yu, J. (2021). Exploring the relationships between achievement goals, community identification and online collaborative reflection. *Educational Technology & Society*, *24*(3), 210–223. https://www.jstor.org/stable/27032866

Kucuk, S., & Richardson, J. C. (2019). A structural equation model of predictors of online learners' engagement and satisfaction. *Online Learning*, *23*(2), 196–216. https://doi.org/10.24059/olj.v23i2.1455

Lee, E., Pate, J. A., & Cozart, D. (2015). Autonomy support for online students. *TechTrends: Linking Research and Practice to Improve Learning*, *59*(4), 54–61. https://doi.org/10.1007/s11528-015-0871-9

Li, J., Wong, S. C., Yang, X., & Bell, A. (2020). Using feedback to promote student participation in online learning programs: Evidence from a quasi-experimental study. *Educational Technology Research and Development*, *68*(1), 485–510. https://doi.org/10.1007/s11423-019-09709-9

Martin, F., & Bolliger, D. U. (2018). Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment. *Online Learning*, *22*(1), 205–222. https://doi.org/10.24059/olj.v22i1.1092

Martin, F., Bolliger, D. U., & Flowers, C. (2021). Design matters: Development and validation of the Online Course Design Elements (OCDE) instrument. *The International Review of Research in Open and Distributed Learning*, *22*(2), 46–71. https://doi.org/10.19173/irrodl.v22i2.5187

Martin, F., & Borup, J. (2022). Online learner engagement: Conceptual definitions, research themes, and supportive practices. *Educational Psychologist*, 1–16. https://doi.org/10.1080/00461520.2022.2089147

Martin, F., Sun, T., & Westine, C. D. (2020). A systematic review of research on online teaching and learning from 2009 to 2018. *Computers & Education*, *159*, 1–17. https://doi.org/10.1016/j.compedu.2020.104009

Moore, M. G. (1989). Editorial: Three types of interaction. *American Journal of Distance Education*, *3*(2), 1–7. https://doi.org/10.1080/08923648909526659

Morse, J. M. (2003). Principles of mixed methods and multi-method research design. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 189-208). Sage.

Picciano, A. G. (2019). *Online education: Foundations, planning, and pedagogy*. Routledge.

Rashid, T., & Asghar, H. M. (2016). Technology use, self-directed learning, student engagement and academic performance: Examining the interrelations. *Computers in Human Behavior*, *63*, 604–612. https://doi.org/10.1016/j.chb.2016.05.084.

Redmond, P., Heffernan, A., Abawi, L., Brown, A., & Henderson, R. (2018). An online engagement framework for higher education. *Online Learning, 22*(1), 183–204. https://doi.org/10.24059/olj.v22i1.1175

Richardson, J. C., Maeda, Y., Lv, J., & Caskurlu, S. (2017). Social presence in relation to students' satisfaction and learning in the online environment: A meta-analysis. *Computers in Human Behavior*, *71*, 402–417. https://doi.org/10.1016/j.chb.2017.02.001

Robinson, C. C., & Hullinger, H. (2008). New benchmarks in higher education: Student engagement in online learning. *Journal of Education for Business*, *84*(2), 101–109.

Sadaf, A., Kim, S. Y., & Wang, Y. (2021). A comparison of cognitive presence, learning, satisfaction, and academic performance in case-based and non-case-based online discussions. *American Journal of Distance Education*, 1–14. https://doi.org/10.1080/08923647.2021.1888667

Sadaf, A., & Olesova, L. (2017). Enhancing cognitive presence in online case discussions with questions based on the Practical Inquiry Model. *American Journal of Distance Education*, *31*(1), 56–69. https://doi.org/10.1080/08923647.2017.1267525

Seaman, J. E., Allen, I. E., & Seaman, J. (2018). *Grade increase: Tracking distance education in the United States* (pp. 1–45). Babson Survey Research Group. https://onlinelearningsurvey.com/reports/gradeincrease.pdf

Seo, K. K. (2007). Utilizing peer moderating in online discussions: Addressing the controversy between teacher moderation and nonmoderation. *American Journal of Distance Education*, *21*(1), 21–36. https://doi.org/10.1080/08923640701298688

Sinatra, G. M., Heddy, B. C., & Lombardi, D. (2015). The challenges of defining and measuring student engagement in science. *Educational Psychologist, 50*(1), 1–13. https://doi.org/10.1080/00461520.2014.1002924

Teddlie, C., & Yu, F. (2007). Mixed methods sampling: A typology with examples. *Journal of Mixed Methods Research, 1*(1), 77-100. https://doi.org/10.1177/2345678906292430

Thomas, R. A., West, R. E., & Borup, J. (2017). An analysis of instructor social presence in online text and asynchronous video feedback comments. *The Internet and Higher Education*, *33,* 61–73. https://doi.org/10.1016/j.iheduc.2017.01.003

Turk, M., Heddy, B. C., & Danielson, R. W. (2022). Teaching and social presences supporting basic needs satisfaction in online learning environments: How can presences and basic needs happily meet online? *Computers & Education*, *180*, 104432. https://doi.org/10.1016/j.compedu.2022.104432

VERBI Software. (2019). MAXQDA 2020 [computer software]. Berlin, Germany: VERBI Software. Available from maxqda.com.

Wang, P. A. (2015). Assessment of asynchronous online discussions for a constructive online learning community. *International Journal of Information and Education Technology*, *5*(8), 598–604. https://doi.org/10.7763/IJIET.2015.V5.575

Watson, F., Castano Bishop, M., & Ferdinand-James, D. (2017). Instructional strategies to help online students learn: Feedback from online students. *TechTrends: Linking Research & Practice to Improve Learning*, *61*(5), 420–427. https://doi.org/10.1007/s11528-017-0216-y

Xie, K., Debacker, T. K., & Ferguson, C. (2006). Extending the traditional classroom through online discussion: The role of student motivation. *Journal of Educational Computing Research*, *34*(1), 67–89.

Xie, K., & Ke, F. (2011). The role of students' motivation in peer-moderated asynchronous online discussions. *British Journal of Educational Technology*, *42*(6), 916–930. https://doi.org/10.1111/j.1467-8535.2010.01140.x

Zydney, J. M., deNoyelles, A., & Kyeong-Ju Seo, K. (2012). Creating a community of inquiry in online environments: An exploratory study on the effect of a protocol on interactions within asynchronous discussions. *Computers & Education*, *58*(1), 77–87. https://doi.org/10.1016/j.compedu.2011.07.009

Memorization and Performance During Pandemic Remote Instruction: Evidence of Shifts from an Interactive Textbook

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Abstract

Students believe mathematics is best learned by memorization; however, endorsing memorization as a study strategy is associated with a decrease in learning (Schoenfeld, 1989). When the world changed with the onset of the COVID-19 global pandemic, instruction transitioned to fully remote instruction where many assignments and examinations became open textbook, open note, and even open Internet. In this new world, did students change their beliefs about the role of memorization in learning? Did academic performance change? And did the relationship between memorization beliefs and academic performance change? The current study takes advantage of data collected in an online interactive statistics textbook used by courses before (in-person) and after (remote) the declaration of the COVID-19 pandemic at three institutions. Results from 2668 students who used the textbook showed that the UC institution had lower memorization belief scores compared to both the CSU and CCC institutions. Even when controlling for institution and chapter of the textbook, lower memorization belief scores were related to higher performance. Surprisingly, there were no significant differences in either memorization beliefs nor performance before and after transitioning to online remote instruction due to the pandemic. Although much of educational research is conducted in one institution, this kind of research can identify differences across institutional contexts to understand how learning can be affected by different teaching formats, including in-person and online/distance, brought on by disruptive social changes such as a global pandemic.

Keywords: Memorization beliefs, COVID-19, academic institution, academic performance, in-person instruction, fully remote instruction

Salas, J.L., Wang, X., Tucker, M.C., & Son J.Y. (2024). Memorization and Performance During Pandemic Remote Instruction: Evidence of Shifts from an Interactive Textbook. *Online Learning Journal, Volume 28*(2), (268-304). DOI: 10.24059/olj.v28i2.343

Many students believe rote memorization is one of the best ways to learn math, but this strategy often leads to suboptimal performance (Schoenfeld, 1989). At the declaration of the COVID-19 pandemic, as all instructors (including math instructors) switched abruptly to fully online teaching (also called remote instruction or distance learning). In that process, many shifted their pedagogy to allow students to use textbooks, notes, and even the Internet on assessments (Daniel, 2020).

The proliferation of online learning materials even before the declaration of the pandemic made it possible to compare student attitudes and performance as the world changed. The Better Book approach (Stigler et al., 2020, housed at CourseKata.org) is an example of such a project that had been tracking performance-related attitudes (such as beliefs about memorization) and learning in statistics courses across a variety of campuses and contexts. Our book is not "better" than other statistics books, but rather there is a continuous improvement process that allows this book to get better based on student data. So, the "better" in Better Book refers to the process of getting better. Specifically, the Better Book project focuses on using student data from an interactive online statistics textbook to help instructors, researchers, and developers continuously improve methods of teaching concepts and skills that take a long time to learn. Our study capitalizes on the opportunity presented by the Better Book model not only to examine the relationship between memorization beliefs and long-term statistics learning across institutions but to additionally examine how pandemic-related changes in pedagogy may have affected this relationship.

Before delving into the details of our study, we will review the pre-COVID-19 research on how memorization beliefs relate to learning, the impact of online learning on memorization and performance, and possible differences across institutions.

Students Believe Memorization is an Efficient Learning Strategy

Students believe that memorization is an efficient learning strategy, especially in mathematics. In interviews and surveys, many students profess that memorizing long lists of math facts or algorithms without trying to gain a conceptual understanding is a productive learning strategy (Boaler et al., 2000; Givvin et al., 2011; Redish et al., 1998). Students have such a strong belief in the centrality of rote memorization such that they believe that people who are best at mathematics must be the best at such memorization (Crawford et al., 1994). Memorization is also related to the commonly held belief that quickness and fluency are important for success in mathematics (espoused by students, Givvin et al., 2011). This belief in the power of memorization extends beyond mathematics; for example, students view physics as disconnected facts that have no connection to the real world but need to be memorized (Gray et al., 2008).

However, such commonly held beliefs in rote memorization are associated with negative outcomes. Students who believe in the importance of memorization are more likely to give up when faced with a difficult question (Phelps-Gregory et al., 2020). They are thus less likely to engage in productive struggle (engaging, unpacking, and trying new things to solve a problem without success for a prolonged time). Holding beliefs about the centrality of memorization is negatively correlated with mathematical performance (House, 2006; Lin & Tai, 2015; Schoenfeld, 1989). Math and science students who believe that these disciplines are static sets of disconnected facts tend to have lower confidence (Wheeler & Montgomery, 2009) and underperform (Songer & Linn, 1991) compared to peers who conceptualize the field as dynamic and relevant to the real world.

In short, these beliefs are important to study because they are interconnected with other beliefs about what it means to do math or be good at math, study strategies, and subsequent performance. House's cross-cultural research (2006) suggests the relationship between these beliefs and performance is context-dependent. In the United States, low performing students are the most likely group to endorse memorization, but in Japan, high performing students attribute their success to memorization. This implies that these memorization beliefs may vary depending on the learning context and surrounding cultural beliefs about what it means to do math, learn math, and be good at math. Thus, as the context of learning changes, these beliefs and learning may also change.

The Abrupt Transition to Remote Courses (COVID-19 Pandemic)

With the COVID-19 pandemic, the world was transformed. In the United States, as well as in many other countries, many schools shut down in-person instruction and switched to fully remote courses (Daniel, 2020). This was a drastic change for many, especially for students and teachers.

Although research is only just emerging about the consequences of this shift on students, early work suggests that many challenges emerged. Students made very little progress, if any at all, in their education with remote learning (Engzell et al., 2021). Some students felt as if they experienced a loss of knowledge and opportunity. These feelings are consistent with declines in grades, measures of reading and math achievement, and the number of students meeting college admissions requirements (e.g., in Los Angeles Unified School District as reported by Esquivel & Lee, 2021). As research begins to document the effects of remote learning on student learning (Barber et al., 2021), there is an urgency to study any disproportionate impacts on already marginalized or economically underserved communities (Deng & Yang, 2021; Engzell et al., 2021; Goudeau et al., 2021; Soria et al., 2020).

After the initial chaos of the pandemic, many instructors attempted to recreate or re-invent the learning experience on Zoom and other online platforms as the new school year started in the latter part of 2020. In doing so, many policies were relaxed; exams and assignments were now open textbook, open note, open Internet, and in some cases, untimed (Er et al., 2021; Nickerson & Shea, 2020).

In this new world, with new policies and affordances, did students' beliefs about memorization change? Would students feel the need to memorize if they have online resources open to them during assignments and exams? In this paper, we use data from students using our free interactive textbook in face-to-face classes both before and after the declaration of the pandemic to examine these questions. After the declaration of the pandemic, these initially face-to-face classes became fully remote.

Research conducted before the onset of the pandemic has examined how some of the "open" features of online learning could affect learners' beliefs about memorization and performance. Research on open-book examinations suggested that this feature (perhaps surprisingly) does not necessarily lead to higher scores but does reduce anxiety during the exam as well as the use of memorization in learning (Block, 2012; Broyles et al., 2005; Theophilides & Dionysiou, 1996). In addition, the level of anxiety a student feels has been shown to be lower when an exam is taken at home (Weber et al., 1983) perhaps by virtue of the extended time limit (Boniface, 1985). Video lectures allow students to pause, replay, and manage their own learning but frequently using these features is not necessarily correlated with stronger performance (Le et al., 2010). And we should keep in mind that regardless of the pandemic, learning affordances are "in the eye of the beholder": for some students, online learning is a highly effective and empowering context while for others, it is not (Myyry & Joutsenvirta, 2015).

Not only does learning differ across different modalities (e.g., remote versus in-person), the institutional context is an important factor to consider when examining beliefs and performance. Although many university students were on Zoom during the pandemic, students across different institutions face different realities in higher education. Also, students in a particular institution may be more similar because they have selected to attend that institution, live in the vicinity, or have been selectively admitted. Often governments and states (e.g., California) have established different institutions to serve a wide variety of students.

The California Master Plan for Higher Education differentiates public postsecondary education into three different segments: University of California (UC), California State Universities (CSU), and California Community Colleges (CCC). Each type of institution has a purported mission. The University of California system serves as the "state's primary academic research institution" (University of California Office of the President, n.d.) such that in addition to educating undergraduates, it provides the greatest number of doctoral and professional degree programs. Meanwhile, the California State University system primarily focuses on undergraduate education and offers graduate education at the master's level. Lastly, the California Community College system has multiple missions, including providing lower division coursework for students to transfer to 4-year institutions, vocational certificates, and remedial instruction (University of California Office of the President, n.d.).

Student Learning Across Different Institutions

Although there are many differences in vision and in practice, one sharp distinction that emerges is the acceptance rate or selectivity in regard to incoming students. According to US News, California Community Colleges have an open admission policy (US News, 2022a), meaning a 100% acceptance rate for those that apply, and some California State Universities have up to ~75% acceptance rate (US News, 2022b). These two segments provide a fairly open path for students who wish to pursue higher education. Meanwhile, University of California institutions have acceptance rates as low as 14% (US News, 2022c). Moreover, the UC and CSU campuses are 4-year institutions, and the CCC campus is a 2-year institution (Public Policy Institute of California Higher Education Center, 2017).

Entangled with admission rates, there are large SES differences among the student populations attending these institutions. For example, within UC institutions, there is a higher enrollment of Asian-American students, compared to their Latino and African-American counterparts (Public Policy Institute of California Higher Education Center, 2017). Another large difference between these institutions is the socioeconomic background of the students. Students from lower SES backgrounds (families making less than $30,000/year) are more likely to attend community colleges compared to students from families with incomes higher than $75,000/year (Public Policy Institute of California Higher Education Center, 2017). Moreover, the rates of degree completion differ among these campuses, with students in UC institutions graduating at highest rates and community college students graduating at the lowest rates (Public Policy Institute of California Higher Education Center, 2017).

The fact that these student populations are quite different as they enter into these institutions and that they graduate at different rates are broad characterizations that hide important differences in the experiences that these students have as they attend college. For example, students who experience financial hardships feel a disproportionate burden applying and attending 4-year institutions due to the cost of tuition, books, housing, and other related expenses (Public Policy Institute of California Higher Education Center, 2017). According to the U.S. Department of Education, community college students, compared to their counterparts at 4-year institutions, are more likely to have full-time employment, dependents, financial independence, no high school diploma, and single parent status (Goan & Cunningham, 2007; Mesa et al., 2014). Although even students at more selective universities also share in some of these struggles, many do not, and we must keep these student experiences in mind as we interpret student attitudes, learning, and performance.

In the current study, we were particularly interested in beliefs about memorization that may affect students' experiences in a statistics courses taken in three different institutions representing the three segments of California's Master Plan for Higher Education. Although these are just individual institutions, not particularly representative of their segment, to our knowledge, there are no studies examining such attitudes and performance across these segments in such a longitudinal manner. Thus, we take these institutions as a starting point for exploring the differences and similarities in student experience in higher education.

Although no comparative studies exist across segments, prior studies have examined beliefs about memorization and mathematics in community college students who were identified for various levels of math remediation. Students taking math in community college generally report high rates of using memorization as a study strategy (Givvin et al., 2011; Stigler et al., 2010). In interviews, community college students expressed that conceptual learning in mathematics was a waste of their time and that the best way to move forward was to memorize the mathematical procedures needed to perform well on the examinations. When prompted, these students were able to reason conceptually but several expressed surprise or disbelief that they could or even should rely on conceptual reasoning in their normal math courses. In our study, we expect students to express strong beliefs in memorization but would go further to compare those beliefs across students taking statistics in several institutions.

Current Study

In this manuscript, we focus on three research questions:

(1) Do memorization beliefs differ before and after transitioning to online learning due to the declaration of the COVID-19 pandemic (e.g., in-person versus fully remote instruction)?

(2) How do these beliefs (as well as changes in these beliefs) differ across institutions (UC, CSU, and CCC)?

(3) What is the relationship between students' memorization beliefs, remote learning during COVID-19, institution, and their performance in the interactive textbook?

Based on prior research on online learning, we hypothesized that beliefs about the importance of memorization would be lower under fully remote instruction compared to in-person instruction. Considering the differences in selectivity of institutions, we predict UC students, compared to CSU and CCC, will have higher performance which has been shown to go together with lower beliefs about memorization. Furthermore, we also expect that memorization beliefs will be negatively correlated with performance. Specifically, students who strongly believe the course will require lots of memorization will perform poorer when compared to students that do not hold that belief, regardless of their academic institution or whether an individual took the course in-person or fully remote.

Method

Our research group has been using an online textbook as the basis of doing educational research and development; we call this the Better Book model of research and development (Stigler et al., 2020). The current focus of the Better Book project is introductory statistics (see CourseKata.org). Stigler et al. 2020 wrote an interactive introductory statistics textbook called "Statistics and Data Science: A Modeling Approach" and created partnerships between instructors, researchers, and developers to examine student data and continuously improve these materials. The long-term goal is to understand and improve how students grasp concepts that take a long time to learn such as those covered in an introductory statistics course.

This textbook has been adopted for introductory statistics courses in a variety of institutions, including high schools, community colleges, and 4-year universities. Moreover, the textbook was adopted even before the declaration of the COVID-19 pandemic when the fully remote instruction was implemented thus resulting in a unique data set of student responses before the declaration as well as after.

Students' responses to formative assessment questions are collected as they go through the pages of this textbook; these pages are typically assigned as homework by their instructor. On each page there are figures, text, videos, as well as embedded formative assessments that are assigned as a normal part of the course. These formative assessment questions range from coding exercises (students learn to code in R, an open-source coding language commonly used by statisticians) to multiple-choice and open-response questions. These questions provide an innovative way to measure learning over an extended period of time (over a whole course), rather than at a single time point. Through the CourseKata.org platform, researchers can analyze de-identified responses about statistical thinking throughout a whole course. In addition to questions about statistics, students are also asked survey questions at various time points in the textbook. For example, Better Book data has been used to explore the relationship between utility value, behavior engagement, and performance (Sutter et al., 2021) to track the ups and downs in student motivation and learning. Other researchers have explored how students learn R and how their attitudes towards coding change through the course (Tucker et al., under review). For our current study, we will be examining both responses to survey questions as well as students' performance on end-of-chapter review questions embedded in the textbook.

Participants

Data were collected from students enrolled in an introductory statistics course using the textbook *Statistics and Data Science: A Modeling Approach* (Son & Stigler, 2016-2021, CourseKata.org). All participants were enrolled at one of three institutions each representing a component of California's Master Plan for Higher Education: University of California (UC), California State Universities (CSU), and California Community Colleges (CCC).

Data were collected from a total of 2,979 undergraduate students. 280 students were excluded from the analysis due to a lack of response on a key survey question relating to beliefs about memorization. Another 31 students were excluded because they repeated the course, leading to duplications in our data. The final sample (see Table 1) included 2,668 participants. UC (n = 1197), CSU (n = 695), and CCC (n = 776). The participants identified themselves as Female (68.3%), Male (29.3%), Non-Binary (1.0%), prefer not to say (0.2%), prefer to self-describe (0.2%), and no data (1.0%). The participants described themselves as Hispanic, Latinx, or of Spanish Origin (42.0%), Asian or Asian American (23.3%), White (18.4%), Prefer to self-describe (7.9%), Black or African American (3.5%), Middle Eastern or North African (1.7%), American Indian or Alaska Native (0.3%), Native Hawaiian or Pacific Islander (0.1%), and no data (2.8%). The majority of the participants were either in their second (38.5%) or third year (32.3%) of college, followed by first year (17.2%), fourth year (5.7%), others (3.9%), and no data (2.4%). These demographics are broken down by institution in Table 1.

Table 1

Demographic Characteristic of Participants

Baseline Characteristics	CCC		CSU		UC		Full sample	
	n	%	*N*	%	*n*	%	*N*	%
Gender								
Female	434	56.0	494	71.1	894	74.7	1822	68.3
Male	324	41.7	181	26.0	277	23.1	782	29.3
Non-binary	4	0.5	7	1.0	15	1.3	26	1.0
Other[a]	14	1.8	13	1.9	11	0.9	38	1.4
Race/Ethnicity								
Hispanic/Latinx/ Spanish Origin	377	48.6	526	75.7	219	18.3	1122	42.0
Asian or Asian American	110	14.2	55	7.9	456	38.1	621	23.3
White	137	17.6	33	4.8	322	26.9	492	18.4
Black or African American	31	4.0	21	3.0	40	3.3	92	3.5
Other[a]	121	15.6	60	8.6	160	13.4	341	12.8
Class year								
First/Freshmen	328	42.3	35	5.0	95	7.9	458	17.2

Second/Sophomore	218	28.1	148	21.3	661	55.2	1027	38.5
Third/Junior	118	15.2	333	47.9	410	34.3	861	32.3
Fourth/Senior	30	3.9	117	16.8	7	0.6	154	5.7
Other[a]	82	10.5	62	8.9	24	2.0	168	6.3
Grand Total	776	29.1	695	26.0	1197	44.9	2668	100

Note. This table highlights the demographic information of our sample. Other[a] includes participants that prefer not to say, prefer to self-describe, and those that did not provide data.

Data collection occurred over the span of two years, such that each participant was enrolled during one academic term from Fall 2019 to Spring 2021. Given the fact that we collected data from multiple institutions, it is important to note that both the CSU and CCC institutions are on the semester system (15 weeks of instruction), while the UC institution is on the quarter system (10 weeks of instruction).

Therefore, students in the CSU and CCC institutions used the textbook during Fall 2019, Spring 2020, Fall 2020, and Spring 2021 semesters. Of these semesters, both Fall 2019 and Spring 2020 semesters were considered pre-COVID-19 (in-person instruction), while Fall 2020 and Spring 2021 were considered post-COVID-19 (fully remote instruction). Note, by using the language of "pre-" and "post-COVID-19," we do not mean the pandemic itself but pre- and post- the declaration of the pandemic in the local areas that resulted in remote instruction.

For the UC institution, we collected data from Fall 2019, Winter 2020, and Winter 2021 quarters. For the quarter system, we considered Fall 2019 and Winter 2020 as pre-COVID-19, while Winter 2021 were considered as post-COVID-19 (see Table 2). The UC institution did not have any instructors that used the textbook during Fall 2020, Spring 2020, and Spring 2021.

Table 2

Institution by COVID-19 Status

	In-Person Instruction (Pre-COVID-19)			Fully Remote Instruction (Post-COVID-19)		
	Terms	# of classes	*N*	Terms	# of classes	*N*

CCC	Fall 2019, Spring 2020	9	308	Fall 2020, Spring 2021	16	468
CSU	Fall 2019, Spring 2020	19	412	Fall 2020, Spring 2021	12	283
UC	Fall 2019, Winter 2020	3	783	Winter 2021	2	414
Total		31	1503		30	1165

Note. This table shows the breakdown of terms by COVID-19 (in-person vs fully remote), number of total classes provided in those terms, as well as total number of participants.

Schools in California shut down during mid-March 2020, resulting in a fair amount of chaotic variation in the transition to remote schooling. Instructors that taught during the Spring 2020 semester began with in-person instruction but abruptly transitioned to remote; Winter 2020 quarter classes went remote during finals week, and Spring 2020 quarter classes were fully remote. Although there was variation in which chapters were completed before the transition, across all Spring 2020 semester classes, at least the first four chapters of the textbook were taught while instruction was still in-person. Thus, we restricted our analysis to the first four chapters of the textbook across all institutions and terms.

Design

The present study used a non-experimental, correlational research design. Our predictor variables of interest were COVID-19 (before and after the declaration of the pandemic which coincides with the shift to remote instruction) and Institution (UC, CSU, and CCC). We are interested in documenting any differences in memorization beliefs as well as the relationship between memorization and performance. However, it is important to note that we initially intended to fit a multi-level model to our data given that students are embedded in classes, embedded in institutions. Unfortunately, based on the number of classes in the UC institution compared to the CSU and CCC institutions (see Table 2), we were unable to run that analysis.

Materials & Procedure

The study made use of student data (on memorization beliefs and performance) from the interactive online textbook (Son & Stigler, 2016-2021, CourseKata.org). The book is accessed via the course in the learning management system (LMS), (e.g., Canvas, Moodle) used by their campus. Thus, all responses occur at the location of their choice at a time that makes sense given the context of the assignment. Each instructor set their own deadlines (e.g., homework due every Monday, homework due before class, etc.) but all instructors assigned the chapters of the textbook in the same relative order (e.g., Chapter 1 due before Chapter 2).

Memorization Beliefs

As part of the "better book" project (Stigler et al., 2020), a 14-item survey (see Appendix A) is embedded at the beginning of the online textbook (right before the Chapter 1 pages). The survey was assigned as part of the first homework assignment (which often included Chapter 1). The approximate time to complete the survey was 10 minutes. Students were informed that their responses in the survey would not count toward their grade in the course. Because the survey was available when the course was available in the LMS, students were able to complete the survey even before the first day of class.

In this study, we will focus on a survey item where students were asked about their beliefs about memorization. Specifically, item 10 of 14 (see Appendix A) on the survey states, "I expect this course will require a lot of memorization." All classes from Fall 2019 to Fall 2020 answered this question with a 5-point scale. Winter 2021 (quarter) and Spring 2021 (semester), classes used a 6-point scale (1 = "Strongly Disagree," 2 = "Disagree," 3 = "Slightly Disagree," 4 = "Slightly Agree," 5 = "Agree", and 6 = "Strongly Agree"). To compare across all students who answered this question, we recoded the 6-point scale responses into a 5-point scale. "Slightly Disagree" (3) and "Slightly Agree" (4) from the 6-point scale were counted as a 3 on the 5-point scale.

The textbook also provides multiple measures of student performance. We focused on our analysis on the review questions that appeared at the end of each chapter. These review questions were a set of 13-21 multiple choice questions on a page that asked students to transfer their cumulative learning to a new data set that had not yet been discussed. All classes analyzed in this research gave credit solely for students' completion of these review questions, so homework scores were not affected by correctness.

Each set of review questions queried students on a new context with a new data set. Some chapters had two sets of review questions (each with a different context, e.g., data from lakes versus bicycle trips) presented on two different pages. Chapter 1, being an introductory chapter, only had one set of review questions. Chapter 2, 3, and 4 all had two sets of review questions. Therefore, there were a total of 7 sets of review questions. All students completed each assessment at the discretion of their instructor. However, some instructors only assigned one of the two sets of review questions for Chapters 2, 3, and 4. We decided to base our data analysis using the higher score of each set of review questions. The rationale for this was so that if one assignment was never assigned, the second assignment, by default, would have the higher score and would be included in the study. In total, each participant had four scores, one for each chapter.

Results

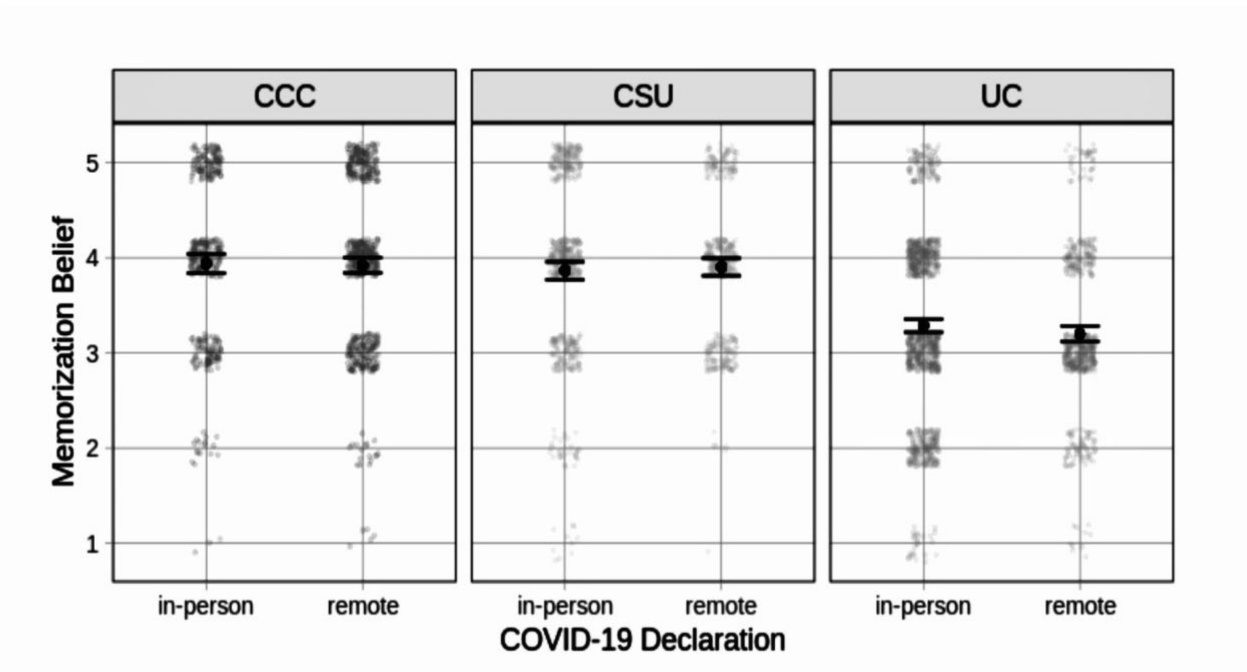
Memorization Beliefs

In this set of analyses, we examined the first two research questions: Do memorization beliefs differ before and after the declaration of the COVID-19 pandemic (e.g., in-person versus fully remote instruction)? and Do memorization beliefs differ across institutions (UC, CSU, and CCC).

A 2x3 ANOVA was performed on students' memorization beliefs scores. The first independent variable was COVID-19 with two levels: in-person instruction and fully remote instruction. The second independent variable was institution with three levels: CCC, CSU, and UC. This analysis revealed a significant main effect of institution ($F(2, 2662) = 83.358$, $p < .001$, $\eta_p^2 = .109$) but no effect of COVID-19 ($F(1, 2662) = 0.051$, $p = .821$, $\eta_p^2 = .002$) and no significant interaction ($F(2, 2662) = 1.13$, $p = 0.323$, $\eta_p^2 = .001$). A post-hoc Tukey HSD indicated participants who were enrolled at the UC institution, in-person or fully remote, had significantly lower beliefs in the role of memorization when compared to both CSU ($p < .001$) and CCC ($p < .001$) students (see Figure 1).

Figure 1

Memorization Beliefs by COVID-19 (in-person, remote) and Institution (CCC, CSU, UC)



Note. A jitter plot showing strength of belief in memorization before and after COVID-19 declaration (i.e., in-person & fully remote instruction) as well as across 3 types of institutions (i.e., CCC, CSU, UC).

The Relationship Between Memorization Beliefs and Performance

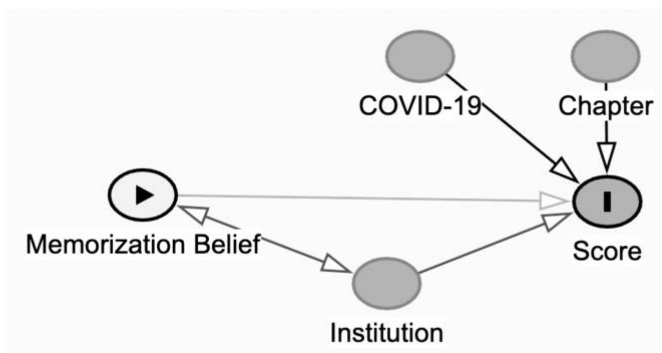
So far, we have seen that memorization beliefs differ across institutions but were unchanged over the declaration of the pandemic. We want to lay bare our assumptions about the underlying causal relationships between memorization, institution, COVID-19 (e.g. in-person versus fully remote instruction), and scores on review questions before embarking on the analysis of those scores. We will use a directed acyclic graph (DAG) in order to make those assumptions explicit. We want to note that our analysis as well as the use of our DAG will not necessarily confirm nor disconfirm our causal assumptions (Cinelli et al., 2022)—but being explicit about them will help us explain the predictor variables included in our model.

Figure 2 shows the DAG that represents the following causal assumptions: Based on prior research, we assume that students' beliefs about memorization are formed during their long experience in the institution of school (K-12) and are relatively enduring. Although our measurement of memorization occurred relatively early in college (e.g., the introductory statistics course is often a prerequisite for other courses or a GE course), it did *not* occur before college began. Nevertheless, we assume that memorization beliefs are relatively stable and presumably affect learning performance (see the arrow to score in Figure 2) and affect which college students end up at (e.g., selective to less selective, see the arrow to institution). However, it is also plausible that the institution they attend, the instruction they receive, and the peers they are around may also impact memorization beliefs. A bidirectional causal relationship between memorization beliefs and institution may exist. This assumption requires further research outside the scope of the data we have gathered.

Being at particular institutions may also affect students' scores as their courses, instructors, and social settings differ (represented in the arrow from institution to score). We had believed that the COVID-19 declaration would have changed memorization beliefs but found that it was not a significant factor (thus there is no arrow between COVID-19 and memorization belief score). However, we assume that COVID-19 may have had an impact on learning performance (see the arrow between COVID-19 and score). Further, we believe that differences between chapters result in different scores (arrow between chapter and score), such that later chapters are more difficult compared to earlier chapters as the material becomes more complex.

Figure 2

Directed Acyclic Graph (DAG)



Note. The figure highlights the causal assumptions between memorization beliefs, institution, COVID-19, chapter, and score on review questions.

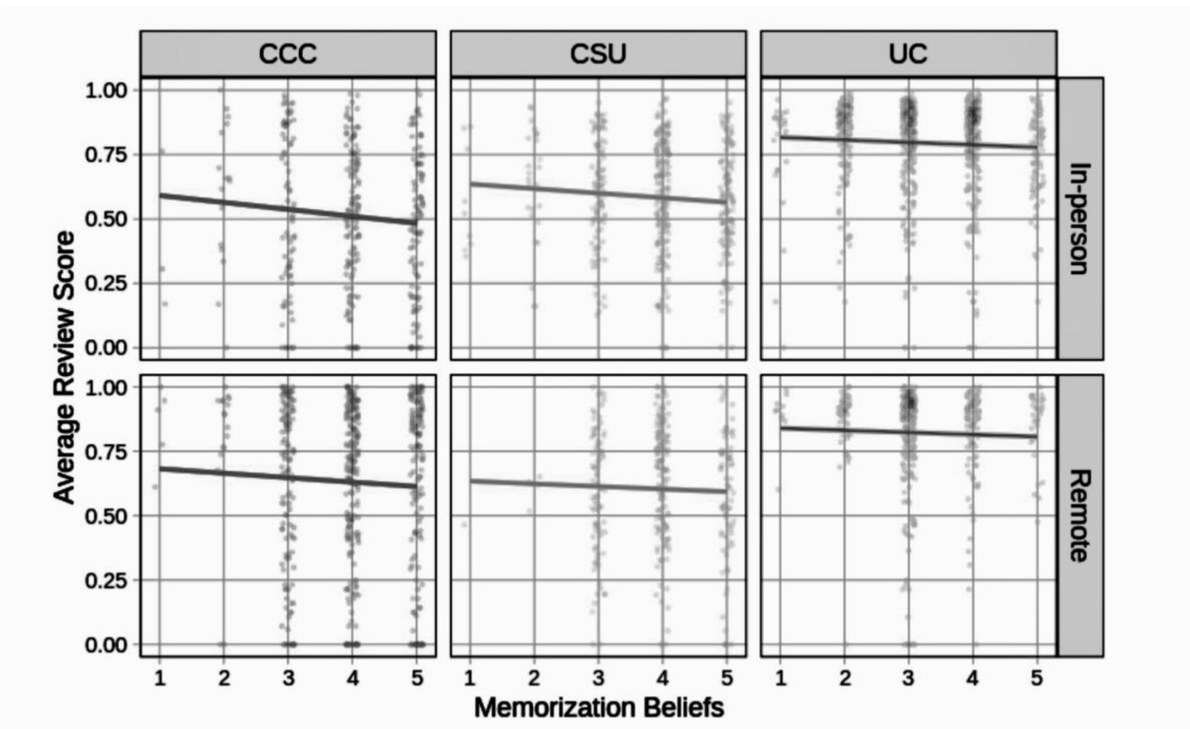
Our primary interest in this study is in examining the relationship between memorization and score on the review questions. We included institution, COVID-19, and chapter in a model to predict score on the review questions. Thus, the full model is specified as follows:

$$Score_{ij} = \beta_0 + \beta_1 Mem_i + \beta_2 COVID_i + \beta_{3k} School_{ik} + \alpha_j Ch_j + Subj_i + \epsilon_{ij}$$

Within this equation, *i* represents each individual subject, while *j* represents each time point, specifically each set of chapter review questions for a total of four. $Score_{ij}$ is each subject's score on one of the four sets of chapter review questions. Mem_i represents each individual's memorization belief score, and $COVID_i$ represents whether each subject took the course before or after the COVID-19 declaration. $School_{ik}$ represents the institution in which the subject (*i*) is enrolled, and *k* represents which of three institutions (UC, CSU, or CCC). Both the $COVID_i$ and $School_{ik}$ variables are dummy coded. Ch_j represents which specific chapter's score is being measured. Moreover, α represents the coefficients for within-subject variables, while β represents the coefficients for between-subject variables. Lastly, $Subj_i$ is the random effect of the individual subject, and ϵ_i is the residual. This model is equivalent to a mixed repeated measures ANOVA with memorization score as a covariate; COVID and institution as between-subject factors, and chapter as a within-subject variable with no interactions specified (see Figure 3).

Figure 3

The Relationship Between Memorization Beliefs, Performance, COVID-19, & Institution



Note. The figure highlights the negative relationship between Memorization Beliefs and Performance (averaged across chapters), while taking into consideration Institution (i.e., CCC, CSU, UC) and COVID-19 (i.e., in-person, remote).

By fitting and testing this model in R, we found significant effects of memorization beliefs ($F(1, 2610) = 115.783$, $p < .001$, $\eta_p^2 = .042$) and institution ($F(2, 2610) = 235.831$, $p <$

.001, η_p^2 = .153), but no effect for COVID-19 (F(1, 2610) = 2.327, p = .127, η_p^2 = .001). Lastly, chapter was also a significant within-subject factor (F(3, 8053) = 327.232, p < .001, η_p^2 = .109).

The effect of memorization beliefs was negative (b = -.015) such that the model adjusts performance downward for every one unit increase in memorization. We performed pairwise comparisons between institutions using estimated marginal means. Although the CSU outperformed CCC by .018, this difference was not significant (p = .315). Additionally, UC outperformed CCC by .223 (p < .001) and the CSU by .205 (p < .001). Furthermore, as chapters progressed, scores declined (e.g., students scored significantly higher on Chapters 1 than 2 and all differences were significant, ps < .001).

Discussion

Summary of Findings and Implications

Past research on memorization as a learning strategy has highlighted that reliance on memorization is maladaptive, leading to lower performance (House, 2006; Lin & Tai, 2015; Schoenfeld, 1989), less confidence (Wheeler & Montgomery, 2009), and a lower likelihood of engaging in productive struggle (Phelps-Gregory et al., 2020). The current study sought to explore this relationship further in the larger context in which a student learns. To our knowledge, this is the first study that has explored memorization beliefs and performance across COVID-19 (i.e., in-person instruction & fully remote instruction) as well as across the different types of institution (e.g., segments of California Master Plan for Higher Education).

As we predicted, students from less selective institutions (i.e., CSU and CCC) professed stronger beliefs in the role of memorization in learning than students from a more selective institution (i.e., UC). Interestingly, there were no differences in these memorization beliefs before and after the declaration of the COVID-19 pandemic in any of the campuses we studied. Like prior research, we found that lower memorization belief scores predicted better performance on end of chapter review questions. Additionally, the UC institution significantly outperformed both the CSU and CCC institutions, and as chapters progressed, performance on end of chapter review questions significantly decreased.

The negative relationship between memorization beliefs and performance is striking given the longitudinal nature of this study. For at least four chapters, the effect holds up, indicating that students who strongly believe the course will require lots of memorization performed poorly relative to students that do not hold that belief, regardless of their academic institution or whether the course was in-person or fully remote. Why does this belief have this predictive power? Perhaps, believing that the course requires memorization either leads to maladaptive learning strategies or is a reflection of the strategies they have used so far in math courses. For example, relying on memorization may lead students to try and memorize individual formulas, code, or definitions rather than understand how they fit together or make connections between concepts in the course. Students may have also attempted to memorize in prior math courses leading to brittle knowledge, thus leaving them ill-prepared for this college level statistics course. Whether memorization beliefs are an indication of poor learning strategies or deficiencies in prior learning, these beliefs can serve as a clue to the variety of learning experiences students may have even when they are all in the same course.

Our study attempted to go beyond the beliefs inside students' heads to consider the wider context: both the context of an unprecedented global pandemic and the institutional contexts that students learn in. We had expected that the COVID-19 pandemic would have had a significant influence on students' beliefs about memorization and on their performance, such that untimed, open textbook, open note, and open Internet assignments and exams would create less of a need to memorize as well as higher performance (Er et al., 2021; Nickerson & Shea, 2020), but this was not the case. It is possible that exams were rendered "easier" with these more open features, and the real-world difficulties of the COVID-19 pandemic may have impacted student learning and/or motivation. For example, especially for students from lower socioeconomic backgrounds, issues such as the lack of internet access as well as more familial and home responsibilities during the pandemic (Pokhrel & Chhetri, 2021) may have added additional stressors to students' lives. Indeed, additional analysis in our lab has shown that both CCC and CSU students (but not the UC students). experienced an increase in overall anxiety due to the abrupt changes caused by the pandemic. Thus, the easing of policies during the pandemic may have been negated by added real-world difficulties.

Most of the past educational research we have drawn upon (and most research linking attitudes to math performance in general) focuses solely on data from one academic institution. And although it is *de rigueur* to mention the limitations of such data in learning about the experiences of students across a variety of different types of campuses, gathering richer data is often impossible. Thus, part of the innovation of this study is making headway into this type of cross-institutional analysis by utilizing an innovative method of data collection—an interactive textbook—adopted by various instructors at the three segments of California's Master Plan for Higher Education.

Institution is, perhaps, one of the most understudied but important contexts when examining data on student learning. Part of the difficulty is in untangling the chain of causality. Since students are not randomly assigned to institutions, there are many pre-existing differences in ethnic diversity, SES, and geography. There are also vast differences in the type of courses offered, expectations of faculty, and graduation and admission rates, all of which shape a student's learning experience. Memorization (even within an institution) had a negative association with performance but when we zoom out to consider institutional context, we found that the UC institution had lower memorization belief scores as well as higher performance when compared to the CSU and CCC institutions. If we were to have done this study solely focusing on the UC institution, our understanding would have been limited and not representative of many students in California's public system of higher education. Therefore, the issue of memorization may be important at a UC, but perhaps even more critical to CCC and CSU students.

Limitations and Future Directions

Although this study makes innovative strides in examining student learning in richer, more authentic contexts, there are several limitations to consider. First, being in a real class setting limited the survey questions we could reasonably ask students. Thus, our measure of students' beliefs about memorization was based on one question from the introductory survey inside the *CourseKata Statistics and Data Science* textbook. Future studies should incorporate a measure for beliefs about memorization that are more robust such that we can disentangle students' beliefs about memorization as related to study strategy, domain of mathematics, and perceptions of mastery or fluency. Future studies should also examine students' beliefs in the power of memorization in a way that can distinguish between more enduring beliefs in the power of memorization and beliefs that are contextualized to the class. Despite this very limited measure, this one question regarding students' beliefs about memorization was a significant predictor of student performance months later across a variety of contexts. This study can establish the initial importance of *memorization beliefs* as a robust construct, but we need more research to unpack what exactly is the mechanism that links these beliefs with academic outcomes.

Another limitation of this study is the generalizability of our results. Although this is one of the first studies to examine these rigorously, using the same materials in a longitudinal manner, in different institutions of higher education, there is large variation in these different segments of California's Master Plan for Higher Education. Future research would gather data from a greater variety of institutions, for example from multiple community colleges or CSUs, and attempt to understand how much of these differences can be explained by selection alone (e.g., differences in students accepted into the institution) versus other behaviors, habits, and contextual forces. As more UC, CSU, and CCC institutions adopt this new and innovative way to learn statistics, future studies can use a multilevel modeling approach. This would enable us to further see differences at the institutional level and gain a better understanding of how educational contexts can predict students' attitudes, beliefs, and learning.

Also, although one strength of this research is that these effects were found in performance on real coursework completed over weeks of instruction, these effects were specific to a statistics learning context in a very particular textbook. Whether beliefs about memorization are negatively associated with a broader range of learning outcomes remains to be seen. Future studies should investigate whether the relationship between beliefs about memorization and performance exists in other subject domains.

As in much of educational research, we want to know the causal underpinnings of academic outcomes. We provided a directed acyclic graph in order to lay bare our assumptions of underlying causal relationships between memorization, institution, COVID-19, and scores. However, this study was correlational in nature, thus, it may be beneficial if future studies can produce experimental designs to figure out the causal relationship between memorization beliefs and academic performance. For example, if an intervention can help students shift their mindset away from memorization and more towards making connections across concepts, would that lead to better scores or different behaviors in the textbook?

Another direction for future studies can include tracking different cohorts as the situation with COVID-19 continues to evolve. In this data, COVID-19 is split into two groups: in-person instruction and fully remote instruction. As the world shifts and re-organizes to provide more hybrid, or more in-person options, we can continue to examine different ways these modalities impact student behavior or selection. Will students who ascribe to different beliefs opt for more online or in-person options? If students fully return to their campuses for in-person instruction, will they exhibit different behaviors than those "in-person" students who took the class before they knew of hybrid or remote learning options? Will learning trajectories be more similar to the original in-person instruction or more similar to the fully remote instruction? Popular press suggests that the COVID-19 pandemic has permanently changed education. There is worry that many students will have to play catch-up with the return to in-person instruction (Bombardieri, 2021). Moreover, George et al. (2021) suggests there may be an enduring impact on students' mental health and that schools may have difficulty keeping up. In addition, there is concern that "distance learning will reinforce teaching and learning approaches that we know do not work well" (Winthrop, 2020, para. 3). All of these worries indicate that student learning has changed, and we may never view education the same way we did before the COVID-19 pandemic. As educators, it is our duty to guide and teach students, so it is imperative that we investigate these conjectures with data in order to better prepare all current and future educators for the educational changes that are occurring around us.

Conclusion

As educators and researchers, we want students to learn and master course content to the best of their ability. In order to do so, we must recognize the power of institutional context and realize that institutions of higher education are made up of communities of students with similar beliefs and similar levels of academic achievement. Knowing this will help us understand how students react to disruptive social changes such as a pandemic but also to help forge a way towards an educational system that works for all students.

Declarations

This project has been made possible in part by a grant from the Chan Zuckerberg Foundation and the California Governor's Office of Planning and Research Grant OPR18115.

The authors have no conflicts of interest to disclose.

This study was granted an exemption by the UCLA Institutional Review Board (IRB).

References

Barber, P. H., Shapiro, C., Jacobs, M. S., Avilez, L., Brenner, K. I., Cabral, C., Cebreros, M., Cosentino, E., Cross, C., Gonzalez, M. L., Lumada, K. T., Menjivar, A. T., Narvaez, J., Olmeda, B., Phelan, R., Purdy, D., Salam, S., Serrano, L., Velasco, M. J., … Levis-Fitzgerald, M. (2021). Disparities in remote learning faced by first-generation and underrepresented minority students during COVID-19:

Insights and opportunities from a remote research experience. *Journal of Microbiology & Biology Education, 22*(1). https://doi.org/10.1128/jmbe.v22i1.2457

Boaler, J., Wiliam, D., & Brown, M. (2000). Students' experiences of ability grouping—disaffection, polarisation and the construction of failure 1. *British Educational Research Journal, 26*(5), 631-648. https://doi.org/10.1080/713651583

Bombardieri, M. (2021, April 15). Covid-19 changed education in America permanently. *Politico.* https://www.politico.com/news/2021/04/15/covid-changed-education-permanently-479317

Boniface, D. (1985). Candidates' use of notes and textbooks during an open-book examination. *Educational Research, 27*(3), 201–209. https://doi.org/10.1080/0013188850270307

Block, R. M. (2012) A discussion of the effect of open-book and closed-book exams on student achievement in an introductory statistics course, *PRIMUS, 22*(3), 228-238. https://doi.org/10.1080/10511970.2011.565402

Broyles, I. L., Cyr, P. R., & Korsen, N. (2005). Open book tests: Assessment of academic learning in clerkships. *Medical Teacher, 27*(5), 456–462. https://doi.org/10.1080/01421590500097075

Cinelli, C., Forney, A., & Pearl, J. (2022). A crash course in good and bad controls. *Technical Report R-493*. http://dx.doi.org/10.2139/ssrn.3689437

Crawford, K., Gordon, S., Nicholas, J., & Prosser, M. (1994). Conceptions of mathematics and how it is learned: The perspectives of students entering university. *Learning and Instruction, 4*(4), 331-345. https://doi.org/10.1016/0959-4752(94)90005-1

Daniel, J. (2020). Education and the COVID-19 pandemic. *Prospects, 49*(1), 91-96. https://doi.org/10.1007/s11125-020-09464-3

Deng, X. N., & Yang, Z. (2021). Digital proficiency and psychological well-being in online learning: Experiences of first-generation college students and their peers. *Social Sciences, 10*(6). https://doi.org/10.3390/socsci10060192

Er, H.M., Nadarajah, V. D., Wong, P. S., Mitra, N. K., & Ibrahim, Z. (2021). Practical considerations for online open book examinations in remote settings [Version 2]. *MedEdPublish, 9*(1). https://doi.org/10.15694/mep.2020.000153.2

Engzell, P., Frey, A., & Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proceedings of the National Academy of Sciences, 118*(17). https://doi.org/10.1073/pnas.2022376118

Esquivel, P. & Lee, R. (2021, October 21). Falling grades, stalled learning. L.A. students "need help now," Times analysis shows. *Los Angeles Times*. https://www.latimes.com/california/story/2021-10-21/covid-era-learning-challenges-lausd-after-school-closures

George, D. S., Strauss, V., Meckler, L., Heim, J., & Natanson, H. (2021, March 15). How the pandemic is reshaping education. *The Washington Post.* https://www.washingtonpost.com/education/2021/03/15/pandemic-school-year-changes/

Givvin, K. B., Stigler, J. W., & Thompson, B. J. (2011) What community college developmental mathematics students understand about mathematics, Part II: The interviews. *The MathAMATYC Educator*, *2*(3), 4-18. https://www.researchgate.net/publication/260908914_What_community_college_developmental_mathematics_students_understand_about_mathematics_Part_II_The_interviews

Goan, S. K., & Cunningham, A. F. (2007). Differential characteristics of 2-year postsecondary institutions (NCES 2007-164rev). Washington, DC: *U.S. Department of Education., National Center for Education Statistics*. https://nces.ed.gov/pubs2007/2007164rev.pdf

Goudeau, S., Sanrey, C., Stanczak, A., Manstead, A., & Darnon, C. (2021). Why lockdown and distance learning during the COVID-19 pandemic are likely to increase the social class achievement gap. *Nature Human Behaviour, 5*(10), 1273-1281. https://doi.org/10.1038/s41562-021-01212-7

Gray, K. E., Adams, W. K., Wieman, C. E., & Perkins, K. K. (2008). Students know what physicists believe, but they don't agree: A study using the CLASS survey. *Physical Review Special Topics. Physics Education Research, 4*(2). https://doi.org/10.1103/PhysRevSTPER.4.020106

House, J. D. (2006). Mathematics beliefs and achievement of elementary school students in Japan and the United States: Results from the Third International Mathematics and Science Study. *The Journal of Genetic Psychology, 167*(1), 31-45. https://doi.org/10.3200/GNTP.167.1.31-45

Le, A., Joordens, S., Chrysostomou, S., & Grinnell, R. (2010). Online lecture accessibility and its influence on performance in skills-based courses. *Computers and Education, 55*(1), 313–319. https://doi.org/10.1016/j.compedu.2010.01.017

Lin, S. W., & Tai, W. C. (2015). Latent class analysis of students' mathematics learning strategies and the relationship between learning strategy and mathematical literacy. *Universal Journal of Educational Research, 3*(6), 390-395. https://doi.org/10.13189/ujer.2015.030606

Mesa, V., Wladis, C., & Watkins, L. (2014). Research problems in community college mathematics education: Testing the boundaries of K—12 research. *Journal for Research in Mathematics Education, 45*(2), 173–192. https://doi.org/10.5951/jresematheduc.45.2.0173

Myyry, L., & Joutsenvirta, T. (2015). Open-book, open-web online examinations: Developing examination practices to support university students’ learning and self-efficacy. *Active Learning in Higher Education, 16*(2), 119–132. https://doi.org/10.1177/1469787415574053

Nickerson, L.A., & Shea, K. M. (2020). First-semester organic chemistry during COVID-19: Prioritizing group work, flexibility, and student engagement. *Journal of Chemical Education, 97*(9), 3201–3205. https://doi.org/10.1021/acs.jchemed.0c00674

Phelps-Gregory, C. M., Frank, M., & Spitzer, S. M. (2020). Prospective elementary teachers’ beliefs about mathematical myths: a historical and qualitative examination. *The Teacher Educator, 55*(1), 6-27. https://doi.org/10.1080/08878730.2019.1618423

Pokhrel, S. & Chhetri, R. (2021). A literature review on impact of COVID-19 Pandemic on teaching and learning. *Higher Education for the Future, 8*(1), 133–141. https://doi.org/10.1177/2347631120983481

Public Policy Institute of California Higher Education Center (2017). *Higher Education in California*. https://www.ppic.org/wp-content/uploads/r_0917hebkr.pdf

Redish, E. F., Saul, J. M., & Steinberg, R. N. (1998). Student expectations in introductory physics. *American Journal of Physics*, *66*(3), 212–224. https://doi.org/10.1119/1.18847

Schoenfeld, A. H. (1989). Explorations of students' mathematical beliefs and behavior. *Journal for Research in Mathematics Education*, *20*(4), 338–355. https://doi.org/10.2307/749440

Songer, N. B., & Linn, M. C. (1991). How do students' views of science influence knowledge integration? *Journal of Research in Science Teaching*, *28*(9), 761–784. https://doi.org/10.1002/tea.3660280905

Soria, K.M., Horgos, B., Chirikov, I., & Jones-White, D. (2020). First-generation students' experiences during the COVID-19 pandemic. SERU Consortium, University of California-Berkeley and University of Minnesota. https://escholarship.org/uc/item/19d5c0ht

Stigler, J. W., Givvin, K. B., & Thompson, B. J. (2010) What community college developmental mathematics students understand about mathematics. *The MathAMATYC Educator, 1*(3), 4-16.

Stigler, J. W., Son, J. Y., Givvin, K. B., Blake, A. B., Fries, L., Shaw, S. T., & Tucker, M. C. (2020). The better book approach for education research and development. *Teachers College Record*, *122*(9), 1–32. https://doi.org/10.1177/016146812012200913

Son, J. Y., & Stigler, J. W. (2016-21), "Statistics and Data Science: A Modeling Approach" https://coursekata.org/preview/default/program

Sutter, C. C., Hulleman, C. S., Givvin, K. B., & Tucker, M. (2022). Utility value trajectories and their relationship with behavioral engagement and performance in introductory statistics. *Learning and Individual Differences, 93*, 102095. https://doi.org/10.1016/j.lindif.2021.102095

Theophilides, C., & Dionysiou, O. (1996). The major functions of the open-book examination at the university level: A factor analytic study. *Studies in*

Educational Evaluation, 22(2), 157–170. https://doi.org/10.1016/0191-491X(96)00009-0

Tucker, C. M., Shaw, S. T., Son, J. Y., & Stigler, J. W. (under review). Teaching statistics and data analysis with R. *Journal of Statistics and Data Science Education. 31*(1), 18–32. https://doi.org/10.1080/26939169.2022.2089410

University of California Office of the President. (n.d.). California master plan for higher education. https://www.ucop.edu/institutional-research-academic-planning/content-analysis/academic-planning/california-master-plan.html

US News. (2022a). Los Angeles Pierce College. https://www.usnews.com/education/community-colleges/los-angeles-pierce-college-CC04814

US News. (2022b). California State University-Los Angeles. https://www.usnews.com/best-colleges/california-state-university-los-angeles-1140

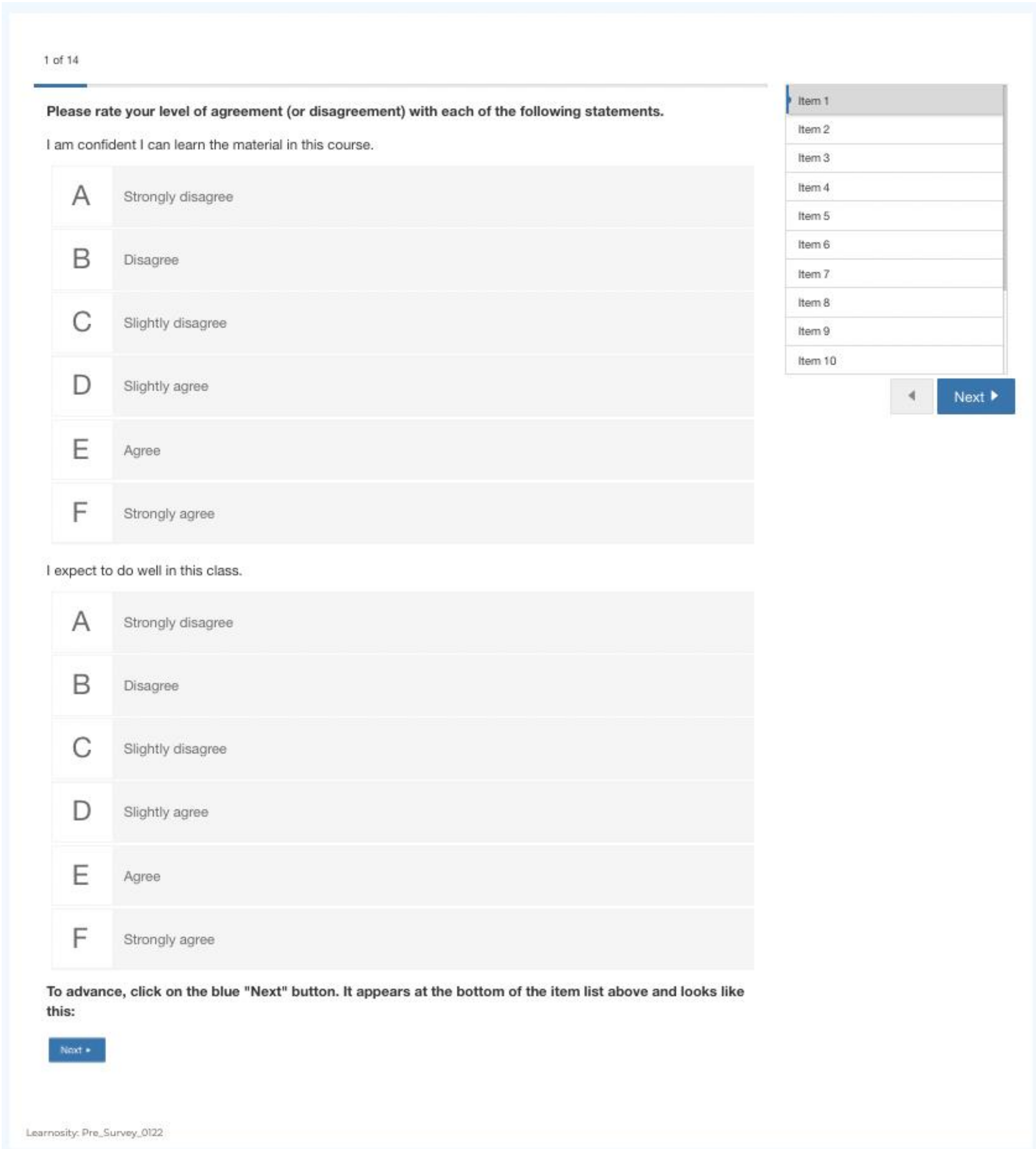
US News. (2022c). University of California-Los Angeles. https://www.usnews.com/best-colleges/university-of-california-los-angeles-1315

Weber, L. J., McBee, J. K., & Krebs, J. E. (1983). Take home tests: An experimental study. *Research in Higher Education, 18*(4), 473–483. https://doi.org/10.1007/BF00974810

Winthrop, R. (2020, April 10). Top 10 risks and opportunities for education in the face of COVID-19. *Brookings*. https://www.brookings.edu/blog/education-plus-development/2020/04/10/top-10-risks-and-opportunities-for-education-in-the-face-of-covid-19/

Wheeler, D. L., & Montgomery, D. (2009). Community college students' views on learning mathematics in terms of their epistemological beliefs: A Q method study. *Educational Studies in Mathematics, 72*(3), 289-306. https://doi.org/10.1007/s10649-009-9

Appendix A: 14-item Pre-Survey



1 of 14

Please rate your level of agreement (or disagreement) with each of the following statements.

I am confident I can learn the material in this course.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

I expect to do well in this class.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

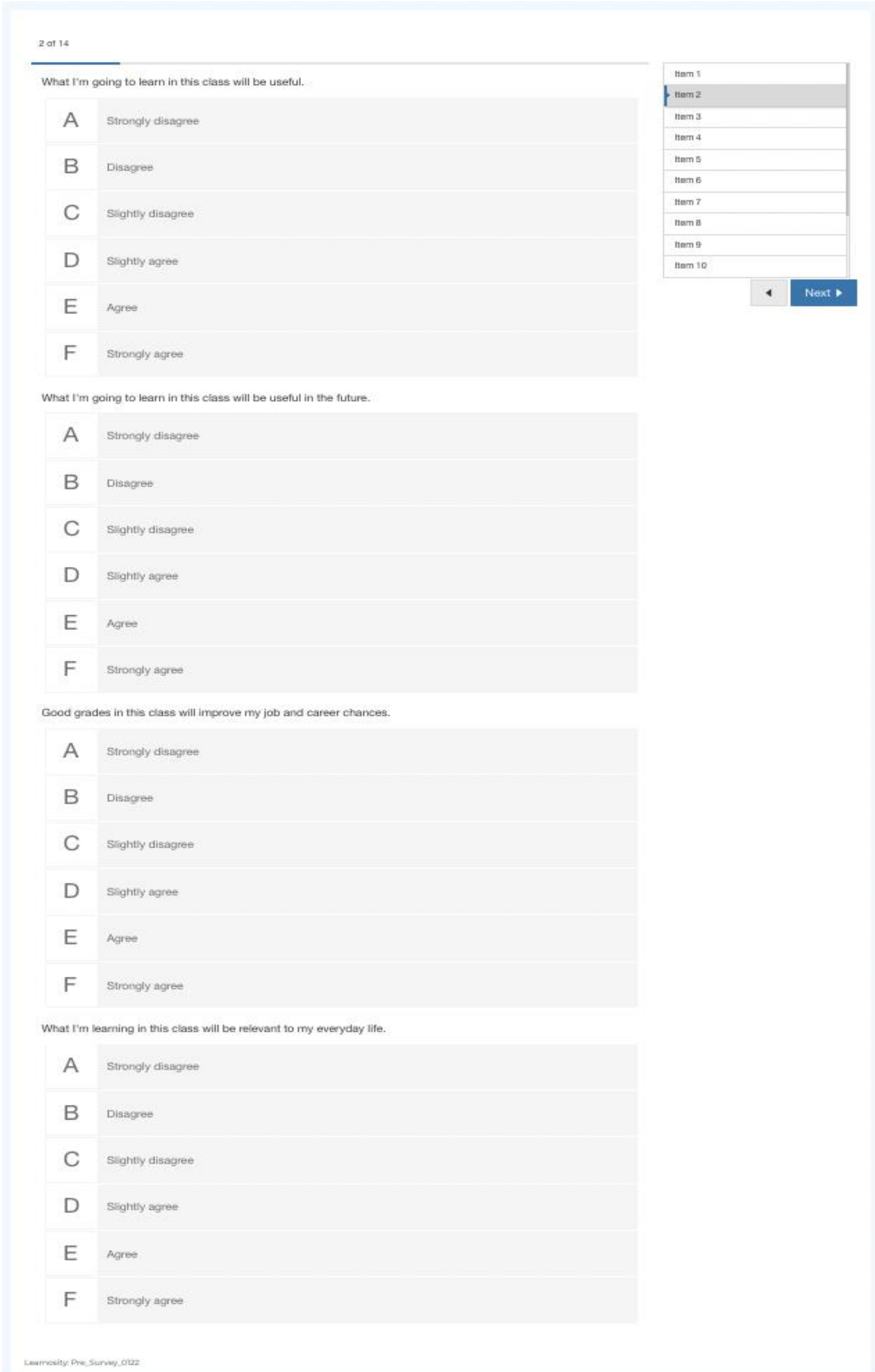
To advance, click on the blue "Next" button. It appears at the bottom of the item list above and looks like this:

Next

Item 1
Item 2
Item 3
Item 4
Item 5
Item 6
Item 7
Item 8
Item 9
Item 10

Next

Learnosity: Pre_Survey_0122


2 of 14

What I'm going to learn in this class will be useful.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

What I'm going to learn in this class will be useful in the future.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

Good grades in this class will improve my job and career chances.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

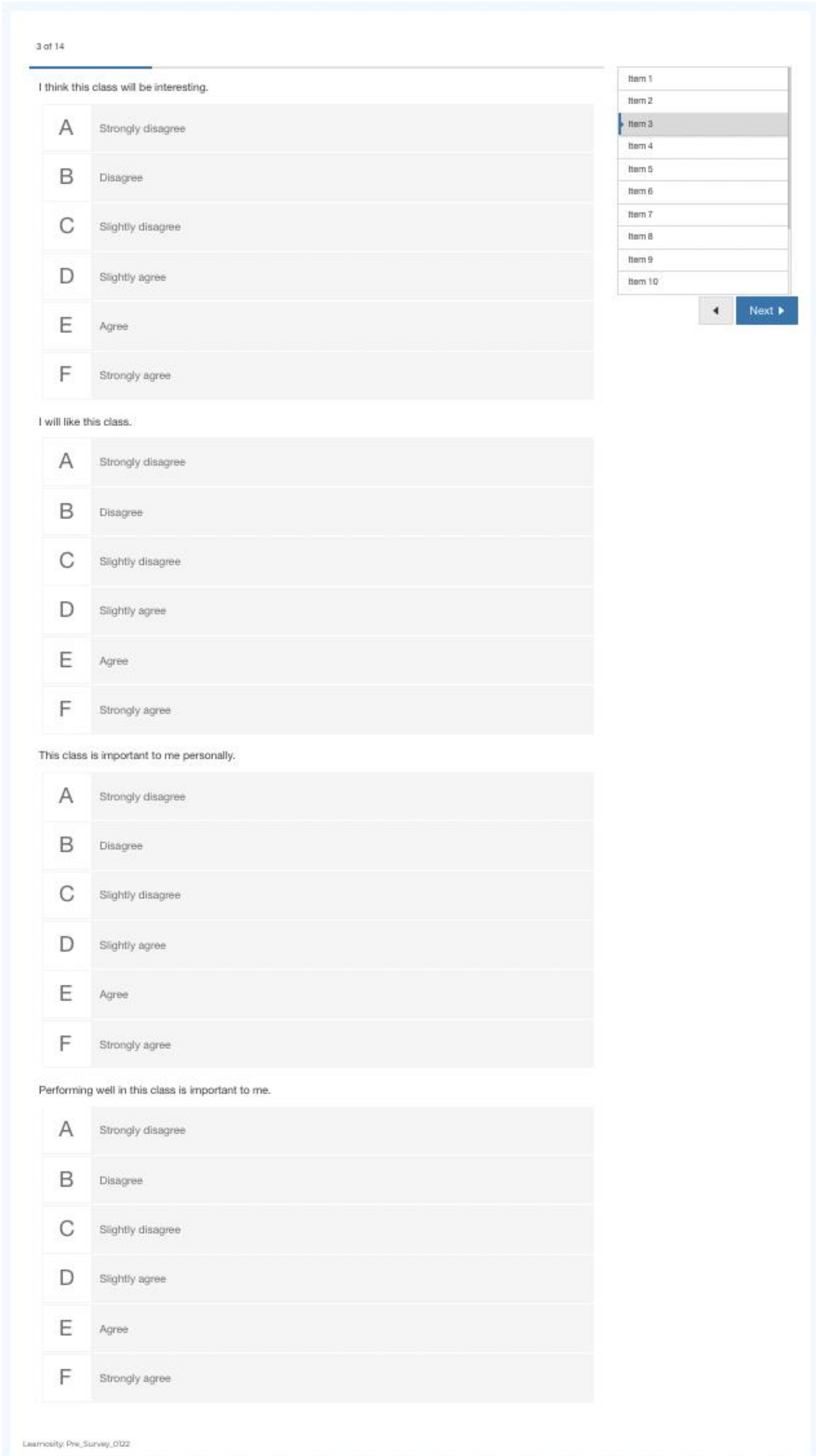
What I'm learning in this class will be relevant to my everyday life.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

Item 1
Item 2
Item 3
Item 4
Item 5
Item 6
Item 7
Item 8
Item 9
Item 10

Next

Learnosity: Pre_Survey_0122



3 of 14

I think this class will be interesting.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

I will like this class.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

This class is important to me personally.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

Performing well in this class is important to me.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

Item 1
Item 2
Item 3
Item 4
Item 5
Item 6
Item 7
Item 8
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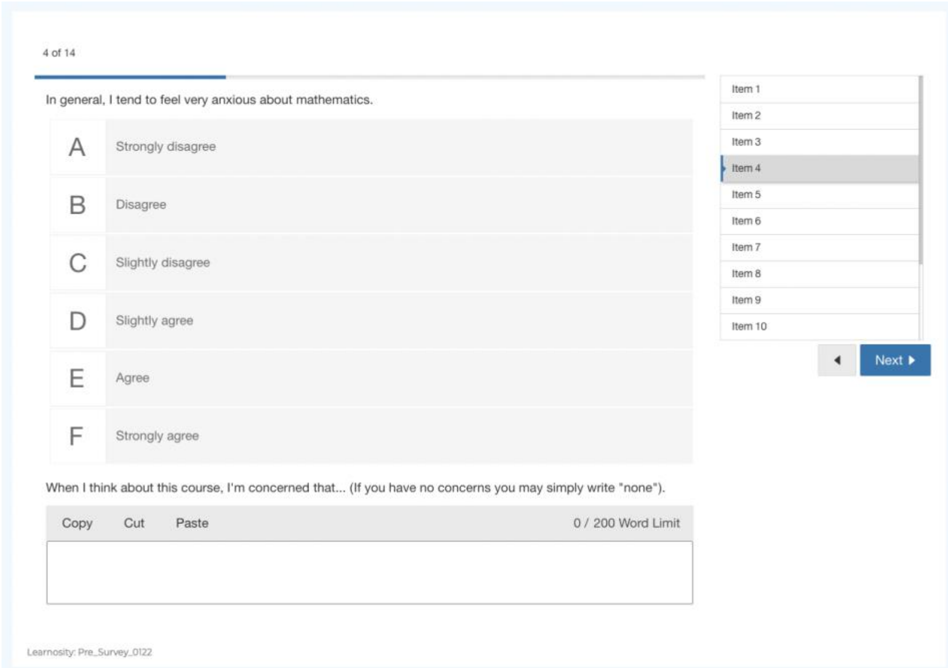
4 of 14
In general, I tend to feel very anxious about mathematics.
A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree
When I think about this course, I'm concerned that... (If you have no concerns you may simply write "none").
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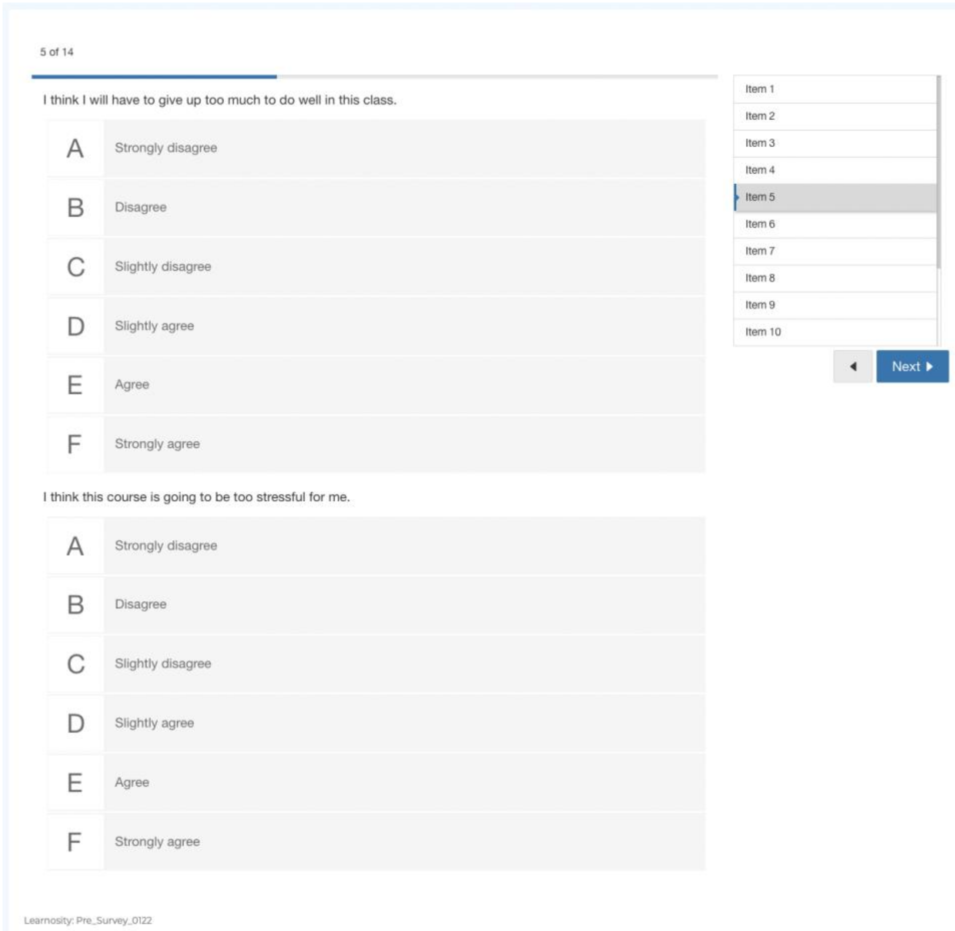
5 of 14
I think I will have to give up too much to do well in this class.
A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree
I think this course is going to be too stressful for me.
A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree
Item 1
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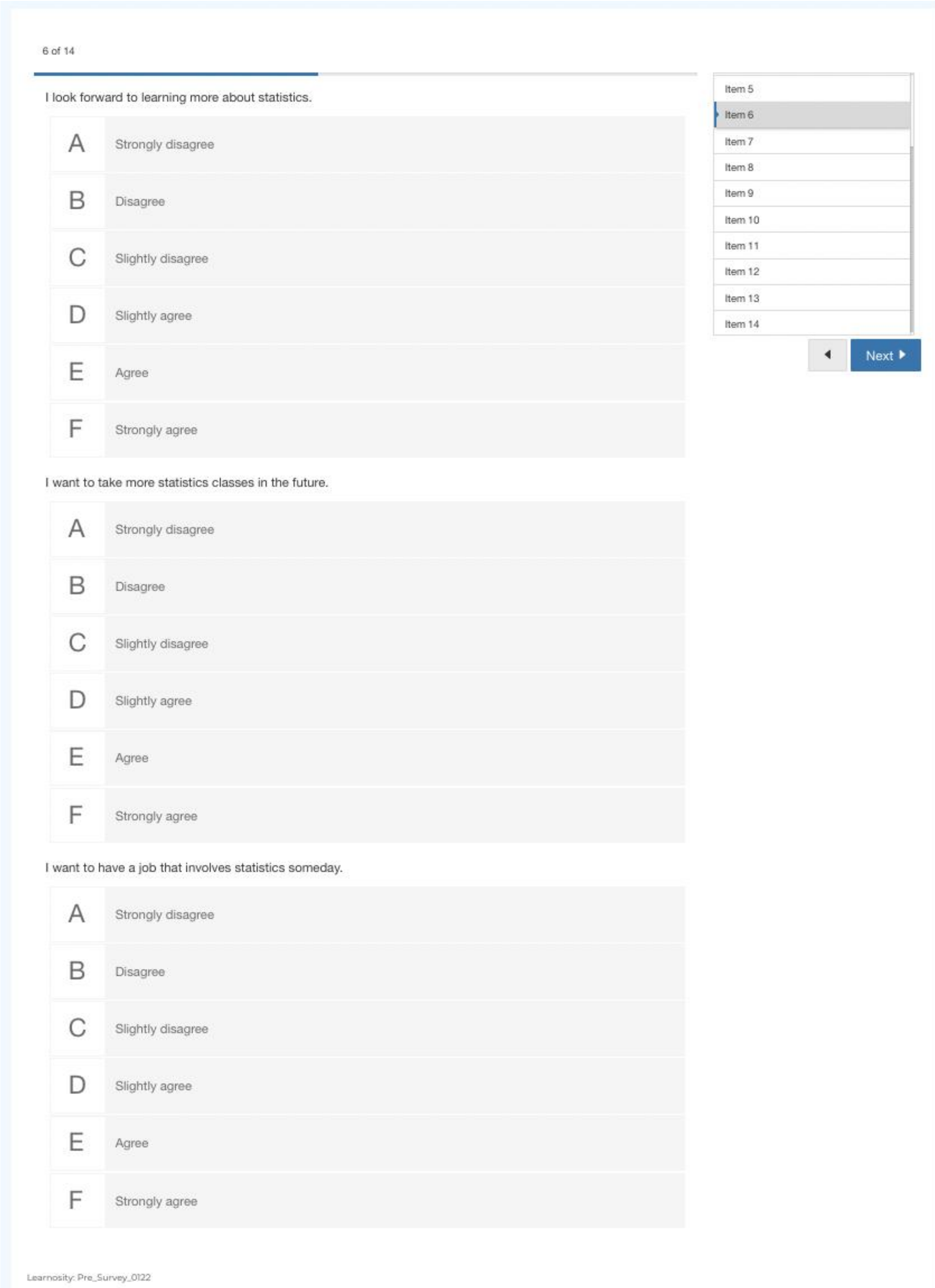

6 of 14

I look forward to learning more about statistics.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

I want to take more statistics classes in the future.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

I want to have a job that involves statistics someday.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

Item 5
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Item 14

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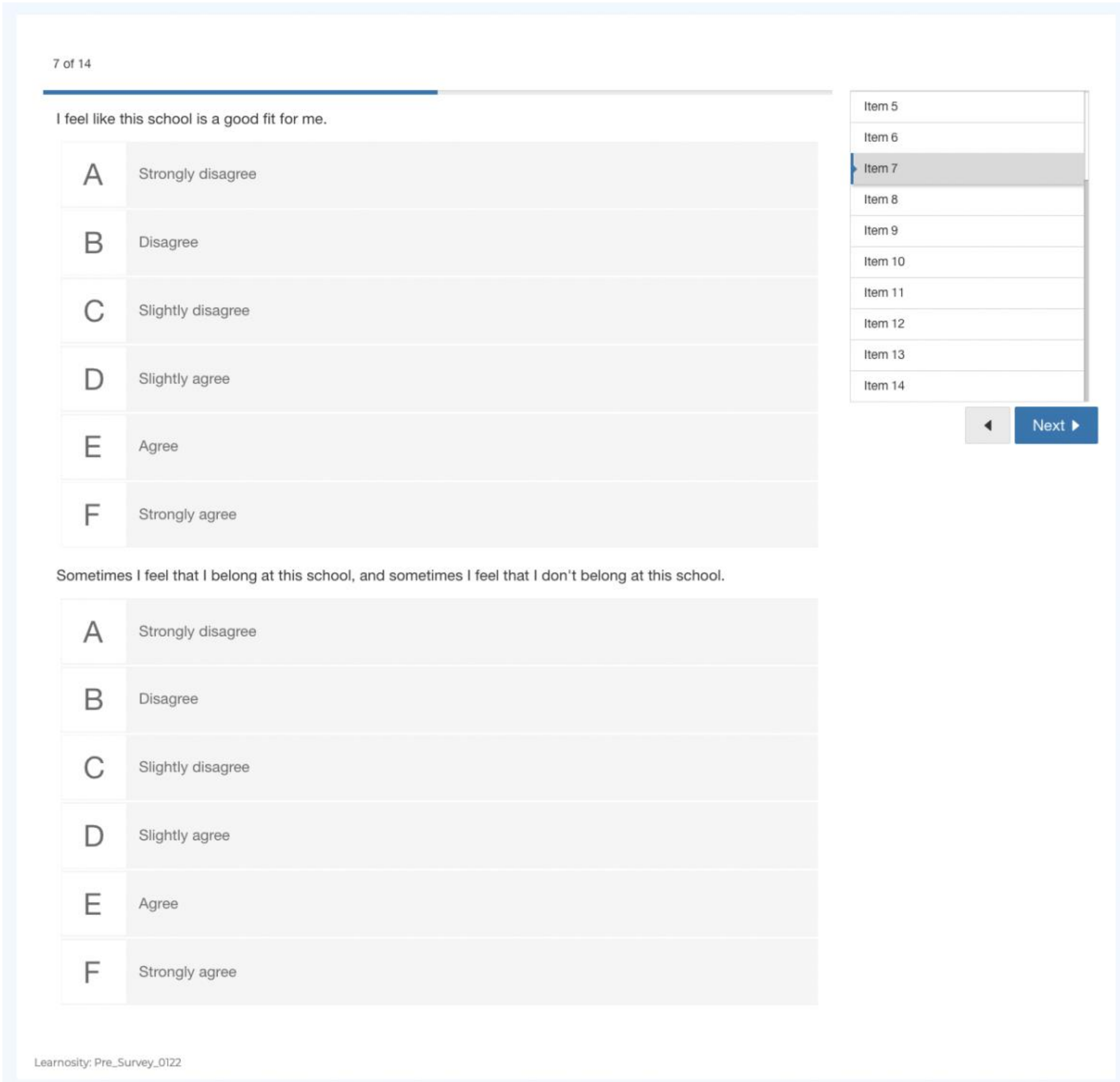

7 of 14

I feel like this school is a good fit for me.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

Sometimes I feel that I belong at this school, and sometimes I feel that I don't belong at this school.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

Item 5
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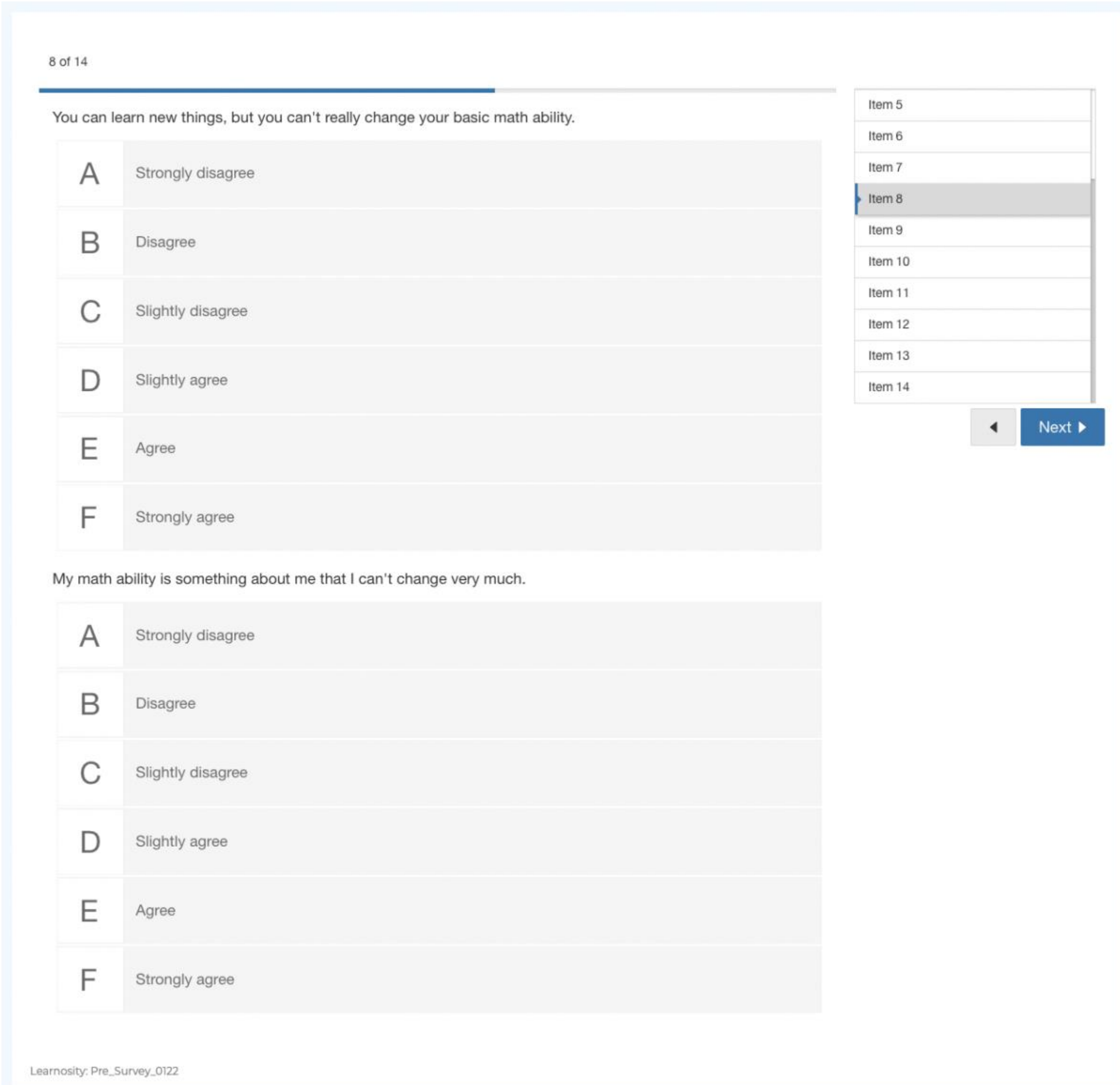

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You can learn new things, but you can't really change your basic math ability.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

My math ability is something about me that I can't change very much.

A Strongly disagree
B Disagree
C Slightly disagree
D Slightly agree
E Agree
F Strongly agree

Item 5
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Item 7
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How confident are you in your R skills?
A
Not at all confident
B
Only a little confident
C
Somewhat confident
D
Mostly confident
E
Completely confident
Item 5
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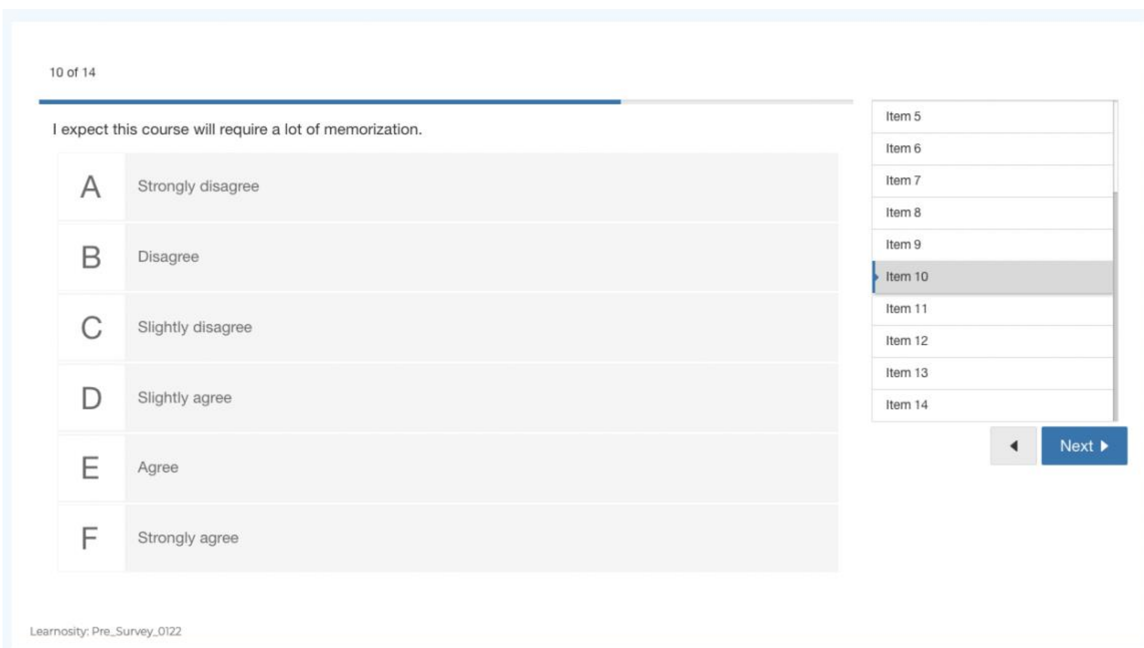
10 of 14
I expect this course will require a lot of memorization.
A
Strongly disagree
B
Disagree
C
Slightly disagree
D
Slightly agree
E
Agree
F
Strongly agree
Item 5
Item 6
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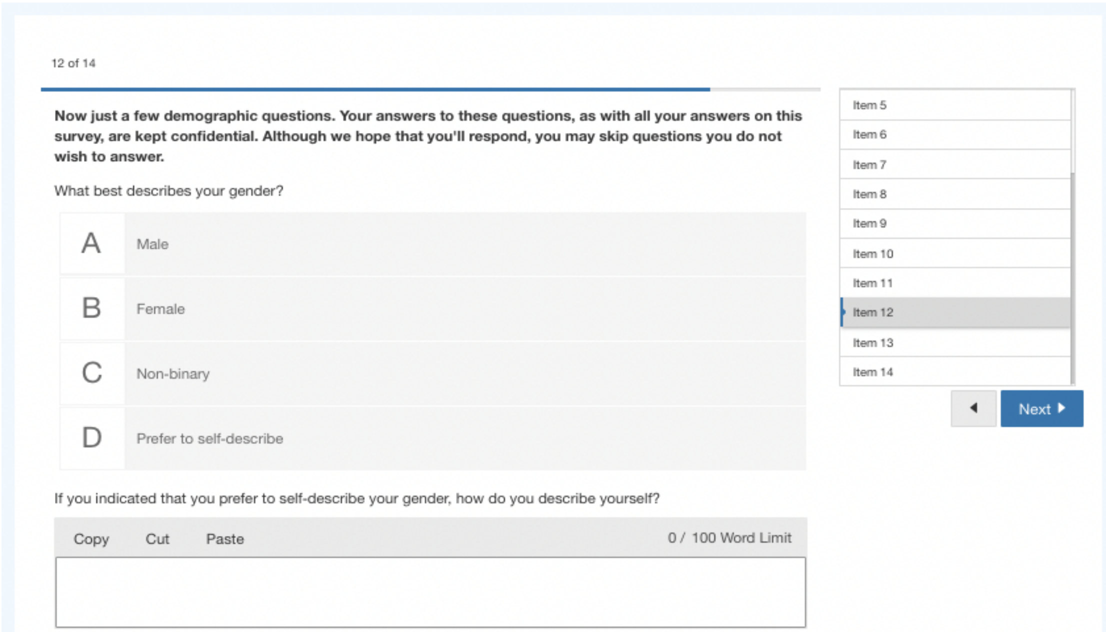
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Now just a few demographic questions. Your answers to these questions, as with all your answers on this survey, are kept confidential. Although we hope that you'll respond, you may skip questions you do not wish to answer.
What best describes your gender?
A Male
B Female
C Non-binary
D Prefer to self-describe
If you indicated that you prefer to self-describe your gender, how do you describe yourself?
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Next

Which of the following categories describe you? If you'd like to use more than one category or if you'd like to use a category not provided, please select "prefer to self-describe" and answer the next question.

A **American Indian or Alaska Native** (Examples include Navajo Nation, Blackfeet Tribe, Mayan, Aztec, Nome Eskimo Community, etc)

B **Asian or Asian Am.** (Examples include Asian American, Chinese, Fillipino, Asian Indian, Vietnamese, Korean, etc.)

C **Black or African Am.** (Examples include African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.)

D **Hispanic, Latino, or Spanish Origin** (Examples include Mexican or Mexican American, Puerto Rican, Cuban, Salvadorian, Dominican, Columbian, etc.)

E **Middle Eastern or North African** (Examples include Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, etc.)

F **Native Hawaiian or Pacific Islander** (Examples include Native Hawaiian, Samoan, Chamorro, Tongan, Fijian, Marshalese, etc)

G **White** (Examples include German, Irish, English, French, Norwegian, etc.)

H Prefer to self-describe my race, ethnicity, or national origin

If you prefer to self-describe your race, identity, or national origin, how do you describe yourself?

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What's your year in school?

A Freshman

B Sophomore

C Junior

D Senior

E Other

What's your age, in years?

Approximately how many hours per week do you work at paid employment?

A I don't currently have paid employment.

B 1-10 hours per week

C 11-20 hours per week

D 21-30 hours per week

E 31-40 hours per week

F 40+ hours per week

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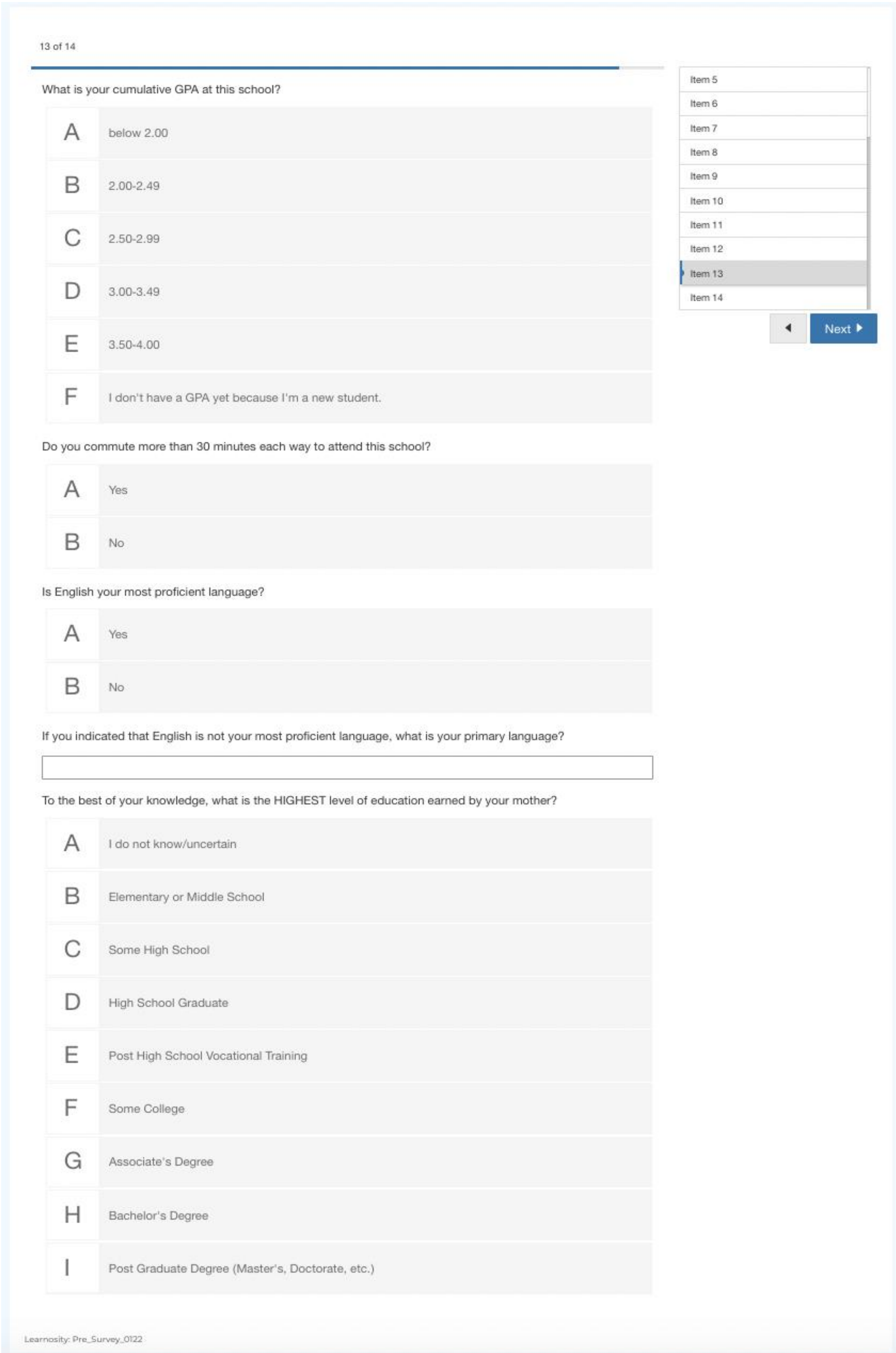

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What is your cumulative GPA at this school?

A below 2.00

B 2.00-2.49

C 2.50-2.99

D 3.00-3.49

E 3.50-4.00

F I don't have a GPA yet because I'm a new student.

Do you commute more than 30 minutes each way to attend this school?

A Yes

B No

Is English your most proficient language?

A Yes

B No

If you indicated that English is not your most proficient language, what is your primary language?

To the best of your knowledge, what is the HIGHEST level of education earned by your mother?

A I do not know/uncertain

B Elementary or Middle School

C Some High School

D High School Graduate

E Post High School Vocational Training

F Some College

G Associate's Degree

H Bachelor's Degree

I Post Graduate Degree (Master's, Doctorate, etc.)

Item 5
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Item 12
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Item 14

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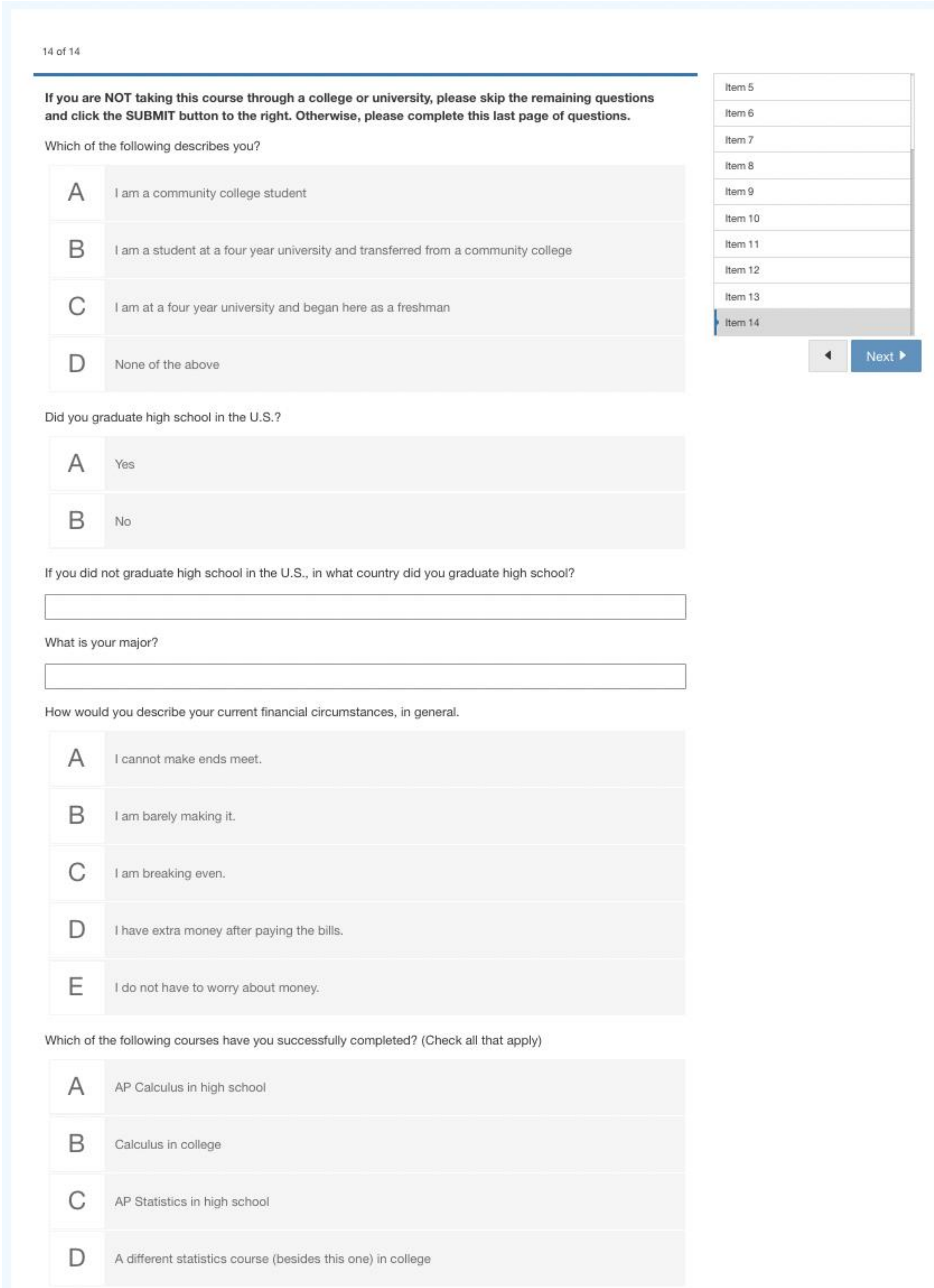

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If you are NOT taking this course through a college or university, please skip the remaining questions and click the SUBMIT button to the right. Otherwise, please complete this last page of questions.

Which of the following describes you?

A I am a community college student

B I am a student at a four year university and transferred from a community college

C I am at a four year university and began here as a freshman

D None of the above

Did you graduate high school in the U.S.?

A Yes

B No

If you did not graduate high school in the U.S., in what country did you graduate high school?

What is your major?

How would you describe your current financial circumstances, in general.

A I cannot make ends meet.

B I am barely making it.

C I am breaking even.

D I have extra money after paying the bills.

E I do not have to worry about money.

Which of the following courses have you successfully completed? (Check all that apply)

A AP Calculus in high school

B Calculus in college

C AP Statistics in high school

D A different statistics course (besides this one) in college

Item 5
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Online Learning Anxiety and Academic Self-Efficacy During the COVID-19 Crisis

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Al-Qasemi Academic College, Baqa-El-Gharbia, Israel

Lena Gnaim-Abu Touma

Al-Qasemi Academic College, Baqa-El-Gharbia, Israel

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Abstract

This study investigated the relationship between students' online learning anxiety (OLA) and academic self-efficacy (ASE) amid global challenges posed by the COVID-19 crisis. Participants in this quantitative research included 718 tertiary education students from 28 countries who responded to a standardized questionnaire. Despite the crisis' widespread negative impact, the adoption of innovative online teaching models created positive learning environments that significantly enhanced students' self-efficacy. The results of this research revealed a positive correlation between ASE and OLA, contrary to Bandura's social-cognitive theory. This unexpected relationship challenged the notion that anxiety arises directly from low self-efficacy beliefs. The findings also partially aligned with existing research on positive correlations between online learning and anxiety, as well as between sociodemographic factors and OLA.

This study contributes to the plethora of research conducted about online learning, anxiety, and self-efficacy in times of crisis.

Keywords: COVID-19, innovative online learning, anxiety, academic self-efficacy, international students

Chaleila, W. A., Qadan, E., Abu Touma, L.G., Assaly, I., Atamna, U., Habayeb H., Masarweh, A. (2024). Online Learning Anxiety and Academic Self-Efficacy during COVID-19 Crisis, *Online Learning, Volume 28*(2), (305-328). DOI: 10.24059/olj.v28i2.

The COVID-19 pandemic precipitated a global state of emergency, necessitating the immediate implementation of social distancing measures in various communal spaces. Terms such as “lockdowns,” “masks,” “quarantines,” and “physical distancing” became ubiquitous globally over the past three years. This new reality forced businesses, universities, schools, and other establishments to close to prioritize public safety (Burgess & Sievertsen, 2020). Consequently, online learning, traditionally viewed as a supplemental educational method, swiftly evolved into the primary mode, gaining universal prominence across different levels and regions worldwide (Dhawan, 2020). In the United States alone, over a thousand universities and colleges transitioned to exclusively online formats, affecting millions of students (Pragholapati, 2020). The sudden shift to a technology-based learning environment has given rise to a generation of online learners, triggering anxiety and panic among large segments of the population (Knolle et al., 2021), especially among students and professors (Weyandt et al., 2020; Wakui et al., 2021). Many postsecondary students have struggled with unconventional and advanced online materials, prompting our research, which is novel for several reasons. First, while extensive research has addressed anxiety, online learning, and academic self-efficacy (ASE) individually (Saadé & Kira, 2009; Hauser et al., 2012; Castro & Tumibay, 2021), our study uniquely evaluates these three aspects together, particularly examining anxiety in its current manifestation, termed "Online Learning Anxiety" (OLA), on a global scale. Second, despite existing studies demonstrating positive correlations between ASE and online learning (Dangal & Bajracharya, 2020; Basheti et al., 2021), no research to our knowledge has explored the relationship between OLA and ASE during crises such as COVID-19. This absence highlights the need for a scale to measure learning anxiety as it specifically pertains to synchronous and asynchronous learning rather than hybrid or blended learning.

Literature Review

Online Learning During COVID-19

Vayre and Vonthorn (2017) expressed concerns about online learning, highlighting the increased responsibility placed on students and potential quandaries such as a "lack of interaction and feedback, difficulty initiating and maintaining communication, ambiguity in posted messages, and technical disruptions" (p. 199). The COVID-19 crisis significantly accelerated the integration of the internet into higher education, impacting both students and educators (Gültekin et al., 2020; Castro & Tumibay, 2021). Despite these challenges, numerous studies indicated positive outcomes for students' academic self-efficacy (ASE) in terms of online and digital learning (Martin & Bolliger, 2018; Heckel & Ringeisen, 2019; Schaefer et al., 2020; Yang X et al., 2021; Nasir, 2020; Alghamdi et al., 2020; Yang J et al., 2021; Al-Kumaim et al., 2021). For instance, Yang J et al. (2021) concluded that e-learning positively affects students' academic self-efficacy and motivation for learning. Several studies revealed a reciprocal positive relationship between ASE and online learning, suggesting that students overcame the dilemmas of isolation and embraced productive, self-directed learning, online self-efficacy beliefs, positive expectations, and technology use (Bates & Khasawneh, 2007; Prior et al., 2016). Additionally, emotional abilities were recognized as crucial alongside cognitive capabilities in students' ability to cope with the demands of higher education, endorsing academic success (Shenaar-Golan et al., 2020).

Online Learning, ASE, and Anxiety

Extensive research underscored the profound impact of the COVID-19 crisis on students' mental, emotional, and social well-being, manifested in increased levels of depression, anxiety, and stress (Chandasiri, 2020). The frequent use of computers without anxiety-reducing mechanisms was associated with elevated anxiety levels (Marakas, et al., 1998; Hauser, et al., 2012). Technology use, when not balanced, resulted in feelings of frustration, confusion, anger, and anxiety, influencing productivity, learning, social relationships, and overall well-being (Saadé & Kira, 2009).

While Bandura (1988) suggested a negative correlation between academic self-efficacy (ASE) and anxiety, Cassady and Finch (2020) argued against viewing this relationship as inherently inverse (p. 10). Despite well-established detrimental effects of test anxiety on memory, attention, and performance, some studies indicated that students increasingly relied on their own abilities for studying and time management (Tobias, 1985; Wigfield & Eccles, 1989). Along these lines, German students' perceived probability of success in remote learning, ASE, and lecturer preparedness were identified as relevant variables (Hoss et al., 2022) and an Israeli study found positive correlations between ASE, social support, and academic success, emphasizing the need for universities to enhance preparedness for online learning environments (Warshawski, 2022). However, other studies showed that in Germany, the rapid shift to digital platforms during the crisis exposed the limitations of existing strategies and highlighted the importance of a comprehensive and supportive framework for digital transformation in education (Kerres 2020). Likewise, in Israel, a 2022 study revealed that 63.2% of 4,710 university students encountered challenges with online learning during COVID-19, triggering the urgency of establishing targeted services to offer tangible support to students in similar cases (Schiff et al., 2022). In the United States, the transition to exclusive online instruction raised apprehensions about the quality of remote educational delivery. Earlier research cautioned that remote courses could disproportionately impact the academic performance of students already facing challenges. Furthermore, studies indicated that as many as 20% of college students had encountered difficulties accessing essential technology, such as functioning laptops and reliable high-speed internet (Smalley, 2021).

Similarly, the experience with online learning contributed to higher online ASE as noted by Panergayo and Mansujeto (2021), while research across six studies demonstrated a positive correlation between online communication and ASE (Peechapol et al., 2018). Elliot and Sheldon (1997) even argued that failure-related anxiety might enhance students' performance in certain cases. Unexpectedly, findings from an OECD study (2020) challenged assumptions about failure-related anxiety predicting academic performance. The study suggested that students who had reported higher degrees of failure-related anxiety achieved higher grades than those who had expressed less anxiety about failing. Moreover, students with the lowest ASE outperformed those with the highest ASE in terms of grades.

Online Learning as a Moderating Factor of Anxiety

While some studies presented divergent views on the impact of online learning, with arguments for both detrimental and constructive effects (Wang et al., 2021; Maqableh & Alia, 2021), a substantial body of research suggested that students' anxiety could be mitigated through appropriate training (Martin & Bolliger, 2018; Heckel & Ringeisen, 2019; Schaefer et al., 2020; Yang X et al., 2021; Nasir, 2020; Alghamdi et al., 2020; Al-Kumaim et al., 2021; Yang J et al., 2021). This moderation of anxiety was attributed to the supportive measures implemented by professors and institutions during the pandemic, including streamlined course loads and open-book exams (Son et al., 2020). Creating a supportive online environment appeared crucial in helping students manage and neutralize anxiety, minimizing its impact as a threatening factor. Al-Kumaim et al. (2021) indicated that accessible and interactive online learning platforms had allowed 72.4% of students to control the adverse effects of anxiety. Other research, such as Shuster et al. (2021), suggested that anxiety naturally diminished over time. Consequently, the adoption of online learning methods played a significant role in reducing students' cognitive anxiety and concurrently enhancing their academic self-efficacy (ASE) and self-motivation.

Research Objectives and Hypotheses

In pursuit of a more profound understanding of the prevailing online pedagogy amid the COVID-19 crisis, and recognizing the scarcity of research specifically exploring students' Academic Self-Efficacy (ASE) and its association with Online Learning Anxiety (OLA) during the pandemic, our study aimed to investigate three research hypotheses:

- Hypothesis One: We hypothesize a significant statistical relationship between ASE and OLA, suggesting that students' academic self-efficacy may be associated with their levels of online learning anxiety.

- Hypothesis Two: We postulate a significant statistical relationship between students' anxiety rates and online learning, aiming to explore the potential link between overall anxiety levels and engagement with online educational platforms.

- Hypothesis Three: We anticipate a significant statistical relationship between sociodemographic factors and OLA, acknowledging the potential influence of demographic variables on students' experiences of online learning anxiety.

Materials and Methods

Participants' Sociodemographic Details

This cross-sectional study employed a snowball sampling technique via an online questionnaire for participant recruitment. It is crucial to acknowledge that in snowball sampling, the number of the overall population is unknown (Raina, 2015). A total of 718 higher education students from various universities and colleges in 28 countries responded to the questionnaire. Notably, 45.8% of response (n=329) came from Israel, 15.5% (n=111) from Germany, and the rest 38.7% (n=278) from 26 other countries. Respondents' ages ranged from 18 to 74 years with 30.6% (n=220) identifying as male and 68% (n=68) as female. Regarding marital status, 70.8% (n = 508) were single, 13.8% (n = 99) were married, and 3.6% (n=26) were married with children. In terms of academic levels, the majority (65.7%, n= 472) were first-degree students, 16.2% (n=116), were second-degree students, 3.6% (n=26) were third-degree students, and the remaining 14.5%, (n=104) were enrolled in other tracks.

Procedure

To maximize the response rate, collaborative efforts were made with national and international fellow researchers across 31 institutions to disseminate the online questionnaire to their students. Utilizing the snowball sampling technique, the sampling process extended through referrals from participating students, ultimately encompassing 109 institutions. Participants were provided with detailed information about the study's objectives, the estimated time required for questionnaire completion (approximately fifteen minutes), and an assurance of anonymity. The questionnaire was presented in English. Data collection took place from April 5th to May 9th, 2021, at the height of the pandemic outbreak and the subsequent shift to online learning.

Measures

Given the preliminary nature of this research, and the absence of readily available questionnaires aligning with the proposed research hypotheses, the study necessitated the development of a pilot questionnaire. Drawing from the literature review and incorporating elements from three previously-validated scales—the 11-item Self-Regulated Learning Scale (Zimmerman et al., 1992), the 8-item Academic Self-Efficacy Inventory (Chemers, Hu, & Garcia, 2001), and the 36-item Test of e-Learning Related Attitudes (TeLRA) scale (Kisanga & Ireson, 2016)—a 75-item pilot questionnaire was devised.

The questionnaire comprised three measuring instruments: A Sociodemographic Scale and general questions about online learning; OLA Scale; ASE Scale. Both the ASE and OLA scales were adjusted as four-point Likert-type scales, commonly used for attitude measurement. Importantly, the phraseology of all items was modified to align with the reality of online learning. For instance, in the OLAS, the phrase "During online learning ensued from the Covid-19 crisis" preceded all items, and all statements were framed to specifically address online learning concerns (e.g., “I am concerned that online assignments will take longer to complete compared to those given in frontal lectures”).

Given the absence of precise and suitable existing instruments addressing both COVID-19 and online learning, a group consensus approach was adopted utilizing the Delphi method (Linstone & Turnoff, 1975) for face and content validity. Six professionals in statistics, psychiatry, and education evaluated the questionnaire, ensuring a comprehensive and representative assessment (Cohen, et al., 2011). Following this process, two ambiguous and three repetitive items were discarded, resulting in a finalized 70-item questionnaire that attained consensus. In addition, the study employed Cronbach’s alpha to assess the reliability and internal consistency of the adapted measurement instruments. The online anxiety scale showed high consistency $\alpha = 0.961$.

Socio-Demographic Scale and General Questions About Online Learning

This instrument consisted of two sections: Eight items focused on gender, age, marital status, citizenship, first language, location of university, study track, academic year level, and specialization, whereas 11 questions focused on online learning practices (e.g., which device do you use for online lectures?). It is noteworthy that ethnicity and race were deliberately omitted from this study. The primary objective was to examine students’ anxiety, and including such inquiries could potentially discourage students from completing the questionnaire. The emphasis was placed on aspects directly relevant to the study's central aim rather than investigating the demographic specifics of ethnic or racial backgrounds.

OLA Scale

The reliability coefficient for the 36-item OLA measuring instrument was calculated to be $\alpha = 0.96$. The subscale used a four-point Likert-type scale ranging from (1) strongly disagree to (4) strongly agree: (e.g., “I get overwhelmed by loneliness and lack of human contact”).

ASE Scale

The 16-item ASE Scale was modified to assess the impact of online learning during the COVID-19 pandemic. Each item was prefaced by the phrase “In your opinion, online learning resulted from COVID-19 has affected…” These items were presented on a 4-point Likert-type scale, with values ranging from 1 (very positively*)* to 4 (very negatively). The reliability coefficient for this modified scale was calculated to be $\alpha = 0.929$. This high alpha value suggests a robust internal consistency among the items within the ASE Scale, indicating that the adapted questions are highly correlated, and that participants’ responses are consistent.

Results

Data Analysis

The data analysis for this study was conducted using statistical software SPSS 23.0. Descriptive analysis was employed to summarize and present the characteristics of the data. In addition, a t-test and an ANOVA test were utilized for comparative analyses, and reliability statistics were computed to assess the internal consistency of the measurement instruments. ROC analysis was performed for diagnostic accuracy assessment, and multivariate analysis was conducted for examining relationships among multiple variables. The threshold for statistical significance was set at $p < 0.05$.

Table 1

Means, Standard Deviations, and Correlations Among Anxiety (Sub-)Scales

	(Sub-) Scales	M	SD	1	2	3	4	5	6	7
1	**ASE Scale**	2.636	0.645	1.0000						
2	**OLA Scale**	2.875	.63300	0.154**	1.0000					
3	**Academic Assessment of Online Learning**	2.862	0.689	0.164**	0.848**	0.299**	1.0000			
4	**Anxiety about Online Academic Failure**	2.850	0.833	0.055	0.834**	0.109**	0.727**	1.0000		
5	**Anxiety about Online Technical Problems**	3.033	0.702	0.157**	0.884**	0.239**	0.699**	0.586**	1.0000	

6	**Anxiety about Communication Problems with Lecturers**	2.747	0.702	0.195**	0.834**	0.310**	0.751**	0.682**	0.668**	1.0000

Correlation is significant at the 0.01 level (2-tailed**)

Based on Table 1, there were significant positive correlations between ASE and three categories of OLA: online academic assessment, technical problems, and communication with lecturers (0.164, 0.157, 0.195, respectively; p < 0.001). The Spearman's correlation coefficients indicated moderate and significant positive correlation (p < 0.001) between the scales, suggesting that as OLA increased, ASE also increased. Furthermore, ASE demonstrated moderate and significant correlations with all variables except for anxiety about academic failure. This implies that students' confidence in their academic abilities was associated with various aspects of OLA.

Table 2

Means and Differences of Anxiety Between Low/High Levels of ASE

	(Sub-) Scales	**ASE**				
		LOW		**HIGH**		**F**
		M	**SD**	**M**	**SD**	
1	OLA	2.8264	0.607	2.9752	0.672	8.842**
2	Anxiety about Academic Assessment of Online Learning	2.790	0.685	3.010	0.675	16.365**
3	Anxiety about Academic Failure	2.824	0.812	2.904	0.874	1.447
4	Anxiety about Technical Problems	2.9927	0.668	3.1165	0.761	4.932*

5	Anxiety about Communication Problems with Lecturers	2.6819	0.677	2.8815	0.735	12.875**

Based on Table 2, students were classified into two cohorts based on their ASE scale scores: those with low ASE (means below 2.861904761 and those with a high level of perception of ASE (means above 2.861904762) determined through ROC analysis. The data revealed that 481 (66.9 %) fell into the low ASE category, while 237 (33.1 %) presented a very high level of perception of ASE. Differences between the two cohorts (high & low) were examined in relation to the five categories of OLA scale. A significant difference (pv<0.001) was observed in three categories: anxiety about academic assessment of online learning, anxiety about technical problems, and anxiety about communication problems with lecturers. Students with high ASE had more OLA than those with low ASE (pv=0.003). However, no significant differences were found between both cohorts in the categories of academic failure {(low(X=2.861904761) high(X=2.861904762)} and somatic-psychological OLA {(low(X=2.8619) high (X=2.903. Therefore, there were no significant differences for the level of ASE in these sub-categories.

Table 3

Correlations Between Scales and Sociodemographic Factors

SCALE	Age	Gender	Marital Status	Study track	Academic year	Specialization
OLA	**- 0.101	0.155**	**0.150-	0.051	0.145**	0.028
ASE	*0.052-	0.021	-0.024	0.042-	**0.155-	0.076**

Based on Table 3, a significant positive correlation was observed between average anxiety levels and both gender and academic year level. Specifically, women exhibited higher levels of anxiety compared to men, and anxiety levels increased with higher academic year levels. Conversely, a significant negative correlation was identified between average anxiety and both age and marital status. Notably, as age increased, there was a corresponding decrease in anxiety levels. Marital status also showed a significant negative correlation, indicating that individuals who were married tended to experience lower levels of anxiety. Additionally, the analysis revealed a significant negative correlation between ASE mean and both age and academic year level. This suggests that as students age and progress through higher academic years, their perceived ASE tends to decrease. Lastly, a significant positive relationship was found between ASE and the choice of specialization. Students with a non-scientific specialization demonstrated higher ASE levels compared to their counterparts with a scientific specialization. These findings demonstrate the complex relationship between demographic and academic factors in shaping anxiety and ASE among the study participants.

Table 4

Descriptive Statistics for Participant Sociodemographic Characteristics

Variables	**OLA MEAN**	***PV***	**Self-Efficacy MEAN**	***PV***
Age (mean (SD), range)		0.000=PV		0.083=PV
1	2.9385		2.6320	
2	2.7175		2.6659	
3	2.6999		2.7380	
4	2.5756		2.4531	
Gender		0.001=PV		0.633=PV
Men	2.7216		2.6308	
Women	2.9422		2.6485	
Marital Status		0.000=PV		0.010=PV
single	2.9394		2.6337	
married	2.8662		2.7034	
married with kids	2.4000		2.4147	

In a relationship	2.6154		2.5156	
Study track		0.001=PV		0.001=PV
B.A./B.Sc./M.D.	2.8757		2.6547	
M.A./M.Sc.	2.8750		2.6247	
Ph.D.	2.5463		2.3233	
Academic year		0.000=PV		0.000=PV
1	2.7841		2.7971	
2	3.0487		2.6362	
3	2.8921		2.4995	
4 >	3.2880		2.7344	
Specialization		PV=0.405		0.074=PV
science	2.8656		2.6137	
other	2.8939		2.6762	

Based on Table 4, first- and second-degree students showed a notably higher average anxiety (X = 2.875) compared to third-degree students, who reported a relatively lower OLA average (X = 2.546). These distinctions are statistically significant (PV > 0.001), indicating a meaningful variation in anxiety levels across different stages of academic progression. Furthermore, the analysis highlighted variations in average anxiety concerning students in different academic years. Freshmen and preparatory year students emerged as the least anxious, with an average anxiety level of 2.784. In contrast, sophomores and juniors demonstrated higher anxiety levels, averaging 2.636, while seniors and those in advanced academic years reported the highest average anxiety at 3.288. These differences are statistically significant (PV > 0.001), underscoring the impact of academic progression on anxiety levels. Examining ASE, freshmen reported an average ASE of 2.797, which decreased among sophomores (2.636) and juniors (2.499). However, there was a subsequent increase in ASE among seniors and above, reaching an average of 2.7344.

Table 5

Descriptive Data About Participants' Online Learning Quality

Variables	**OLA MEAN**	***PV***	**Self-Efficacy MEAN**	***PV***
Did you take online learning courses (fully or partially) before the Covid-19 Crisis?		0.233		0.831
NO	2.8600		2.6251	
YES	2.9010		2.6558	
Which device do you use for online lectures?		0.000		0.336
Home Computer/ Laptop	2.8281		2.6324	
Smartphone	3.1260		2.6472	
Tablet	2.9384		2.7622	
Other	2.7707		2.4063	
What are your preferred learning methods for online learning?		0.840		0.493

Synchronous lectures that can be recorded and uploaded to the course website	2.9172		2.6609	
Partially synchronous lectures	2.8511		2.5983	
Asynchronous lectures that are pre-recorded and can be found on the course website	2.8877		2.5775	
Receiving reading materials	2.8735		2.6495	
Most professors hold synchronous lectures:		0.040		0.993
At the lectures' designated timeslot	2.8640		2.6369	
At another time and by prior arrangement with students	2.9767		2.6373	
Most professors respond to questions and inquiries within:		0.062		0.000
A few hours	2.8564		2.7229	
A day	2.8631		2.6213	
A few days	2.9059		2.6117	
A week	2.9182		2.4089	
other	2.8768		1.6875	

How do you generally evaluate professors' response?		0.000		0.001
They do not respond	3.2229		2.3906	
Bad	3.1332		2.3141	
Unsatisfactory	3.0294		2.5729	
Good	2.8269		2.6664	
You prefer completing the course assignments:		0.101		0.003
Alone	2.8527		2.5946	
In groups	2.9085		2.6977	
My institution applies student attendance policy		0.000		0.000
NO	2.9658		2.6711	
YES	2.8290		2.5366	

As shown in Table 5, students reported that 90.5% of lecturers responded to their questions within a reasonable timeframe of 1-3 days; 78% students described the quality of such responses as "good." It was reported that 61.6% of the education institutions applied student attendance policy during the pandemic while 27.7% did not. The data revealed that most students (69.3%) favored synchronous lectures, whereas only 12.4% preferred asynchronous ones.

Discussion

First, the findings of this research align partially with previous studies (e.g., Dangal & Bajracharya, 2020), revealing a positive correlation between ASE and OLA during the crisis, supporting Hypothesis One. Notably, students with high OLA displayed higher ASE than those with low OLA, except in health or somatic-psychological state. In this specific aspect, ASE levels showed no correlation with OLA, suggesting that in cases of existential anxiety or anxiety related to failure or uncertainty about the future, both cohorts exhibited similar anxiety levels. In addition, this positive correlation between OLA and ASE extended to technical issues, academic evaluation, and communication with lecturers, with significant differences between cohorts in these areas. It is evident that despite the anxiety, actions taken by institutions during the crisis, such as enhancing prevalence and adaptation along with cooperative and dynamic communication, effective administrative policies, and educational support systems, may have contributed to the improvement of ASE (Bashir et al., 2021; Biwer et al., 2021). Second, students' reports about varying levels of anxiety related to online learning were consistent with Hypothesis Two. That is, around 33.2% reported low anxiety, 34.5% reported moderate anxiety, and 32.1% reported high anxiety. Third, sociodemographic factors (marital status, gender, age, academic year level, and specialization) demonstrated varied correlations, partially supporting Hypothesis Three while the "study track" factor did not show a statistically significant relationship with either OLA or ASE. As for age and academic year level, a negative correlation was observed with ASE. Freshmen and females exhibited higher overall anxiety levels, while being older, married, or a parent correlated with lower overall anxiety. This finding could potentially be explained by assuming that older and married students might have higher psychological well-being and resilience (Yin, et al., 2018; Gove, et al., 1983), and higher resilience may result in lower anxiety (Leys, et al. 2021). Another potential reason could be that marital status might function as a protective factor (Jace and Makridis, 2021). As for gender, several studies confirm that being a female online learner is associated with higher levels of anxiety (Pelucio et al., 2022; Zhang et al., 2022). One possible explanation for this pattern could be that biological distinctions between males and females appear to be crucial in interpreting the variations in anxiety-related feelings (Metin et al., 2022). As for age, one study consistent with our findings revealed that COVID-19 was associated with a greater increase in anxiety among younger adults compared to older adults (Collier Villaume et al., 2023).

Another significant sociodemographic factor was specialization. The findings revealed that students with non-science specializations were less anxious in terms of somatic-psychological anxiety than those with science specializations and more anxious when it came to technical problems. We argue that since most students with science specializations were not subject to a student attendance policy, they were more relaxed and less stressed and, hence, technical problems were not an issue. One plausible interpretation of this result might be that during the lockdown these students were possibly more isolated and therefore had less human interaction. Human interaction with lecturers and with other students probably enhanced participants' well-being and resilience *(Shah et al., 2021) and may explain why they were more anxious in the* somatic-psychological category.

Limitations of the Study

The innovative nature of this study underscores the potential for adaptation and the establishment of supportive digital adjustments in online learning pedagogy to mitigate the adverse consequences of crises, such as the COVID-19 pandemic. However, certain limitations should be reported, and future research efforts should address these considerations:

Disproportionate Response Rate

The higher number of responses from Israel and Germany compared to other countries may be attributed to several factors, including the degree of encouragement from fellow researchers, students' self-motivation, and the availability of free time and dedication.

Small Sample Size

The study's sample size, varying from small to more significant across countries, may be deemed relatively small for an international study. First, the voluntary nature of questionnaire participation and the absence of a specific target population resulted in a diverse but limited participant pool. That is, the study did not target a specific population of students, nor did it focus on their differences, but rather targeted participants who were all students and who were all enrolled in Higher Education Institutions, and all experienced online learning and lockdowns during the crisis in different geographical zones. Although some studies argued that statistical tests were designed for sample analysis rather than population studies (Faber & Fonseca, 2014), we believe that a larger sample size should be considered in subsequent studies for the sake of generalization and therefore some additional measures should be enacted to increase the number of participants.

Timing

The impending end of lockdowns and pandemic restrictions in Israel, scheduled for June 1, 2021, led to a decreased response rate as global patient numbers declined. As a result, data collection was initiated promptly. Future studies should explore strategies to secure more extended participation periods or adapt to changing circumstances.

Sociodemographic Factors

Certain sociodemographic factors, specifically "location of university" and "citizenship," were not thoroughly examined due to the complexity of transnational comparisons. Future research endeavors should include these factors, providing a more comprehensive understanding of their potential influence on the study variables.

Conclusion and Recommendations

Although the current study did not provide data regarding the support offered by governments or administrations, it did provide data regarding professors’ support with respect to their commitment to timetables and responses to students’ enquiries. Findings obtained from the general questions regarding learning and teaching indicated the significance of student-teacher and student-student interactions, but also indicated that asynchronous lectures were more demanding and required more preparation and individual work and therefore higher ASE. The above-mentioned moderating factors, together with those mentioned earlier such as contextual and didactical variables related to online learning quality, possibly played a significant moderating role of the anxiety-self-efficacy relationship. In this sense, Despite the pandemic, the combination of guided instruction and professors' cooperation proved efficient in facilitating an innovative online learning environment, ultimately positively impacting the educational process. These findings suggest that the adaptation process, coupled with the prevalence of COVID-19, may have mitigated the crisis's adverse effects. However, for future studies, we suggest that more factors should be measured when investigating OLA, including the length of time during which students are exposed to a threatening situation (COVID-19) and the quality of online teaching delivery modes. We believe that these factors are essential in modulating the negative effects elicited by crises.

Based on the above, this study brings new insights into the current body of research about anxiety and online learning and about students' ASE during a crisis. Advocating studies by Bates and Khasawneh (2007) and Prior et al. (2016) to make the learning experience more effective and innovative in times of crisis in general, we recommend that pivotal steps should be undertaken at four levels:

1. **Students' Learning Method Adjustments:** Numerous studies propose various approaches to reduce anxiety, thereby enhancing Academic Self-Efficacy (ASE). However, when anxiety transforms into a persistent trait intertwined with our lives, it becomes imperative to explore strategies for managing its negative effects. In this context, experts recommend coping mechanisms such as behavioral coping, mindful coping, and coping through social media (Barron et al., 2021). These strategies aim not only to alleviate anxiety but also to equip students with practical tools to tackle the challenges induced by anxiety, fostering a more resilient and empowered approach to learning. As students adapt and integrate these coping strategies into their learning methods, it is anticipated that they may experience a positive impact on their overall ASE, contributing to a more effective and fulfilling educational experience.

2. **Professors' Instructional Adjustments:** Aristovnik et al. (2020) maintain that the teaching staff has a significant role in mitigating the adverse impacts of COVID-19 and enhancing learning environments. Hence, there is a pressing need to enhance and refine existing pedagogical practices by professionally and efficiently equipping professors to employ alternative teaching approaches. Professors need to actively advocate and endorse online learning, fostering a broader implementation of interactive online learning methods across all academic levels. Moreover, each course should be systematically developed to accommodate various scenarios, allowing for online learning mode, hybrid mode, or traditional face-to-face mode. A seamless and straightforward transition between these instructional modes is needed to ensure adaptability to changing

circumstances and provide students with a flexible and enriched educational experience. This proactive approach to instructional adjustments not only addresses the challenges caused by the pandemic but also positions educators to enhance the overall quality and accessibility of education in diverse learning environments.

3. **Institutional Level:** In a post-crisis reality, higher education institutions should earnestly contemplate retaining elements of online learning, given its observed positive impact on maintaining students' ASE despite anxiety. Punjani and Mahadevan (2021) emphasize the benefits of online learning, advocating for a deliberate orientation towards its continued integration. To achieve this, institutions are encouraged to proactively advance, expand, and extend online teaching methods and strategies. This can be facilitated through the establishment of qualification programs for professors, ensuring they are adept in utilizing online instructional tools effectively. Moreover, institutions should establish clear and consistent attendance policies and explore alternative attendance options. Creating dedicated support units, particularly for freshmen who may require additional assistance in navigating online learning, is crucial for fostering a supportive educational environment. Moreover, institutions should consider initiating emergency services tailored to the needs of both students and professors who may require mental health care support. Additionally, preparedness for potential mental health setbacks faced by the academic community and the establishment of emergency hotlines becomes imperative. These hotlines are vital resources for individuals requiring immediate assistance and guidance in times of heightened stress or crisis.
4. **Ministerial and Governmental Level:** Governments worldwide have demonstrated agility and effectiveness in making administrative decisions to handle the conundrums triggered by the new situation, as highlighted in the UNESCO Annual Report (2020). However, there is a pressing need for the development of more advanced and guided educational platforms and support systems to better prepare for and address future emergencies. This comprehensive approach aims to assist students, not only pedagogically and technically but also emotionally, acknowledging the multifarious nature of the hurdles faced in contemporary education. To achieve this, governments are encouraged to provide aid and counseling services to both professors and students. This support can be facilitated through the creation of digital kits comprising manuals and resources that offer guidance on navigating the complexities of online learning and managing associated stressors. Furthermore, the introduction of progressive mobile applications and digital appliances can enhance accessibility and streamline the learning experience for both educators and learners.

Statement and Declaration

I) Ethical approval: This study was carried out in accordance with the recommendations of the Ethics Committee of our academic institution. All subjects submitted written informed consent.

II) Funding details: There is no funding.

III) Conflict of interest: There is no potential conflict of interest.

IV) Data and materials are available upon request.

References

Alghamdi, A., Karpinski, A. C., Lepp, A., & Barkley, J. (2020). Online and face-to-face classroom multitasking and academic performance: Moderated mediation with self-efficacy for self-regulated learning and gender. *Computers in Human Behavior*, *102*, 214-222. https://doi.org/10.1016/j.chb.2019.08.018

Al-Kumaim, N. H., Alhazmi, A. K., Mohammed, F., Gazem, N. A., Shabbir, M. S., & Fazea, Y. (2021). Exploring the impact of the COVID-19 pandemic on university students' learning life: An integrated conceptual motivational model for sustainable and healthy online learning. *Sustainability*, *13*(5), 2546. http://doi.org/10.3390/su13052546

Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., & Umek, L. (2020). Impacts of the COVID-19 pandemic on life of higher education students: A global perspective. *Sustainability*, *12*(20), 8438. MDPI AG. http://doi.org/10.3390/su12208438

Bandura, A. (1988). Self-efficacy conception of anxiety, *Anxiety Research*, 1:2, 77-98, DOI: 10.1080/10615808808248222

Barron, E. Singhal, D. Vijayaraghavan, P. Seshadri, S. Smith, E. Dixon, P. et al. (2021) Health anxiety, coping mechanisms and COVID 19: An Indian community sample at week 1 of lockdown. PLoS ONE 16(4): e0250336. https://doi.org/10.1371/journal.pone.0250336

Basheti I. A., Mhaidat Q.N., & Mhaidat H.N. (2021). Prevalence of anxiety and depression during COVID-19 pandemic among healthcare students in Jordan and its effect on their learning process: A national survey. *PLOS ONE*, *16*(4), e0249716. https://doi.org/10.1371/journal.pone.0249716

Bashir A., Bashir S., Rana K., Lambert P. & Vernallis A. (2021) Post-COVID-19 Adaptations; the shifts towards online learning, hybrid course delivery and the implications for biosciences courses in the higher education setting. *The International Journal of Science Education*. 6:711619. http://doi.org/10.3389/feduc.2021.711619

Bates, R. & Khasawneh, S. (2007). Perceptions and use of online learning systems. *Computers in Human Behavior, 23, 175-191*. https://doi.org/10.1016/j.chb.2004.04.004

Burgess, S. & Sievertsen, H.H. (2020). Schools, skills, and learning: The impact of COVID-19 on education. *VoxEu. org*, *1*(2), 73-89. https://voxeu.org/article/impact-covid-19-education

Biwer, F., Wiradhany W., oude Egbrink M., Hospers H., Wasenitz S., Jansen W. & de Bruin A. (2021). Changes and adaptations: How university students self-regulate their online learning during the COVID-19 pandemic. *Frontiers in Psychol*ogy. 12:642593. http://doi: 10.3389/fpsyg.2021.642593

Cassady, J. C., & Finch, W. H. (2020). Revealing nuanced relationships among cognitive test anxiety, motivation, and self-regulation through curvilinear analyses. *Frontiers in Psychology*, *11*, 1141. https://doi.org/10.3389/fpsyg.2020.01141

Castro, M. & Tumibay, G. (2021) A literature review: Efficacy of online learning courses for higher education institution using meta-analysis. *Education and Information Technologies*, *26*(2), 1367-1385. http://doi.org/10.1007/s10639-019-10027-z

Chandasiri, O. (2020). The COVID-19: Impact on education. *International Journal of Advanced Education and Research, 5*(3), 13-14.

Chemers, M. M., Hu, L.-t., & Garcia, B. F., (2001). Academic self-efficacy and first year college student performance and adjustment. *Journal of Educational Psychology, 93*(1), 55–64. https://doi.org/10.1037/0022-0663.93.1.55

Cohen, L., Manion, L., & Morrison, K. (2011). “Research methods in education”. 7th edition. Routledge.

Collier Villaume S, Chen S, Adam EK. Age disparities in prevalence of anxiety and depression among us adults during the COVID-19 pandemic. *JAMA Network Open.* 2023;6(11):e2345073. doi:10.1001/jamanetworkopen.2023.45073

Dangal, M. R., & Bajracharya, L. S. (2020). Students’ anxiety experiences during COVID-19 in Nepal. *Kathmandu University Medical Journal (KUMJ), 18*(70), 53–57. https://doi.org/10.3126/kumj.v18i2.32957

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems, 49*(1):5-22. https://doi.org/10.1177/0047239520934018

Elliot, A. & Sheldon, K. (1997). Avoidance achievement motivation: A personal goals analysis. *Journal of Personality and Social Psychology, 73*(1), 171-185. http://dx.doi.org/10.1037//0022-3514.73.1.171.

Faber, J., & Fonseca, L. M. (2014). How sample size influences research outcomes. *Dental Press Journal of Orthodontics*, *19*(4), 27–29. https://doi.org/10.1590/2176-9451.19.4.027-029.ebo

Gove, W. R., Hughes, M., & Style, C. B. (1983). Does marriage have positive effects on the psychological well-being of the individual? *Journal of Health and Social Behavior, 24*(2), 122–131. https://doi.org/10.2307/213663

Gültekin, O., Erkaplan, S., Uzun, H., & Güney, E. (2020). Investigation of academic staff's self-efficacy using the educational internet. *Higher Education Studies*, *10*(3), 26. https://doi.org/10.5539/hes.v10n3p26

Hauser, R., Paul, R. & Bradley, J. (2012). Computer self-efficacy, anxiety, and learning in online versus face-to-face medium. *Journal of Information Technology Education*, *11*, 141-154. https://doi.org/10.28945/1633

Heckel, C., & Ringeisen, T. (2019). Pride and anxiety in online learning environments: Achievement emotions as mediators between learners' characteristics and learning outcomes. *Journal of Computer Assisted Learning*, *35*, 667-677. https://doi.org/10.1111/jcal.12367

Hoss, T., Ancina, A., & Kaspar, K. (2022). German university students' perspective on remote learning during the COVID-19 pandemic: A quantitative survey study with implications for future educational interventions. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.734160

Jace, C.E.; Makridis, C.A. Does marriage protect mental health? Evidence from the COVID-19 pandemic. *Social. Science Quarterly.* 2021, *102*, 2499–2515.

Kerres M. (2020). Against all odds: Education in Germany coping with Covid-19. *Postdigital Science and Education*, *2*(3), 690–694. https://doi.org/10.1007/s42438-020-00130-7

Kisanga, D., & Ireson, G. (2016). Test of e-learning related attitudes (TeLRA) scale: Development, reliability and validity study. *International Journal of Education and Development Using ICT*, *12*(1), 20–36.

Knolle, F., Ronan, L. & Murray, G.K. (2021). The impact of the COVID-19 pandemic on mental health in the general population: a comparison between Germany and the UK. *BMC Psychology, 9, 60.* https://doi.org/10.1186/s40359-021-00565-y

Kotsou, I., Shankland, R., Firmin, M., Péneau, S., & Fossion, P. (2021). Resilience predicts lower anxiety and depression and greater recovery after a vicarious trauma. *International Journal of Environmental Research and Public Health, 18(23),* 12608.

Linstone, H., & Turnoff, M. (1975). *The Delphi method: Techniques and applications*. Addison Wesley.

Maqableh, M., & Alia, M. (2021). Evaluation of online learning of undergraduate students under lockdown amidst COVID-19 pandemic: The online learning experience and students' satisfaction. *Children and Youth Services Review, 128*. https://doi.org/10.1016/j.childyouth.2021.106160

Marakas, G., Yi, M. & Johnson, R. (1998). The multilevel and multifaceted character of computer self-efficacy: Toward clarification of the construct and an integrative framework for research. *Information Systems Research 9* (2), 126-163. https://doi.org/10.1287/isre.9.2.126

Martin, F., & Bolliger, D. U. (2018). Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment. *Online Learning, 22*, 205-222. https://doi.org/10.24059/olj.v22i1.1092

Metin, A., Erbiçer, E. S., Şen, S., & Çetinkaya, A. (2022). Gender and COVID-19 related fear and anxiety: A meta-analysis. *Journal of Affective Disorders, 310*, 384–395. https://doi.org/10.1016/j.jad.2022.05.036

Nasir, M. K. (2020). The influence of social presence on students' satisfaction toward online course. *Open Praxis, 12*, 485-493. https://doi.org/10.5944/openpraxis.12.4.1141

OECD (2020). *PISA 2018 results* (Volume III)*: What school life means for students' lives*. https://doi.org/10.1787/2f9d3124-en

Panergayo, A., & Mansujeto, K. (2021). Assessment of self-efficacy in an online learning of teacher education students in one state university in the Philippines. *International Journal of Computing Sciences Research, 5*(1). http://doi.org/10.25147/ijcsr.2017.001.1.65

Peechapol, C., Na-Songkhla, J., Sujiva, S., & Luangososai, A. (2018). An exploration of factors influencing self-efficacy in online learning: A systematic review. *International Journal of Emerging Technologies in Learning (iJET) 13*(09),64. https://doi.org/10.3991/ijet.v13i09.8351

Pelucio, L., Simões, P., Dourado, M.C.N. (2022). Depression and anxiety among online learning students during the COVID-19 pandemic: a cross-sectional survey in Rio de Janeiro, Brazil. *BMC Psychology 10*, 192. https://doi.org/10.1186/s40359-022-00897-3

Pragholapati, A. (2020). COVID-19 impact on students.

Prior, D.D., Mazanov, J., Meacheam, D., Heaslip, G., & Hanson, J. (2016). Attitude, digital literacy and self-efficacy: Flow-on effects for online learning behavior. *The Internet and Higher Education, 29*, 91-97. https://doi.org/10.1016/j.iheduc.2016.01.001

Punjani, K. K., & Mahadevan, K. (2021). Transitioning to online learning in higher education: Influence of awareness of COVID-19 and self-efficacy on perceived net benefits and intention. *Education and information technologies*, 1–30. Advance online publication. https://doi.org/10.1007/s10639-021-10665-2

Raina S. K. (2015). Establishing association. *The Indian Journal of Medical Research, 141*(1), 127. https://doi.org/10.4103/0971-5916.154519

Saadé, R., G. & Kira, D. (2009). Computer anxiety in e-learning: The effect of computer self-efficacy. *Journal of Information Technology Education, 8*, 177-191. http://www.jite.org/documents/Vol8/JITEv8p177-191Saade724.pdf.

Schaefer, M., Abrams, S. S., Kurpis, M., Abrams, M., & Abrams, C. (2020). "Making the unusual usual:" Students' perspectives and experiences of learning at home during the COVID-19 pandemic. *Middle Grades Review, 6*(2). https://scholarworks.uvm.edu/mgreview/vol6/iss2/8

Schiff, M., Pat-Horenczyk, R., & Benbenishty, R. (2022). University students coping with COVID-19 challenges: Do they need help? *Journal of American College Health,*1–9. Advance online publication. https://doi.org/10.1080/07448481.2022.2048838

Shah, S. S., Memon, F. A., Qureshi, F., Soomro, A. B., Kemal, A. A., & Shah, A. A. (2021). Mental well-being during COVID-19 pandemic: The role of fear, social isolation and psychological resilience. *Cogent Psychology, 9*(1). https://doi.org/10.1080/23311908.2021.2006993

Shenaar-Golan, V., Walter, O., Greenberg, Z., & Zibenberg, A. (2020). Emotional intelligence in higher education: Exploring its effects on academic self-efficacy and coping with stress. *College Student Journal, 54*(4), 443-459.

Shuster, A., O'Brien, M., Luo, Y., Berner, L. A., Perl, O., Heflin, M., Kulkarni, K., Chung, D., Na, S., Fiore, V. G., & Gu, X. (2021). Emotional adaptation during a crisis: decline in anxiety and depression after the initial weeks of COVID-19 in the United States. *Translational Psychiatry, 11*(1), 435.

https://doi.org/10.1038/s41398-021-01552-y

Smalley, Andrew. "Brief Higher Education Responses to Coronavirus (COVID-19)." National Conference of State Legislatures, March 22, 2021. https://www.ncsl.org/education/higher-education-responses-to-coronavirus-covid-19

Son, C., Hegde, S., Smith, A., Wang, X., & Sasangohar, F. (2020). Effects of COVID-19 on college students' mental health in the United States: Interview survey study. *Journal of Medical Internet Research, 22*(9), e21279. https://doi.org/10.1080/07448481.2022.2048838

Tobias, S. (1985). Test anxiety: Interference, defective skills, and cognitive capacity. *Educational Psychologist, 20*(3), 135-142. DOI: 10.1207/s15326985ep2003_3

UNESCO, IESALC. (2020). *Annual report: Response to COVID-19.* https://www.iesalc.unesco.org/wp-content/uploads/2021/06/IESALC_Annual_Report_2020_ENG.pdf

Vayre E., & Vonthorn, A-M. (2017). Psychological engagement of students in distance and online learning: Effects of self-efficacy and psychosocial processes. *Journal of Educational Computing Research*, *55*(2):197-218. doi:10.1177/0735633116656849

Wakui N., Abe S., Shirozu S., Yamamoto Y., Yamamura M., & Abe Y. (2021). Causes of anxiety among teachers giving face-to-face lessons after the reopening of schools during the COVID-19 pandemic: a cross-sectional study. *BMC Public Health, 21*. https://doi.org/10.1186/s12889-021-11130-y

Wang, X., Li, G., Malik, S., & Anwar, A. (2021). Impact of COVID-19 on achieving the goal of sustainable development: E-learning and educational productivity, *Economic Research-Ekonomska Istraživanja*. https://doi.org/10.1080/1331677X.2021.1927789

Warshawski S. (2022). Academic self-efficacy, resilience and social support among first-year Israeli nursing students learning in online environments during COVID-19 pandemic. *Nurse Education Today*, 110, 105267. https://doi.org/10.1016/j.nedt.2022.105267

Weyandt, L., Francis, A., Shepard, E., Gudmundsdottir, B.G., Channell, I., Beatty, A., & DuPaul, G. (2020). Anxiety, depression, impulsivity, and mindfulness among higher education faculty during COVID-19. *Health Behavior and Policy Review, 7*, 532-545.

Wigfield, A., & Eccles, J. (1989). Test anxiety in elementary and secondary school students. *Educational Psychologist, 24*(2), 159-183. https://doi.org/10.1207/s15326985ep2402_3

Yang J., Peng MY-P., Wong S. & Chong W. (2021). How e-learning environmental stimuli influence determinates of learning engagement in the context of COVID-19? SOR Model Perspective. *Frontiers in Psychology*, *12*, 584976. https://doi.org/10.3389/fpsyg.2021.584976

Yang, X., Zhang, M., Kong, L., Wang, Q., & Hong, J. C. (2021). The effects of scientific self-efficacy and cognitive anxiety on science engagement with the “question-observation-doing-explanation” model during school disruption in COVID-19 pandemic. *Journal of Science Education and Technology*, *30*(3), 380-393. https://doi.org/10.1007/s10956-020-09877-x

Yin, J., Tang, J., He, J. (2018). Analysis on the status quo of college students’ psychological capital --- the case study on the colleges and universities in Hengyang. *International Journal of New Developments in Engineering and Society* Vol. 2: 108-113.

Zhang, X., Zhou, F., & Xu, J. (2022). Technical college students’ practical performance anxiety during online learning: difference in gender and average time of online learning. *Sustainability*, 14, 8218. https://doi.org/10.3390/su14138218

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American Educational Research Journal*, *29*(3), 663–676. https://doi.org/10.3102/00028312029003663

Towards Connectivism: Exploring Student Use of Online Learning Management Systems During the COVID-19 Pandemic

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Abstract

The COVID-19 pandemic precipitated a global shift to fully remote learning via learning management systems (LMS). Despite this significant shift, there has been a paucity of research exploring how students of varying academic performance engage with online learning resources.

Towards Connectivism: Exploring Student Use of Online Learning Management Systems During the COVID-19 Pandemic

This study investigates the utilization of LMS among students with different academic performances at an Australian public research university. Utilizing a dataset of 129,567 activity logs from 313 students, we examined their interactions with the course files, discussion forums, grade book, and online quizzes, underpinned by self-regulated learning theory and connectivism theory. Our methodology entailed a granular analysis of LMS log data to identify engagement patterns, using the Kruskal-Wallis H Test to detect variations in resource utilization across performance levels—above-credit, credit, and below-credit. The findings revealed significant disparities in the frequency of engagement with course files and online quizzes and participation in forums between students of varying academic standings, with higher engagement associated with superior academic performance. In addition, our results suggest no significant difference in gradebook views. These insights have profound implications for the design and implementation of online learning strategies. They suggest the necessity of fostering active engagement with learning materials and collaborative platforms for improved educational outcomes. In addition, these findings improve our understanding of online learning engagement during an unprecedented educational disruption and lay the groundwork for future inquiries into the intricate dynamics of student interaction with digital learning tools post-pandemic. The limitations of our study are also discussed.

Keywords: Learning management system; online learning platform; online learning; pandemic; connectivism theory; academic performance

Liu D., Carter L., Lin, J. (2024). Towards connectivism: Exploring student use of online learning management systems during the COVID-19 pandemic. *Online Learning*, *28*(2). (329-358). DOI: https://doi.org/10.24059/olj.v28i2.4047

The unprecedented COVID-19 pandemic has catalyzed a paradigm shift in higher education, thrusting higher education into an involuntary experiment in mass online learning. According to McKinney & Company (2022), the COVID-19 pandemic caused the most substantial education disruption in history. The temporary closure of education institutions displaced 1.6 billion students from in-person instruction, including 220 million from higher education institutions (HEIs) (Farnell et al., 2021; UNESCO, 2021). This sudden shift not only tested the resilience of educational infrastructures but also challenged the pedagogical, technological, and psychological preparedness of institutions and individuals (Alshamrani et al., 2023; Mushtaha et al., 2022).

The response from HEIs comprised quickly migrating the existing curriculum to an entirely online environment to allow students to access course materials remotely. Online learning, or e-learning, comprises an ecosystem of human participants–educators, students, and nonhuman entities incorporating the relevant technologies (Mushtaha et al., 2022). A Learning Management System (LMS), also referred to as an Online Learning Platform (OLP), is a comprehensive internet-based application that melds content delivery, educational resource management, and instructional facilitation for online learning (Jaffar et al., 2022). LMSs enhance students' learning experiences by offering features such as interactive content and collaborative discussion forums, enabling them to engage actively with course materials (Tajuddin et al., 2023). LMSs increase the impetus for students to assume responsibility for their studies (Hsu, 2023; Taridi et al., 2023; Wang & Zhan, 2020).

As the crisis unfolded, LMSs became more than just tools; they evolved into complex ecosystems enabling interaction, engagement, and the replication of classroom dynamics to some extent. LMSs have gained prominence through improved Internet access and the necessity for adaptable, scalable educational solutions amid the growing demands of online education (Mhlongo et al., 2023). Many HEIs have been effectively using the LMS and exploring its impact on improving educational performance (Alturki & Aldraiweesh, 2021). Recent studies reveal that the LMS and associated tools increase student engagement (Alhazmi et al., 2021; Alturki & Aldraiweesh, 2021; Jones et al., 2021) and performance (Baragash & Al-Samarraie, 2018; Beatson et al., 2020; Cobo-Rendon et al., 2021). In addition, the LMS allows educators to track education activities, predict student performance, and then modify teaching practices (Gamage et al., 2022; Price et al., 2021). Educators continue adopting the LMS and technology-enhanced learning content (Gamage et al., 2022).

The transition was not without its issues, as disparities in access and use emerged, intensifying the call for inclusive and equitable online learning solutions. Farnell et al. (2021) highlight the need for research on the consequences of COVID-19 on teaching and learning. Rasheed et al. (2020) stress the importance of investigating the relationship between LMS adoption and academic performance to inform the ongoing development of these platforms, ensuring they can be tailored to enhance learning outcomes and support students' academic success. Sun and Yang (2023) call for research into the teaching, learning, and assessment methods during the pandemic to improve student learning outcomes. To date, few studies have explored student utilization of online learning resources during the pandemic. Furthermore, few studies have examined the relationship between student performance and the use of various LMS utilities during the pandemic's enforced and exclusive reliance on online learning.

This study seeks to bridge this knowledge gap by analyzing how disruptive times such as the pandemic have reshaped the use of online learning resources, with a focus on the implications for students' academic outcomes. In particular, we aim to answer the research question: How does the pattern of LMS resource utilization vary among students of different academic performance levels? We delve into the intricate dynamics of LMS resource utilization among students with varied academic performances. Distinct from previous works, our investigation probes into the students' engagement patterns in exclusive reliance on online learning platforms due to COVID-19 restrictions. Our findings illuminate the pathways through which online learning can bolster academic success. Furthermore, our study navigates the complexities of online learning and offers a timely exploration of the online learning landscape reshaped by the pandemic. Moreover, our analysis merges empirical data with theoretical insights to enhance educational strategies in the face of future challenges.

Relevant Literature and Theoretical Foundation

Online Learning

An LMS is a web-based information system pivotal for managing learning materials and assessment instruments, as well as tracking and reporting on student course activities, learning progress, and academic performances (Avcı & Ergün, 2022). An LMS includes a range of solutions for content management, course delivery, online learning, and student management, such as enrollment and activity management (Kasim & Khalid, 2016; Veluvali & Surisetti, 2022). Accordingly, the LMSs have increasingly become attractive for analyzing how student engagement with online resources correlates with academic performance (Avcı & Ergün, 2022).

An LMS also enhances collaborative learning by facilitating interactions among students and educators, thereby cultivating a comprehensive and dynamic educational experience (Bradley, 2021). Digital tools on an LMS empower students to actively read and engage with learning resources and interact with peers and instructors using web browsers on a wide range of operating systems and devices (Haleem et al., 2022; Marachi & Quill, 2020). The versatility of LMS tools is essential in modern educational paradigms, where adaptive learning and personalized education paths are becoming increasingly prevalent.

Various LMSs are currently accessible for educational purposes across the world. According to Gartner (2023)'s rating of higher education, Canvas, Moodle, and Blackboard have been the highest-ranked learning systems and have seen a significant user growth. Moodle's user base increased from 78 million in 2015 to approximately 328 million in 2022 (Moodle Project, 2022). Consequently, the predominant use of LMSs such as Moodle during the pandemic calls for a deeper investigation into their adoption and adaptation across diverse learning environments (Altinpulluk & Kesim, 2021; Moodle Project, 2022).

The evolution of LMS functionality has accommodated the extensive shift to online education (Mushtaha et al., 2022; Ozdamli & Karagozlu, 2022). During the pandemic, students were compelled to rely on online education as part of the formal curriculum (Ali, 2020; Potra et al., 2021). Students extensively used the LMS to access course files, upload assignments, and view marks online (Ortiz-López et al., 2023). In addition, students increasingly utilized the LMS to interact with lecturers, other students, and learning tools (e.g., taking online assessments such as quizzes and exams) (Goldie et al., 2023; Sumardi et al., 2021). The utilization of various LMS tools has become increasingly critical in fostering academic success during the pandemic (Junus et al., 2021; Xing et al., 2023). In addition, the utilization has featured disparities in access and engagement, revealing a research gap in our understanding of how students of varying performance navigate and utilize LMS features, particularly within the constraints of continuous and exclusive online learning necessitated by COVID-19.

Connectivism in Online Learning

Connectivism theory is a learning theory for the digital age, often associated with the use of technology in education (Dziubaniuk et al., 2023). Connectivism theory posits that technology is a major component of the learning process (Downes, 2019). It promotes technology-enabled collaboration, discussion, and learning activities that extend beyond the individual level, facilitated by online learning tools, blogs, or social media (Goldie, 2016). Connectivism theory was introduced as a learning theory for the digital age and provides a theoretical framework for instructional design and helps educators construct effective learning environments (Gogus, 2023; Goldie, 2016).

Connectivism underscores the notion that individual learning is a networked process, where knowledge is disseminated and constructed through the interplay of digital technologies and the collaborative involvement of educational participants, such as learners and educators (Chang et al., 2022). In online learning, individuals feed information to a learning community and connect to an LMS (Madge et al., 2019). The LMS provides digital functions that facilitate the connections between various entities in the online learning network, such as individuals, digital tools, or resources, that can be interconnected to facilitate learning (Dang et al., 2019). On an LMS such as Moodle, learning occurs when instructors, peers, and digital innovations collaboratively interact (Dahal, 2022; Kumar & Sharma, 2016).

The application of connectivism has proven effective in evaluating the influence of online learning platforms on learner behavior (Downes, 2019). For example, Mpungose and Khoza (2022), whose research is underpinned by connectivism theory, investigated postgraduate students' experiences with using Moodle and Canvas. They found that students used Moodle and Canvas primarily for downloading readings and participating in discussion forums. In online learning structures facilitated by an LMS, students are encouraged to seek the opinions, suggestions, and ideas of others, as there is no longer a single source of knowledge (Kompen et al., 2019). Such findings underscore the importance of LMS features in student academic engagement, which our study seeks to further elaborate by examining the differences in resource utilization among students of varying academic achievements.

Self-Regulated Learning

Self-regulated learning (SRL) plays a pivotal role in digital education, highlighting the individual's capacity to autonomously oversee and direct their learning processes toward achieving goals within an online setting (Chang et al., 2023; Wong et al., 2019). It emphasizes learning steered by metacognition and strategic action, which includes planning, monitoring, and evaluating personal progress (Wirth et al., 2020). Self-regulated learners are cognizant of their strengths and weaknesses and employ a range of strategies to navigate the daily challenges of academic tasks (Teng & Huang, 2019). Embodying a proactive approach, these learners emphasize the value of their learning objectives. They are skilled at self-monitoring their progress and adjusting their learning strategies as needed (Teng & Huang, 2019).

The significance of SRL was further accentuated during the pandemic, with students encountering heightened challenges in time and workload management due to increased isolation and diminished peer engagement (Hensley et al., 2022). Consequently, the competency to self-direct one's learning journey has been increasingly essential, enabling students to effectively navigate the unique challenges posed by the shift to online education (Martin, 2020). Students who perform at a high level are more likely to be self-regulated learners (Broadbent et al., 2021; Hadwin et al., 2022). This regular and strategic use of the LMS likely contributes to their high academic performance. For instance, students who excel in online courses often actively access course announcements, engage with lecturers, and communicate attentively with peers (You, 2016). Conversely, unsuccessful learners struggle to allocate an appropriate amount of time and effort to complete such tasks (Pereira et al., 2020; You & Kang, 2014). In online environments, students less able to self-regulate struggle with virtual interaction and reduced in-person support from teachers (Longhurst et al., 2020).

SRL emphasizes an individual's autonomy and control over their learning trajectory, while connectivism underscores the importance of digital connections and interactions. The LMS, acting as a technological nexus, not only fosters the connections and interactions central to connectivism but also provides learners with the tools and resources they need to navigate their learning journey, in line with SRL principles. Consequently, this study aims to investigate the LMS landscape, integrate SRL with connectivism, and provide profound insights into optimizing online learning outcomes.

Hypothesis Development

A student is motivated to use an online learning platform by its learning contents and features (Aikina & Bolsunovskaya, 2020). Specifically, an LMS enhances the online learning experience by providing a repository for course materials and by facilitating interactions through features like discussion forums, quizzes, and feedback mechanisms. These tools are not only essential for the dissemination of information but also for fostering a collaborative and interactive learning environment. However, the literature suggests that the utilization of these online resources is not uniform among students.

Research indicates that high achieving students tend to access online course files with greater frequency, suggesting a relationship between course file utilization and academic success (Soffer & Cohen, 2019). In a study of online education, Crampton et al. (2012) find that fail-grade students access fewer lecture slides when compared to students who achieve a pass grade or above. This discrepancy in resource utilization may highlight a gap in learning strategies between different groups of students. High-performing students may demonstrate more proactive and strategic use of these resources, reflecting their self-regulated learning skills (Nnadozie & Khumalo, 2023). On the other hand, students who perform less well may need additional support in effectively accessing and utilizing such online learning resources as course files to improve their academic outcomes. Therefore, we propose:

> ***Hypothesis 1:*** Students at various academic performance levels view course files at different frequencies.

In addition to viewing course files, engagement in online forums differs among student groups. In an online learning environment, it is likely that students at different academic performance levels interact with forum posts at different frequencies for several reasons (Galikyan & Admiraal, 2019). For instance, students who are performing well, as Chiu and Hew (2018) find, tend to be more motivated and confident, leading them to engage more with peers in online discussions. In addition, these students may view forum posts more frequently to stay more engaged and to learn and grow. On the other hand, students who are academically struggling may view forum posts less frequently when they are not as interested in the learning materials or lack the confidence to engage with their peers (Saqr & López-Pernas, 2021). Furthermore, Hromalik and Koszalka (2018) suggest that high performing students typically exhibit better self-regulation and employ effective learning strategies, including frequent use of course discussion forums to support their learning. Lower-performing students may lack these strategies and thus not prioritize forum engagement. Hung and Zhang (2008) posit students with a higher "number of messages posted, number of messages read, and frequency of synchronous discussions attended" are better academic performers. Crampton et al. (2012) discover students who pass the subject post more messages on the discussion forums than students who fail. Therefore, we have the following hypotheses:

> ***Hypothesis 2:*** Students at various academic performance levels view forum posts at different frequencies.
>
> ***Hypothesis 3****:* Students at various academic performance levels create forum posts at different frequencies.

The course gradebook is another useful resource for students, facilitating self-regulation and academic monitoring (Kuznekoff & Munz, 2022). Empirical evidence reveals that students at different academic performance levels view their course gradebooks at different frequencies.(Liu (2023) suggests that the gradebook acts as a mechanism for students to manage their educational progress proactively. Geddes (2009) observes that business school students who excel academically tend to check their gradebook more often, suggesting an association between grade monitoring and academic success. High achieving students are typically more motivated and may utilize the gradebook strategically to ensure they remain on course to achieve their goals, hence their more frequent engagement with it. In contrast, students who are struggling in the course may be discouraged by their current performance, thereby not seeing the value in regularly checking their grades. Therefore, we propose the following:

> ***Hypothesis 4:*** Students at various academic performance levels view course gradebooks at different frequencies.

Online quizzes are an integral component of online learning, facilitating course assessment and reinforcing learning (Raes et al., 2020). For instance, Dobbins and Denton (2017) reveal that students unanimously agree incorporating quizzes in online learning is an effective method for enhancing their engagement and interaction during lectures. Self-regulated learning theory posits that students with high academic achievement are often adept at managing their learning processes, which includes utilizing online quizzes as a means of self-assessment. Parte and Mellado (2022) extend this understanding by unveiling that students leverage quizzes to identify areas needing improvement, thereby optimizing their study approaches and performance.

High achieving students possess potent metacognitive abilities, facilitating their use of online quizzes to scrutinize their comprehension and fine-tune their study methodologies as required. Conversely, students with lower academic performance may be predominantly extrinsically motivated, engaging with quizzes chiefly as they bear a direct impact on their grades. Their metacognitive skills may also be less mature, potentially curtailing their efficacious use of quizzes for self-assessment and modification of learning strategies. Consequently, they may not resort to online quizzes as regularly to assess their progress. Hence, we put forth the following proposition:

> ***Hypothesis 5:*** Students at various academic performance levels view online quizzes differently.

Methodology

Participants

The study's participants consisted of 313 undergraduate students enrolled in two sessions of an information technology course at an Australian public research university. The course was fully delivered online via Moodle 3.7, a platform that became increasingly instrumental in the shift to online learning during the pandemic. The students relied on the LMS to access the course contents and functions remotely. The demographic breakdown was 53.04% male and 46.96% female students (Table 1). Students were categorized into three groups based on their academic performance: above-credit, credit, and below-credit, aligning with the university's grading standards (Table 2). These classifications provided a diverse cohort for examining LMS utility use across different academic performance levels.

Table 1

Students' Demographics

Demographics	Percent (%)	N
Gender		
Female	46.96%	147
Male	53.04%	166
Total	100%	313
Academic Performance		
Above-credit	36.74%	115
Credit	41.85%	131
Below-credit	21.41%	67
Total	100%	313

Table 2

Academic Performance Definition Used in Grading

Student Performance Groups	United States Equivalent	Description
Above-credit (Distinction and High Distinction)	A and B	A superior or outstanding performance, indicating that the student has demonstrated superior or above superior ability across the entire content of the course.
Credit	C	An acceptable performance, indicating that the student has demonstrated the ability to think analytically and contextually across the entire content of the course.
Below-credit (Pass and Fail)	D and F	A performance below-credit.

Instruments

The primary data source was the log data from Moodle 3.7, which served as the virtual learning environment where all course-related activities were conducted. Several key variables were the focus of our study: Course File Views tracked students' access to learning materials such as lecture slides, readings, and recordings; Forum Views and Posts captured students' engagement in asynchronous discussions; Gradebook Views captured students' access to their academic records; and Online Quiz Views traced students' access to formative assessments which were used to evaluate students' learning outcome. These aspects were integral to online learning, providing insights into student engagement, content delivery, and course assessment. The data was systematically logged by the Moodle server. The demographics such as students' gender and academic performance categories were also collected.

The reliability and validity of our study's data instruments rely on the robust features of Moodle 3.7, which systematically tracks and records user interactions within the LMS. The variables of interest—course file views, forum views, forum posts, gradebook views, and online quiz views—are direct measures of student engagement with the course content, discussions, and assessment tools. The reliability of these measures is underpinned by the automated logging processes of the Moodle server, which ensures a consistent and error-free recording of student activities. These logs offer a reliable temporal footprint of student engagement, with each action timestamped to ensure accurate tracking over the course period.

The validity of these measures is substantiated by their established use in educational research as indicators of student engagement and academic behavior. Furthermore, the granularity of the Moodle log data allows for a detailed analysis of student behavior patterns, which aligns with the study's aim to dissect the nuances of LMS resource utilization among students of varied academic performances. By relying on objective server data, the study avoids common pitfalls associated with self-reporting methods. In summary, the direct counting of Moodle use frequency from log files stands as a reliable and valid approach to measuring student engagement in online learning environments.

Data Collection Procedure

We collected the data over the course of an entire academic term from May 31 to August 26, 2020, which included ten weeks of lectures and two weeks of exams. This period was selected as it represented a time when all teaching and learning activities transitioned to a fully online format due to pandemic-related restrictions. Upon receiving ethics committee approval, which ensured adherence to privacy and ethical research standards, the research team utilized Moodle server logs to capture students' interactions with the LMS. These logs included a timestamp for each student's activities, providing a granular view of engagement with the platform's tools. Personal identifiers were stripped from the data to maintain student confidentiality, and all information was secured to limit access exclusively to the research team for the purposes of this study.

The focus was on five primary LMS utilities: course file views, forum views, forum posts, gradebook views, and online quiz views. These utilities were selected for their relevance in assessing the patterns of student engagement and their potential impact on academic performance. The usage data collected totaled 129,567 records from the student cohort. We present the statistics describing students' use of these utilities in Table 3.

Table 3

Descriptive Statistics of Logs

LMS Utility	Count	Individual Records			
		Minimum	Maximum	Mean	Std. Dev
Course File Views	96063	65	1067	306.911	145.755
Forum Views	12035	0	273	38.450	41.746
Forum Posts	139	0	16	0.444	1.438
Gradebook Views	2214	0	86	7.073	9.035
Online Quiz Views	19116	0	142	61.073	25.266

Informed by the statistics of the five LMS utilities (Table 3), course file views have a high mean of 306.911 and a large standard deviation of 145.755, indicating frequent but variable usage among students. In other words, course files are a critical resource for students, but their usage may depend on individual learning styles. Forum views have a mean of 38.450 and a standard deviation of 41.746, indicating that students often view forums but not as frequently as course files. The high standard deviation suggests that while some students find forums useful for their learning, others may not engage with them as much. Forum Posts have a low mean of 0.444 and a standard deviation of 1.438, suggesting that students do not post in forums often. This indicates that students are more comfortable consuming information from forums than actively participating in discussions. Gradebook views have a mean of 7.073 and a standard deviation of 9.035, indicating that students check their grades occasionally. The relatively high standard deviation suggests that some students check their grades more frequently than others, possibly reflecting different levels of concern about academic performance. Online quiz views have a mean of 61.073 and a standard deviation of 25.266, suggesting that students are frequently accessing online quizzes. The lower standard deviation compared to course file views and forum views indicates less variability in quiz usage among students.

Analysis Method

We employed the Kruskal-Wallis H Test as our primary analytical method. This non-parametric test was selected due to its suitability for the ordinal nature of our data and its robustness against non-normal distributions (Liu & Weistroffer, 2022; Mishra et al., 2019). Before conducting the test, we verified its assumptions, such as the independence of observations and the scale of measurement of the data. The Kruskal-Wallis H Test aimed to analyze statistically significant differences in the frequency of use of LMS utilities between the performance groups (i.e., above-credit group, below-credit group, and credit group).

Results

The statistics illuminate that the utilization of LMS utilities varies considerably across different academic performance groups (Table 4). Testing the significance of these utilization patterns via the Kruskal-Wallis H Test is crucial in answering our research question.

Table 4

Descriptive Statistics of Logs of Three Student Groups

LMS Utility	Group	N	Minimum	Maximum	Mean	Std. Dev
Course File Views	Above Credit	115	132	1067	337.809	163.200
	Credit	131	105	959	307.550	140.725
	Below Credit	67	65	565	252.627	103.741
Forum Views	Above Credit	115	0	273	48.878	49.220
	Credit	131	0	257	36.947	39.345
	Below Credit	67	0	111	23.493	24.156
Forum Posts	Above Credit	115	0	16	0.765	2.112
	Credit	131	0	5	0.344	0.918
	Below Credit	67	0	1	0.090	0.288
Gradebook Views	Above Credit	115	0	41	7.530	8.324
	Credit	131	0	86	7.405	10.146
	Below Credit	67	0	51	5.642	7.798
Online Quiz Views	Above Credit	115	34	140	68.870	23.688
	Credit	131	0	136	59.939	24.643
	Below Credit	67	0	142	49.910	24.847

The results of the Kruskal-Wallis H Test (See Table 5) indicate that students of various academic performances behave differently when viewing online course files, forum posts, and online quizzes. The results also reveal that students of various academic performances behave differently when posting on forums. However, students do not behave differently when viewing the gradebook.

Table 5

Statistics of the Kruskal-Wallis H Test

LMS Utility	Comparison Group	N1	N2	Kruskal-Wallis Statistic	*p*-Value
Course File Views	Above Credit—Below Credit	115	67	5078	0.000 ***
	Above Credit—Credit	115	131	8398.5	0.120 (ns)
	Below Credit—Credit	67	131	3461	0.015 **
Forum Views	Above Credit—Below Credit	115	67	5287.5	0.000 ***
	Above Credit—Credit	115	131	8663	0.042 *
	Below Credit—Credit	67	131	3338.5	0.006 **
Forum Posts	Above Credit—Below Credit	115	67	4393	0.016 *
	Above Credit—Credit	115	131	7981.5	0.240 (ns)
	Below Credit—Credit	67	131	4011.5	0.103 (ns)

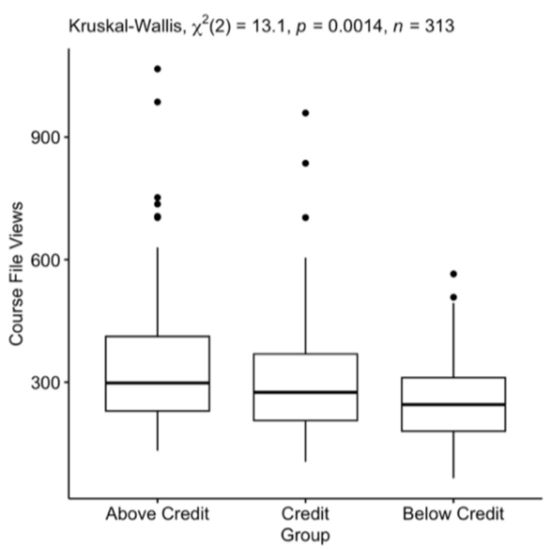
Gradebook Views	Above Credit—Below Credit	115	67	4420.5	0.095 (ns)
	Above Credit—Credit	115	131	7765.5	0.674 (ns)
	Below Credit—Credit	67	131	3871.5	0.172 (ns)
Online Quiz Views	Above Credit—Below Credit	115	67	5755	0.000 ***
	Above Credit—Credit	115	131	9370.5	0.001 **
	Below Credit—Credit	67	131	3194.5	0.002 **

Viewing Course Files

The Kruskal-Wallis H Test reveals that students at various academic performance levels view course files at significantly different frequencies (p = 0.001), rejecting the null hypothesis (Figure 1). The mean view frequency of above-credit students is 337.809, while the mean frequency values of credit students and below-credit students are 307.55 and 252.627, respectively. The test reveals that the mean view frequency of above-credit students is significantly greater than that of the below-credit students. In addition, the mean view frequency of credit students is significantly greater than that of the below-credit students at 252.627. Noticeably, the mean view frequency of above-credit students is not significantly greater than that of the credit students. Thus, H1 is partially supported.

Figure 1

Course File Views



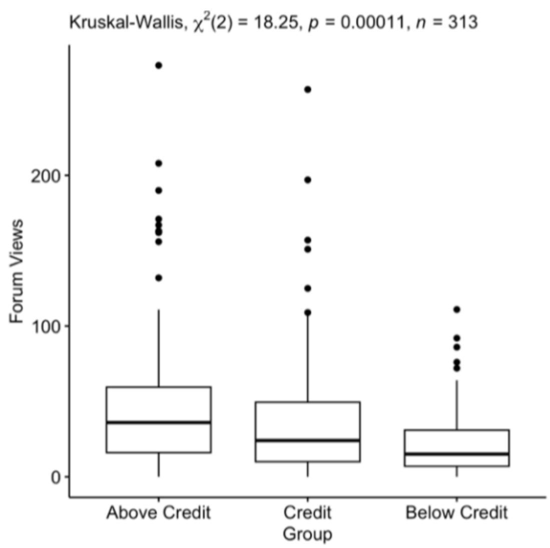
The test results indicate students who frequently engage with course files perform better academically. In comparison, students in the below-credit group have the lowest mean frequency. Our results suggest a relationship between engagement with course files and academic performance.

Viewing Forum Posts

The Kruskal-Wallis H Test shows that students at various academic performance levels view forum posts at significantly different frequencies (p = 0.001), rejecting the null hypothesis (Figure 2). We observe a significant difference in the behavior of viewing forum posts among students of different academic performances. The mean view frequency of above-credit students is 48.878, significantly higher than the frequency of credit students at 36.947 and the frequency of below-credit students at 23.493. In addition, the mean view frequency of credit students is significantly higher than that of the below-credit students. Thus, H2 is fully supported.

Figure 2

Forum Views



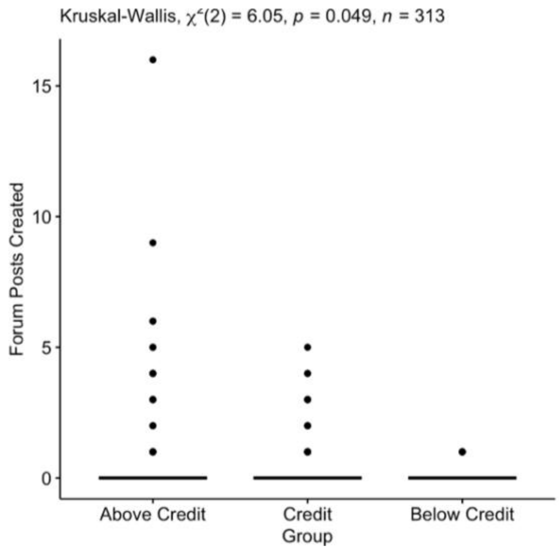
In other words, students who frequently view course forums perform better academically. In comparison, students in the below-credit group view course forums only half as frequently as above-credit students. This difference suggests a positive relationship between the frequency of viewing forum posts and academic performance.

Posting on Course Forums

The Kruskal-Wallis H Test result indicates a significance of 0.049, rejecting the null hypothesis (Figure 3). Specifically, the mean view frequency of above-credit students is 0.765, significantly greater than that of the below-credit students at 0.090. Accordingly, H3 is partially supported.

Figure 3

Forum Posts Created



Viewing Gradebook

The test indicates a significance of 0.230, failing to reject the null hypothesis (Figure 4). This finding suggests no significant differences in gradebook views among students of different academic performances. Therefore, H4 is not supported.

Figure 4

Gradebook Views

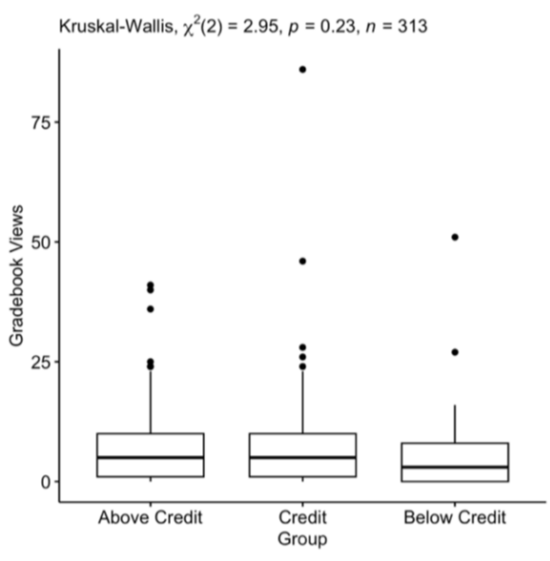
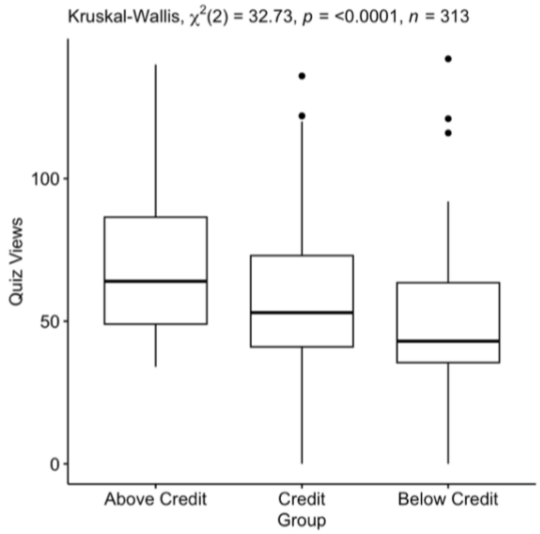


Figure 5

Online Quiz Views



Viewing Online Quizzes

The result of the Kruskal-Wallis H Test indicates a significance < 0.001, rejecting the null hypothesis (Figure 5). The mean view frequency of above-credit students is 68.870, significantly higher than the frequency of credit students at 59.939 and the frequency of below-credit students at 49.910. In addition, the mean view frequency of credit students is significantly higher than that of the below-credit students. This finding indicates significant differences in online quiz view frequency among students of different academic performances. Therefore, H5 is fully supported.

The results of the Kruskal-Wallis H Test are synthesized in Table 6. These results underscore the importance of certain LMS features (H1, H2, H3, and H5) in relation to academic performance.

Table 6

Summary of Hypothesis Testing Results

Hypotheses	Engagement with LMS	$\chi 2$	*p*-Value	Result
H1	Viewing Course Files	13.10	0.001**	Partially Supported
H2	Viewing Forum Posts	18.25	0.000***	Supported
H3	Posting on Course Forums	6.05	0.049*	Partially Supported
H4	Viewing Gradebook	2.95	0.230	Not Supported
H5	Viewing Online Quizzes	32.73	0.000***	Supported

Discussion

The adoption of online LMSs has been well documented, yet research into the differentiated use of LMS tools during the pandemic remains scarce. Addressing this research void, our study delves into the relationship between students' academic achievements and their interaction with Moodle's online learning tools, such as course files, discussion forums, gradebook, and online quizzes. Our findings contribute to the body of literature by demonstrating nuanced patterns of online resource utilization during a period of widespread disruption in higher education. Students' differential engagement with LMS resources aligns with self-regulated learning theories, suggesting that proactive and strategic use of online learning tools is associated with higher academic performance. Higher academic performance is linked to more frequent engagement with course files and online quizzes and active participation in forums, reinforcing the pedagogical principle that student interaction with learning content and peers is pivotal to the learning process.

Implications for Research

Our findings reveal that students with superior academic performance tend to frequently interact with course files and review online assessments, as well as being actively involved in forum discussions. These patterns demonstrate the pivotal role of such resources in reinforcing the learning process. Despite these insights, the comparable frequency of accessing course files between the highest-performing (above-credit) and moderately performing (credit) students suggests the influence of other factors on superior academic outcomes. Additionally, the varying frequency of forum interactions—both in viewing and posting—across different levels of academic achievement implies that such proactive participation may enhance academic success. Yet, the absence of notable differences in posting frequency across specific academic groups hints that mere participation in forums is not the sole factor for academic enhancement. In contrast, the regularity of gradebook monitoring did not show marked differences across academic levels, implying that the act of grade monitoring alone may not be closely tied to academic performance. Thus, while it is vital to stay informed of academic standings, it does not emerge as a decisive factor in academic triumph. These insights emphasize the crucial role of active engagement with digital learning tools in achieving academic excellence and offer valuable considerations for the structuring of online academic programs and pedagogical strategies.

The analysis reveals distinctive patterns in the usage (e.g., use frequency) of Moodle functionalities across different academic performance tiers. This underscores the importance of considering the distinct value each feature offers, as they are not uniformly embraced by all student demographics. Through the research lens of connectivism, we examine the connection magnitude, in terms of use frequency, between peers and a variety of LMS features. In particular, we see strong connections between peers and such features as course files, forums, and online quizzes through the peer activities of "view." These strong connections are likely to powerfully impact the learners using the LMS. Those weaker connections (with lower frequency) suggest that the activities of viewing gradebook and posting on forums are not as common to the learners as those main activities to maintain connectedness. By examining the connections between students and various digital features, we gain a better understanding of which features are most instrumental in supporting online learning.

The view course file and view course forum features of Moodle support predominantly one-way communication, which may suit students who prefer to process learning material individually. However, the feature for posting on forums, which enables interactive two-way communication, is not utilized to the same extent. This discrepancy might hint at a preference among certain students for more direct, perhaps less public, forms of communication with instructors, such as emails or personal meetings, which this study's data collection methods may not capture. Educators, recognizing these patterns, could enhance support for passive learners by offering alternative engagement options like personalized feedback or one-on-one sessions to encourage more active involvement. In addition, educational strategies might incorporate reflective prompts or collaborative tasks that validate passive engagement while nudging towards active participation. Future research is needed to understand the relationship between passive engagement and academic performance, as well as to develop interventions that can help transform passive online interactions into more active and meaningful learning experiences.

Implication for Education Practice

The discrepancies in LMS feature utilization have tangible implications for educational practice. Educators and administrators should consider these findings when choosing and implementing online learning platforms, ensuring that the tools provided align with pedagogical objectives and student needs. Strategic use of these tools, as our findings suggest, can lead to enhanced academic outcomes. Therefore, it is crucial for educators to not only implement these tools but also to train students in their effective use, making them integral parts of the learning strategy.

Our findings reveal that high performing students view online course files more frequently—in other words, frequently viewing course learning files is related to better academic performance. Therefore, our study reassures the importance of learning materials in online learning. It is important for online course instructors to provide relevant, organized, and easily accessible course files to improve students' online learning experience. Moreover, educators should focus on developing high-quality course files and promoting their use to engage more students. Moreover, we find that frequently viewing forum posts is related to better academic performance in online learning. This finding underscores the importance of fostering active forum engagement among students inclusively. Accordingly, in online teaching, educators should design and develop engaging features to encourage students to view and participate in forum discussions.

Our findings suggest that the students did not use two-way communication features as frequently as using one-way communication features. In this regard, there exist good opportunities for system designers and developers to improve LMSs to encourage two-way communication, particularly for lower-performing students who may benefit from more interaction in a remote environment. For example, Moodle provides limited support for formatting scripts (e.g., Python) in a preferred manner and for creating forum posts with customizable privacy settings. Developers should compare student posts on various platforms (e.g., with and without advanced capabilities) to determine if they should provide students with more flexible options for posting in a forum.

Our study clearly shows that students' engagement with course files and forum posts varies with their academic performance, but such variance is not observed in how they view gradebooks. This indicates that active engagement with course files and discussions is more influential on academic success than frequent grade checks. Educators should, therefore, encourage students to prioritize active learning and interaction with course content over mere performance monitoring. Another implication is that educators can build early warning systems that analyze students' online behavior to identify those likely to be at risk of academic failure. For instance, if a student is not regularly accessing course files or participating in discussions, this could be a signal that they are struggling and may need additional support.

The rapid advancement of artificial intelligence (AI) and its pervasiveness in various facets of daily life heralds a transformative potential for online learning. Despite this, current integrations of AI functionalities within platforms like Moodle are scarce, particularly in personalizing the educational journey, automating progress tracking, and facilitating adaptive assessments. This study's findings, which highlight the differential engagement of students with online learning resources, underscore the need for such AI-driven personalization. By embedding AI features in the LMS, developers can tailor learning experiences to individual student profiles, thereby addressing the engagement challenges highlighted in this research. The ability of AI to provide real-time feedback and predictive analytics could be pivotal in enhancing learner engagement and academic outcomes. Therefore, future endeavors may explore the utilization of AI elements in online platforms to elevate the quality of learners and to overcome the barriers to engagement identified throughout our study.

Conclusion

The COVID-19 pandemic has profoundly influenced the educational landscape, prompting a swift transition to online learning platforms across higher education institutions. Our study investigates how students' engagement with online resources varies amidst such global challenges. The differential use of LMS features among student performance groups reveals that engagement levels with course files, discussion forums, and quizzes are nuanced, underscoring the complex nature of online learning and its implications for academic success. These insights underscore the multifaceted role of digital tools in learning processes and provide a foundation for educational stakeholders to refine remote learning practices. The study contributes to a deeper understanding of the interplay between technology use and academic performance, marking a theoretical advancement by contextualizing usage patterns within the frameworks of self-regulated learning and connectivism, enriching the discourse on online learning adoption during unforeseen educational disruptions.

However, it is crucial to acknowledge the study's limitations. While our analysis of log data provides a quantitative measure of student engagement with LMS features, it lacks the qualitative depth to explain the motivations behind these behaviors. The insights gained are bound by the context of the pandemic, which presents an extraordinary situation that may not represent typical online learning conditions. Additionally, the study is limited to a single institution's data, potentially limiting the generalizability of the results. We encourage future research to delve into the underlying reasons for the observed behaviors by examining student perceptions, demographic variables, and motivational factors. Another limitation that future studies might address is the exclusive focus on the pandemic period; comparisons with pre- and post-pandemic online learning behaviors could provide a more holistic view of the evolution of students' engagement with online learning platforms. These limitations do not diminish the significance of the study's contributions but rather define the scope within which the findings should be interpreted. They also highlight the pathways for subsequent research to build on the groundwork laid by this study, contributing to a richer and more nuanced understanding of online learning in higher education.

References

Aikina, T., & Bolsunovskaya, L. (2020). Moodle-based learning: Motivating and demotivating factors. *International Journal of Emerging Technologies in Learning*, *15*(2), 239-248. https://doi.org/10.3991/ijet.v15i02.11297

Alhazmi, A. K., Imtiaz, A., Al-Hammadi, F., & Kaed, E. (2021). Success and failure aspects of LMS in e-learning systems. *International Journal of Interactive Mobile Technologies*, *15*(11), 133-147. https://doi.org/10.3991/ijim.v15i11.20805

Ali, W. (2020). Online and remote learning in higher education institutes: A necessity in light of COVID-19 pandemic. *Higher Education Studies*, *10*(3), 16-25. https://doi.org/10.5539/hes.v10n3p16

Alshamrani, K. M., Ghulam, E. M., Alattas, M., Aljaddani, H., Alhakami, M., Al Nufaiei, Z. F., & Althaqafy, M. S. (2023). Transition to remote/hybrid learning during the COVID-19 pandemic among Saudi students of the College of Applied Medical Sciences: A cross-sectional study. *Frontiers in Medicine*, *10*. https://doi.org/10.3389/fmed.2023.1257589

Altinpulluk, H., & Kesim, M. (2021). A systematic review of the tendencies in the use of learning management systems. *Turkish Online Journal of Distance Education*, *22*(3), 40-54. https://doi.org/10.17718/tojde.961812

Alturki, U., & Aldraiweesh, A. (2021). Application of learning management system (LMS) during the COVID-19 pandemic: A sustainable acceptance model of the expansion technology approach. *Sustainability*, *13*(19), 10991. https://doi.org/10.3390/su131910991

Avcı, Ü., & Ergün, E. (2022). Online students' LMS activities and their effect on engagement, information literacy and academic performance. *Interactive Learning Environments*, *30*(1), 71-84. https://doi.org/10.1080/10494820.2019.1636088

Baragash, R. S., & Al-Samarraie, H. (2018). Blended learning: Investigating the influence of engagement in multiple learning delivery modes on students' performance. *Telematics and Informatics*, *35*(7), 2082-2098. https://doi.org/10.1016/j.tele.2018.07.010

Beatson, N., Gabriel, C.-A., Howell, A., Scott, S., van der Meer, J., & Wood, L. C. (2020). Just opt in: How choosing to engage with technology impacts business students' academic performance. *Journal of Accounting Education*, *50*, 100641. https://doi.org/10.1016/j.jaccedu.2019.100641

Bradley, V. M. (2021). Learning Management System (LMS) use with online instruction. *International Journal of Technology in Education*, *4*(1), 68-92. https://doi.org/10.46328/ijte.36

Broadbent, J., Sharman, S., Panadero, E., & Fuller-Tyszkiewicz, M. (2021). How does self-regulated learning influence formative assessment and summative grade? Comparing online and blended learners. *The Internet and Higher Education*, *50*, 100805. https://doi.org/10.1016/j.iheduc.2021.100805

Chang, D. H., Lin, M. P.-C., Hajian, S., & Wang, Q. Q. (2023). Educational design principles of using ai chatbot that supports self-regulated learning in education: Goal setting, feedback, and personalization. *Sustainability*, *15*(17), 12921. https://doi.org/10.3390/su151712921

Chang, M., Walimuni, A. C., Kim, M.-c., & Lim, H.-s. (2022). Acceptance of tourism blockchain based on UTAUT and connectivism theory. *Technology in Society*, *71*, 102027. https://doi.org/0.1016/j.techsoc.2022.102027

Chiu, T. K., & Hew, T. K. (2018). Factors influencing peer learning and performance in MOOC asynchronous online discussion forum. *Australasian Journal of Educational Technology*, *34*(4). https://doi.org/10.14742/ajet.3240

Cobo-Rendon, R., Lobos Peña, K., Mella-Norambuena, J., Cisternas San Martin, N., & Peña, F. (2021). longitudinal analysis of teacher technology acceptance and its relationship to resource viewing and academic performance of college students during the COVID-19 pandemic. *Sustainability*, *13*(21), 12167. https://doi.org/10.3390/su132112167

Crampton, A., Ragusa, A. T., & Cavanagh, H. (2012). Cross-discipline investigation of the relationship between academic performance and online resource access by distance education students. *Research in Learning Technology*, *20*(1), n1. https://doi.org/10.3402/rlt.v20i0/14430

Dahal, N. (2022). Understanding and uses of collaborative tools for online courses in higher education. *Advances in Mobile Learning Educational Research*, *2*(2), 435-442. https://doi.org/10.25082/AMLER.2022.02.012

Dang, M. Y., Zhang, G. Y., & Amer, B. (2019). Social networks among students, peer TAs, and instructors and their impacts on student learning in the blended environment: A model development and testing. *Communications of the Association for Information Systems*, *44*(1), 36. https://doi.org/10.17705/1CAIS.04436

Dobbins, C., & Denton, P. (2017). MyWallMate: An investigation into the use of mobile technology in enhancing student engagement. *TechTrends*, *61*(6), 541-549. https://doi.org/10.1007/s11528-017-0188-y

Downes, S. (2019). Recent work in connectivism. *European Journal of Open, Distance and E-Learning*, *22*(2), 112-131. https://doi.org/10.2478/eurodl-2019-0014

Dziubaniuk, O., Ivanova-Gongne, M., & Nyholm, M. (2023). Learning and teaching sustainable business in the digital era: A connectivism theory approach. *International Journal of Educational Technology in Higher Education*, *20*(1), 1-23. https://doi.org/10.1186/s41239-023-00390-w

Farnell, T., Skledar Matijevic, A., & Šcukanec Schmidt, N. (2021). *The Impact of COVID-19 on Higher Education*. https://op.europa.eu/en/publication-detail/-/publication/876ce591-87a0-11eb-ac4c-01aa75ed71a1/language-en

Galikyan, I., & Admiraal, W. (2019). Students' engagement in asynchronous online discussion: The relationship between cognitive presence, learner prominence, and academic performance. *The Internet and Higher Education*, *43*, 100692. https://doi.org/10.1016/j.iheduc.2019.100692

Gamage, S. H., Ayres, J. R., & Behrend, M. B. (2022). A systematic review on trends in using Moodle for teaching and learning. *International Journal of STEM Education*, *9*(1), 1-24. https://doi.org/10.1186/s40594-021-00323-x

Gartner. (2023). *Higher education learning management systems reviews and ratings*. https://www.gartner.com/reviews/market/higher-education-learning-management-systems

Geddes, D. (2009). How am I doing? Exploring on-line gradebook monitoring as a self-regulated learning practice that impacts academic achievement. *Academy of Management Learning & Education*, *8*(4), 494-510. https://doi.org/10.5465/AMLE.2009.47785469

Gogus, A. (2023). Adaptation of an activity theory framework for effective online learning experiences: bringing cognitive presence, teaching presence, and social presence to online courses. *Online Learning Journal*, *27*(2), 265-287. https://doi.org/10.24059/olj.v27i2.3073

Goldie, J. G. S. (2016). Connectivism: A knowledge learning theory for the digital age? *Medical Teacher*, *38*(10), 1064-1069. https://doi.org/10.3109/0142159X.2016.1173661

Goldie, K., Ironside, R., & Pirie, E. (2023). “It feels real”: Events management and online experiential learning in COVID-19. *Distance Education*, *44*(2), 230-245. https://doi.org/10.1080/01587919.2023.2198490

Hadwin, A. F., Sukhawathanakul, P., Rostampour, R., & Bahena-Olivares, L. M. (2022). Do self-regulated learning practices and intervention mitigate the impact of academic challenges and COVID-19 distress on academic performance during online learning. *Frontiers in Psychology*, *13*, 813529. https://doi.org/10.3389/fpsyg.2022.813529

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*, 275-285. https://doi.org/10.1016/j.susoc.2022.05.004

Hensley, L. C., Iaconelli, R., & Wolters, C. A. (2022). “This weird time we’re in”: How a sudden change to remote education impacted college students’ self-regulated learning. *Journal of Research on Technology in Education*, *54*(sup1), S203-S218. https://doi.org/10.1080/15391523.2021.1916414

Hromalik, C. D., & Koszalka, T. A. (2018). Self-regulation of the use of digital resources in an online language learning course improves learning outcomes. *Distance Education*, *39*(4), 528-547. https://doi.org/10.1080/01587919.2018.1520044

Hsu, L. (2023). EFL learners’ self-determination and acceptance of LMOOCs: The UTAUT model. *Computer Assisted Language Learning*, *36*(7), 1177-1205. https://doi.org/10.1080/09588221.2021.1976210

Hung, J.-L., & Zhang, K. (2008). Revealing online learning behaviors and activity patterns and making predictions with data mining techniques in online teaching. *MERLOT Journal of Online Learning and Teaching*, *4*(4), 426-437. http://jolt.merlot.org/vol4no4/hung_1208.pdf

Jaffar, M. N., Mahmud, N. H., Amran, M. F., Abdul Rahman, M. H., Abd Aziz, N. H., & Che Noh, M. A. (2022). Online learning and teaching technology services: USIM's experience during COVID-19 pandemic. *Frontiers in Education*, *7*, 813679. https://doi.org/10.3389/feduc.2022.813679

Jones, D., Lotz, N., & Holden, G. (2021). A longitudinal study of virtual design studio (VDS) use in STEM distance design education. *International Journal of Technology and Design Education*, *31*(4), 839-865. https://doi.org/10.1007/s10798-020-09576-z

Junus, K., Santoso, H. B., Putra, P. O. H., Gandhi, A., & Siswantining, T. (2021). Lecturer readiness for online classes during the pandemic: A survey research. *Education Sciences*, *11*(3), 139. https://doi.org/10.3390/educsci11030139

Kasim, N. N. M., & Khalid, F. (2016). Choosing the right learning management system (LMS) for the higher education institution context: A systematic review. *International Journal of Emerging Technologies in Learning*, *11*(6), 55-61. https://doi.org/10.3991/ijet.v11i06.5644

Kompen, R. T., Edirisingha, P., Canaleta, X., Alsina, M., & Monguet, J. M. (2019). Personal learning environments based on Web 2.0 services in higher education. *Telematics and Informatics*, *38*, 194-206. https://doi.org/10.1016/j.tele.2018.10.003

Kumar, V., & Sharma, D. (2016). Creating collaborative and convenient learning environments using cloud-based moodle LMS: An instructor and administrator perspective. *International Journal of Web-Based Learning and Teaching Technologies*, *11*(1), 35-50. https://doi.org/10.4018/IJWLTT.2016010103

Kuznekoff, J. H., & Munz, S. M. (2022). COVID-19 and the transition to online learning in the basic course: Examining effects on student learning. *Higher Learning Research Communications*, *12*(2), 45-61. https://doi.org/10.18870/hlrc.2022.v12i2.1331

Liu, C. (2023). Automating student assessment using digital data to improve education management effectiveness in higher education institutions. *Education and Information Technologies*. https://doi.org/10.1007/s10639-023-11898-z

Liu, D., & Weistroffer, H. R. (2022). Statistically significant! But is trust of practical significance? *Journal of Computer Information Systems*, *62*(2), 247-258. https://doi.org/10.1080/08874417.2020.1783723

Longhurst, G. J., Stone, D. M., Dulohery, K., Scully, D., Campbell, T., & Smith, C. F. (2020). Strength, weakness, opportunity, threat (SWOT) analysis of the adaptations to anatomical education in the United Kingdom and Republic of Ireland in response to the Covid-19 pandemic. *Anatomical Sciences Education*, *13*(3), 301-311. https://doi.org/10.1002/ase.1967

Madge, C., Breines, M. R., Dalu, M. T. B., Gunter, A., Mittelmeier, J., Prinsloo, P., & Raghuram, P. (2019). WhatsApp use among African international distance education (IDE) students: t\Transferring, translating and transforming educational experiences. *Learning, Media and Technology*, *44*(3), 267-282. https://doi.org/10.1080/17439884.2019.1628048

Marachi, R., & Quill, L. (2020). The case of Canvas: Longitudinal datafication through learning management systems. *Teaching in Higher Education*, *25*(4), 418-434. https://doi.org/10.1080/13562517.2020.1739641

Martin, L. (2020). *Foundations for Good Practice: The Student Experience of Online Learning in Australian Higher Education during the COVID-19 Pandemic*. https://eric.ed.gov/?id=ED610395

McKinney & Company. (2022). *How COVID-19 caused a global learning crisis*. https://www.mckinsey.com/industries/education/our-insights/how-covid-19-caused-a-global-learning-crisis

Mhlongo, S., Mbatha, K., Ramatsetse, B., & Dlamini, R. (2023). Challenges, opportunities, and prospects of adopting and using smart digital technologies in learning environments: An iterative review. *Heliyon*, e16348. https://doi.org/10.1016/j.heliyon.2023.e16348

Mishra, P., Pandey, C. M., Singh, U., Keshri, A., & Sabaretnam, M. (2019). Selection of appropriate statistical methods for data analysis. *Annals of Cardiac Anaesthesia*, *22*(3), 297. https://doi.org/10.4103/aca.ACA_248_18

Moodle Project. (2022). *Moodle statistics*. https://stats.moodle.org/

Mpungose, C. B., & Khoza, S. B. (2022). Postgraduate students' experiences on the use of Moodle and Canvas learning management system. *Technology, Knowledge and Learning*, *27*, 1-16. https://doi.org/10.1007/s10758-020-09475-1

Mushtaha, E., Dabous, S. A., Alsyouf, I., Ahmed, A., & Abdraboh, N. R. (2022). The challenges and opportunities of online learning and teaching at engineering and theoretical colleges during the pandemic. *Ain Shams Engineering Journal*, *13*(6), 101770. https://doi.org/10.1016/j.asej.2022.101770

Nnadozie, V., & Khumalo, S. (2023). Self-agency and academically high-performing students' success: Towards a praxis for academic support in one South African university. *Journal of University Teaching and Learning Practice*, *20*(1), 17. https://doi.org/10.53761/1.20.01.17

Ortiz-López, A., Olmos-Migueláñez, S., & Sánchez-Prieto, J. C. (2023). Toward a new educational reality: A mapping review of the role of e-assessment in the new digital context. *Education and Information Technologies*, 1-28. https://doi.org/10.1007/s10639-023-12117-5

Ozdamli, F., & Karagozlu, D. (2022). Online education during the pandemic: A systematic literature review. *International Journal of Emerging Technologies in Learning*, *17*(16). https://doi.org/10.3991/ijet.v17i16.32287

Parte, L., & Mellado, L. (2022). Academic performance in distance education: Quizzes as a moderator variable and students' perception and expectation through linguistic analysis. *Online Learning Journal*, *26*(2), 124-147. https://doi.org/10.24059/olj.v26i2.2699

Pereira, F. D., Oliveira, E. H., Oliveira, D. B., Cristea, A. I., Carvalho, L. S., Fonseca, S. C., Toda, A., & Isotani, S. (2020). Using learning analytics in the Amazonas: understanding students’ behaviour in introductory programming. *British Journal of Educational Technology*, *51*(4), 955-972. https://doi.org/10.1111/bjet.12953

Potra, S., Pugna, A., Pop, M.-D., Negrea, R., & Dungan, L. (2021). Facing COVID-19 challenges: 1st-year students’ experience with the Romanian hybrid higher educational system. *International Journal of EnvironmentalResearch and Public Health*, *18*(6), 3058. https://doi.org/10.3390/ijerph18063058

Price, E., Lau, A. C., Goldberg, F., Turpen, C., Smith, P. S., Dancy, M., & Robinson, S. (2021). Analyzing a faculty online learning community as a mechanism for supporting faculty implementation of a guided-inquiry curriculum. *International Journal of STEM Education*, *8*(1), 1-26. https://doi.org/10.1186/s40594-020-00268-7

Raes, A., Vanneste, P., Pieters, M., Windey, I., Van Den Noortgate, W., & Depaepe, F. (2020). Learning and instruction in the hybrid virtual classroom: An investigation of students’ engagement and the effect of quizzes. *Computers & Education*, *143*, 103682. https://doi.org/10.1016/j.compedu.2019.103682

Rasheed, H. M. W., He, Y., Khalid, J., Khizar, H. M. U., & Sharif, S. (2020). The relationship between e-learning and academic performance of students. *Journal of Public Affairs*, e2492. https://doi.org/10.18178/ijiet.2020.10.3.1360

Saqr, M., & López-Pernas, S. (2021). The longitudinal trajectories of online engagement over a full program. *Computers & Education*, *175*, 104325. https://doi.org/10.1016/j.compedu.2021.104325

Soffer, T., & Cohen, A. (2019). Students' engagement characteristics predict success and completion of online courses. *Journal of Computer Assisted Learning*, *35*(3), 378-389. https://doi.org/10.1111/jcal.12340

Sumardi, D., Suryani, N., & Musadad, A. A. (2021). Website-based learning management system (LMS) as a tool for learning in the COVID-19 pandemic period for junior high schools. *Journal of Education Technology*, *5*(3), 346-355. https://doi.org/10.23887/jet.v5i3.38371

Sun, Z., & Yang, Y. (2023). The mediating role of learner empowerment in the relationship between the community of inquiry and online learning outcomes. *The Internet and Higher Education*, *58*, 100911. https://doi.org/10.1016/j.iheduc.2023.100911

Tajuddin, N. I. I., Abd Rahman, N. J., Aziz, K. A., Yusop, N., & Izni, N. A. (2023). Al-Chemy: E-learning platform for foundation students. *Bulletin of Electrical Engineering and Informatics*, *12*(5), 3170-3178. https://doi.org/10.11591/eei.v12i5.4476

Taridi, M., Risnita, Yaakob, M. F. M., & Khairani, M. (2023). An evaluative study for communicative language teaching (CLT) on online teaching and learning in higher education: Indonesian and Malaysian university context. *Education and Information Technologies*, 1-37. https://doi.org/10.1007/s10639-023-12221-6

Teng, F., & Huang, J. (2019). Predictive effects of writing strategies for self-regulated learning on secondary school learners' EFL writing proficiency. *TESOL Quarterly*, *53*(1), 232-247. https://doi.org/10.1002/tesq.462

UNESCO. (2021). *One year into COVID-19 education disruption: Where do we stand?* https://en.unesco.org/news/one-year-covid-19-education-disruption-where-do-we-stand

Veluvali, P., & Surisetti, J. (2022). Learning management system for greater learner engagement in higher education—A review. *Higher Education for the Future*, *9*(1), 107-121. https://doi.org/10.1177/23476311211049855

Wang, W., & Zhan, J. (2020). The relationship between English language learner characteristics and online self-regulation: A structural equation modeling approach. *Sustainability*, *12*(7), 3009. https://doi.org/10.3390/su12073009

Wirth, J., Stebner, F., Trypke, M., Schuster, C., & Leutner, D. (2020). An interactive layers model of self-regulated learning and cognitive load. *Educational Psychology Review*, *32*(4), 1127-1149. https://doi.org/10.1007/s10648-020-09568-4

Wong, J., Baars, M., Davis, D., Van Der Zee, T., Houben, G.-J., & Paas, F. (2019). Supporting self-regulated learning in online learning environments and MOOCs: A systematic review. *International Journal of Human–Computer Interaction*, *35*(4-5), 356-373. https://doi.org/10.1080/10447318.2018.1543084

Xing, Y., Xie, T., Shell, J., & Fahy, C. (2023). Investigating undergraduate student experiences of NEE courses in Guangdong, China during the COVID-19 pandemic from 2020 to 2021. *Sustainability*, *15*(5), 4174. https://doi.org/10.3390/su15054174

You, J. W. (2016). Identifying significant indicators using LMS data to predict course achievement in online learning. *The Internet and Higher Education*, *29*, 23-30. https://doi.org/10.1016/j.iheduc.2015.11.003

You, J. W., & Kang, M. (2014). The role of academic emotions in the relationship between perceived academic control and self-regulated learning in online learning. *Computers & Education*, *77*, 125-133. https://doi.org/10.1016/j.compedu.2014.04.018

Learner Perceptions of the Feedback Process in the Online Component of a Blended Course

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Abstract

Despite extensive research on feedback models, there is still sparse empirical evidence of their validity and application in higher education learning settings, whether online, hybrid, or face-to-face. Understanding how a feedback framework—integrated in the instructional cycle—is perceived by the learners can provide empirical support about its intended purpose and effectiveness. Recent reviews of research on student perceptions of feedback in different learning environments have revealed the need to research feedback as a process with the use of a more solid methodological approach. The aim of the present descriptive survey study is to investigate learners' perceptions of an established feedback model, Matrix of Feedback for Learning (Brooks et al., 2019), in the asynchronous online component of an undergraduate blended course. More specifically, the impact of its application on learners' encounters with three types of feedback (feed-up, feed-back and feed-forward) and three levels of feedback (task, process, and self-regulatory) is explored. A 36-item survey, previously piloted and preliminarily validated, was used to explore learners' perceptions (N=135) of the three feedback types and levels. Approximately 68% of responses showed that students recognized feedback and the possibilities to use and act on feedback as helpful to their learning. This present survey supports a line of research on feedback model validation in online learning environments while offering meaningful insights from the learners that can inform both course design and interventions to support engagement with feedback.

Keywords: Blended course, higher education, feedback process, survey, learner perceptions

Moni, A. (2024). Learner Perceptions of the Feedback Process in the Online Component of a Blended Course. *Online Learningl*, *Volume 28*(2), (359-384). DOI: 10.24059/olj.v28i2.3967

In the last twenty years, research studies on feedback have advanced our understanding of feedback from different perspectives. Feedback, far from only being information provided to the learner from the instructor, is a process that actively and purposefully involves the learner (Carless, 2015) with engagement and agency on feedback received (Handley et al., 2011; Lipnevich et al., 2016; Nieminen et al., 2022; Winstone et al., 2017). Formative assessment and feedback are crucial drivers of student learning and are strictly interconnected (Hattie & Clarke, 2018; Hattie & Timperley, 2007; Lipnevich et al., 2016; Lui & Andrade, 2022; Shute, 2008; Smith & Lipnevich, 2018). However, formative assessment and feedback relationships do not denote a linear input-output response (Esterhazy, 2019).

Feedback as part of the learning process stems from the relation among the learners, the instructor, and the discipline-specific learning environment (Esterhazy, 2019), where formative assessment is one of the crucial elements, but not the only one. Research shows that feedback is a very powerful and critical aspect of learning (Hattie & Clarke, 2018); the same feedback process might work in one learning setting but not in another (Hattie & Clarke, 2018). Literature suggests that feedback supports and impacts student learning (Hattie & Timperley, 2007; Lipnevich & Smith, 2018; Shute, 2008), nevertheless there is no clear evidence of how feedback relates specifically to academic success and achievement (Hattie, 2009; Hattie & Anderman, 2019). Designing effective feedback processes in higher education with a learning-focused approach is a challenging (Winstone & Carless, 2020) yet not replicable task. In fact, feedback processes are inherent to the specific knowledge domain of a discipline (Boud & Molloy, 2013; Esterhazy, 2019; Winstone & Carless, 2020; Winstone et al., 2017;) and the ways this knowledge is organized and generated. Many are the feedback models and typology (Lipnevich & Panadero, 2022) supported by the literature, but only a few provide empirical evidence on their implementation, validity, and effectiveness.

The current research is driven by the theoretical framework that conceptualizes feedback as part of the learning process and, more specifically, as a relational process that emerges from the encounters among the discipline-specific learning environment, the learners, and the instructor (Esterhazy, 2019; Winstone & Carless, 2020). Within this framework, a principled course, assessment, and feedback design sustain several opportunities for encounters with feed-up, feed-back and feed-forward feedback types at three levels (task, process, and self-regulatory) (Brooks et al., 2019; Hattie & Timperley, 2007). Students engage with feedback that comes from different agents (Evans, 2013; Hattie & Timperley, 2007; Lipnevich et al., 2016) before, during, and after assessment (Dawson, 2023; Esterhazy, 2019).

The design of nested, scaffolded, ongoing, formative assessment as well as summative, multi-staged assessment offers opportunities for feedback agentic behavior on feedback, uptake of feedback, and resubmission of revised and improved tasks (Winstone et al., 2017). This study, conducted with the use of a student survey, contributes to the line of empirical research on the implementation of feedback models (Lipnevich & Panadero, 2021). Specifically, the researcher provides empirical evidence on the application of the feedback model conceptualized in a Matrix of Feedback for Learning (Brooks et al., 2019) in the online component of an English for Academic Purposes blended course and investigates the perceptions learners have of the feedback process in the asynchronous part of the course. A 36-question survey was used to explore learners' perceptions of feedback usefulness in relation to the whole feedback process, feed-up, feed-back, and feed-forward (Brooks et al., 2019). The research question of this quantitative study addressed the impact of feedback design on learners' perceived benefits of the feedback process in the online component of the course.

Feedback as Part of the Learning Process

In feedback research, there is a consensus that feedback is not information provided to the learner after assessment, but a process that unfolds incessantly during the instructional cycle (Esterhazy et al., 2109; Hattie & Clarke, 2018; Winstone & Carless, 2020). The feedback process is planned and integrated into the learning processes from the outset (Esterhazy et al., 2019; Winstone & Carless, 2020) and supports a learner-focused approach, emphasizing learner agency on feedback (Carless & Boud, 2018; Nieminen et al., 2022; Winstone & Carless, 2020) and ongoing actionable feedback (Boud & Molloy, 2013; Carless, 2015; Esterhazy, 2019).

A learner-focused approach implies a shift of the focus of instruction from the instructor to the student who, in turn, engages with the instructor, peers, and instructional content and activities (Hoidn, 2016). ~~It~~ A learner-focused approach relies on the design of student-centered learning environments which support a dynamic relation of the learner to the learning environment and its agents (Hoidn, 2016), where learners also feel ownership and control over their learning. Regarding feedback which is requested, received, self-assessed, and generated from peers, learners make sense of the feedback received, negotiate, and decide when to use it to improve their performance (Carless & Boud, 2018; Henderson et al., 2019; Winstone & Carless, 2020). This highlights a paradigm shift (Careless, 2015): Feedback is received, understood, and used by the learner, rather than merely given to the learner (Careless, 2015; Hattie et al., 2017).

Ongoing actionable feedback provides several opportunities for feedback encounters along the instructional process (Esterhazy, 2018; Winstone & Carless, 2020) and promotes learners' application and use of feedback in future tasks and other learning opportunities (Winstone & Carless, 2020). To support a student-centered approach to feedback and multiple actionable feedback opportunities, course design needs to embed planning, designing, and effectively integrating a feedback model with instructional and pedagogical components that promote learners' agency with feedback from the onset (Winstone & Carless, 2020). Thus, feedback becomes a key element for successful instructional practices and offers guidelines for enhancing its impact on learners with gradual and purposeful progress towards the learning goals (Brooks et al. 2019; Carless & Boud, 2018; Hattie & Timperley, 2007; Lipnevich & Pandero, 2022; Nicol & Macfarlane-Dick, 2006).

A Feedback Model for Instructional Intervention

Lipnevich & Pandero (2021) reviewed 14 of the most acclaimed feedback models and contended that choosing a feedback model and theory for empirical investigations depends on the aims of the researcher and the level of applicability to different instructional scenarios. Lipnevich & Pandero's (2022) seminal integrative model of feedback elements—MISCA—represents today a precious tool to navigate feedback models and to support empirical research where the acronym MISCA stands for the integration of five feedback thematic areas: message, implementation, students, context, and agents. According to Dawson et al. (2023), "the MISCA model serves to frame the range of elements that interplay on how feedback messages are crafted, interpreted and actioned" (p. 3). This integrative model acknowledges feedback as part of the learning process and underlines the learner's central role: the agentic behavior, the cognitive processing of the feedback message, the motivation, emotions, and experiences with feedback within the instructional learning context.

Among the many feedback frameworks presented in their review, Lipnevich & Panadero (2022) singled out the seminal theoretical framework by Hattie & Timperley (2007) as one of the most applied models. The model is simple, intuitive, and based on sound empirical investigations. It is "applicable to a wide range of behaviors, contexts, and instructional situations" (Lipnevich & Panadero, 2021, p.15). Based on empirical research on effective qualities of feedback, Hattie & Timperley's (2007) feedback model successfully categorizes

feedback in diverse learning settings (Harris et al., 2015; Lipnevich et al., 2013). , The feedback model presents specific instructional practices and pedagogical guidelines to impact student learning that can be smoothly and meaningfully integrated in course design from the beginning of instruction and in different instructional settings (Lipnevich & Panadero, 2021).

Considering previous contributions to feedback research (over 500 meta-analyses), Hattie & Timperley's (2007) feedback model contends that feedback's primary goal is to close the performance gap between the desired outcomes and the existing level of performance (Hattie & Timperley, 2007). According to Hattie & Timperley (2007), effective feedback should address three fundamental questions:

Where am I going? (Feed-Up): This aspect of feedback involves providing clarity about the learning goals and objectives. It helps learners understand what they are trying to achieve, setting clear expectations, standards, and criteria for specific activities or assessments. In essence, it guides students in understanding the direction they should take in their learning (Fisher & Frey, 2009; Hattie & Clark, 2018; Narciss & Huth, 2004; Sadler, 2010; Wang & Li, 2011; Wiggins, 1996).

How am I doing? (Feed-Back): At this level, feedback focuses on assessing the learners' current progress against success criteria. It highlights strengths and areas that require improvement. This feedback offers a snapshot of learners' performance and helps them understand where they currently stand in relation to the learning (Elder & Brooks, 1992; Kulhavy & Stock, 1989; Narciss & Huth, 2004).

What comes next? (Feed-Forward): Feed-Forward is about providing guidance for future improvement following success criteria. It goes beyond identifying weaknesses and suggests processes, guided strategies, and remediation techniques for learners to enhance work and future learning (Hounsell et al., 2008; Sadler, 2010; Sadler et al., 2023; Vardi, 2013). It empowers students to make informed decisions about their work.

Furthermore, Hattie & Timperley (2007) highlighted that the above questions should be used at four different levels:

Task Level: Feedback at this level pertains to how the specific task or assignment was accomplished or performed (Ashford, 1986; Ashford et al.,2003; Glover & Brown, 2006; Shute, 2008). It focuses on the task's execution and achievement of objectives for a specific performance.

Process Level: This level of feedback includes commentaries on the strategies and approaches needed to effectively accomplish the task. s (Arts et al., 2021; Carless & Boud, 2018). It guides students throughout the learning process.

Self-Regulatory Level: This feedback level relates to learners' internal feedback mechanisms, self-assessment, and ability to direct and regulate actions toward achieving learning goals. It promotes metacognition and self-awareness (Arts et al., 2021; Deci & Ryan, 2000; Pintrich & De Groot, 1990).

Self-Level: The self-level involves praising and acknowledging learners' efforts and achievements. It is the least helpful of the four feedback levels (Kirschner et al., 2018.)

Importantly, Hattie & Timperley (2007) recognized that the timing of feedback is critical, especially concerning where students are in the instructional cycle. They emphasized the importance of shifting from a task-focused approach to addressing task-related strategies and self-regulation of processes. The effectiveness of feedback also depends on how the learners master the task, making it a dynamic and adaptive process in the learning journey.

The feedback model by Hattie & Timperley (2007) was further built on by Brooks et al. (2019) with the conceptual Matrix of Feedback for Learning that connects theory with application using practical examples (see Figure 1). Brooks et al.'s (2019) innovation was in proposing a matrix representing how each feedback type (feed-up, feed-back and feed-forward), within the overall feedback model, relates to each feedback level (task, process, and self-regulatory) and to learner stage with a task: novice, proficient and advanced learner. According to Brooks et al. (2019), generally task level feedback matches more the need of novice learners, while process and self-regulatory are mostly directed to proficient and advanced learners. In a different line from Hattie & Timperley (2007), Brooks et al., (2019) excluded the "self-level" feedback. The "self-level" feedback is frequently associated with praise and can have a negative impact on learning (Dweck, 2007; Hattie, 2009; Kluger & DeNisi, 1996).

Figure 1

Matrix of Feedback for Learning (Brooks et al., 2019)

Learner Stage	Feedback Level	Feeding Up: Where am I going?	Feeding Back: How am I going?	Feeding Forward: What do I have to do next?
Novice	Task	**Feeding Up Prompts:** ☐ Today we are learning… ☐ Success in this task will look like…(exemplar/model) ☐ The key criteria for success are… ☐ We are looking for… **Feedback Strategies** ☐ Reduce complexity ☐ Use exemplars/models ☐ Identify misconceptions ☐ Use diagnostic assessment for goal setting	**Feedback Prompts:** ☐ You *have/haven't* met the learning intention by… ☐ You *have/haven't* met the success criteria by… ☐ Your answer/work is/isn't what we are looking for because… **Feedback Strategies** ☐ Avoid over emphasis of error analysis ☐ Feedback must be immediate ☐ Match feedback to success criteria	**Feed Forward Prompts:** ☐ To fully meet the learning intention you could… ☐ Addressing the following success criteria would improve your work… ☐ Adding/removing ____ would improve your work. **Feed Forward Strategies** ☐ Use language from the success criteria ☐ Use scaffolding ☐ Feed Forward must be timely ☐ Use challenge ☐ Refer to goals
Proficient	Process	**Feeding Up Prompts:** ☐ The key ideas/concepts in this task are… ☐ These ideas/concepts are related by… ☐ Key questions you could ask about this task are… ☐ Skills you will need in this task are… ☐ Strategies you will need in this task are… **Feeding Up Strategies** ☐ Use graphical organisers ☐ Reduce scaffolding ☐ Increase complexity ☐ Use mastery goals	**Feedback Prompts:** ☐ Your understanding of the ideas/concepts within this task is… ☐ Your thinking about this task is… ☐ You demonstrated _____ skills to a ___ level. ☐ You used ______ strategies to a ____ level. **Feedback Strategies** ☐ Feedback amount can start to increase ☐ Feedback complexity can increase ☐ Use prompts or cues	**Feed Forward Prompts:** ☐ You could improve your understanding of_____ concepts by… ☐ Thinking further about____ could improve your work by… ☐ You could improve your _____skills by… **Feed Forward Strategies** ☐ Feed Forward amount can start to increase ☐ Feed Forward complexity can increase ☐ Use prompts or cues ☐ Use challenge
Advanced	Self-Regulatory	**Feeding Up Prompts:** ☐ How will you use the learning intention? ☐ How could you use the success criteria? ☐ Which other ways could you monitor your work? **Feeding Up Strategies:** ☐ Reduce emphasis of exemplars ☐ Mastery and performance goals	**Feedback Prompts:** ☐ Are you on track with your work? ☐ How do you know? ☐ To which level are you satisfying the success criteria? ☐ Are you on track to achieving your goal? ☐ How do you know? **Feedback Strategies:** ☐ Delay feedback ☐ May only require verification feedback	**Feed Forward Prompts:** ☐ How could you deepen your understandings? ☐ How could you improve your work? ☐ What is the next step for your learning? ☐ How do you know? **Feed Forward Strategies:** ☐ Delay feedback ☐ Reduce teacher reliance ☐ Develop self-regulated learners

According to the feedback model, when this framework is integrated in the learning process and in the learning environment, opportunities for different types and levels of feedback can arise from different components of instruction (Brooks et al., 2019; Hattie & Clarke, 2018; Hattie & Timperley, 2007). Feedback on aspects of one's understanding and/or performance is provided by different agents, such as teachers, peers, professional practitioners, learners themselves and learners' experiences in the field, textbooks, and automated answers. Consequently, course design may leverage these learning and feedback opportunities. In this context, feedback can have many functions, such as directing students' attention to the learning intentions and standards required for success, reinforcing success, correcting errors, or helping to unravel misconceptions (Carless, 2006; Hattie, 2023; Hattie & Clarke, 2018). It may also help suggest specific improvements and/or alternative strategies to understand content, complete a task, detect errors, give improvement advice for the future on aspects of one's understanding and/or performance, among others (Brooks et al., 2019; Hattie & Timperley, 2007; Winstone & Carless, 2020). Hence this feedback framework presents interconnections among different components: instructional context, feedback agents, the type and level of messages, and the feedback uptake (Panadero & Lipnevich, 2023). In conducting a comprehensive literature review, it became evident that research on the topic lacked implementation details. More specifically, in their case study of the use of Hattie & Timperley's (2007) feedback model in higher education, Lipsch-Wijnen & Dirkx (2022) point out that despite the model's prevalent use in educational settings, there is a gap regarding the specifics of its utilization in teaching and learning. Furthermore, in relation to Brooks et al.'s matrix of feedback for learning (2019), two studies emerged as directly pertinent to the research question. Beltran (2021) mapped types and levels of feedback in a higher education course in online synchronous and asynchronous sessions to Brooks et al.'s, 2019 matrix during a 6-week COVID period. A student survey showed mismatches between learners' feedback perceptions and the researcher's observations of the learning environment and the need to further investigate the application of this feedback model. In addition, Moni's (2023) research study used the Matrix of Feedback for Learning (Brooks et al., 2019) to investigate with content analysis how the feedback and assessment feedback design, —in the online component of a blended course in English for Academic Purposes—could sustain opportunities for feedback encounters and enable student uptake of feedback.

These findings underscore the necessity for additional quantitative and qualitative research into the application of this feedback model in online learning environment to close the identified gap.

Learner Perceptions of Feedback in Research

Student perceptions are of central importance in research on feedback practices as they provide insights on how the feedback is regarded, understood, and interpreted by learners. According to Scherer et al. (2016), one of the most crucial factors in determining instructional effectiveness is primarily students' perceptions of instructional quality. This is also true for evaluation of the feedback process, unanimously recognized as part of the instructional process (Boud & Molloy, 2013; Esterhazy, 2018; Winstone & Carless, 2020). Survey studies on students' perceptions of feedback as part of the learning process can support the investigation of feedback "as a function of the nature of the learning setting" (Lipnevich et al., 2016, p.170). Typically, surveys help researchers to consider the "state, transient and situation-specific" learner perceptions of feedback (Lipnevich et al., 2016, p.179).

Previous investigations of learner perceptions of feedback, few on feedback processes, and numerous on single or different aspects of feedback (Pokorny & Pickford, 2010; Winstone, 2022), revealed learner perceptions in relation to different dimensions: usefulness, effectiveness, quality, characteristics, response, context, and action (Lipnevich et al., 2016; Van der Kleij & Lipnevich, 2021). Among these, a large body of research investigated how the feedback is understood in relation to usefulness, effectiveness, and quality (Lipnevich et al., 2016). Results pointed out that there is little probability that feedback will have any impact on students' subsequent work unless they consider it to be useful, helpful, specific, and objective (Jonsson & Panadero, 2018; Lipnevich & Smith, 2009).

Method

An anonymous survey was used to examine the student perceptions of the feedback process in the online component of a 13-week English for Academic Purposes (EAP 1002) undergraduate blended course delivered in Blackboard (LMS). Institutional Review Board (IRB) approval was obtained prior to the piloting and data collection.

Setting

In the EAP blended course, instruction combines 6 hours in-class and 3 hours asynchronous online study and activities per week. In this course, students enhance their mastery of academic English and acquaint themselves with the study skills essential for college-level academics. The 13-week course is carefully organized into weekly segments, further divided into folders for face-to-face (F2F) and online instruction. The F2F folders serve as spaces where instructors can detail what is covered during in-person lessons only. In contrast, the online folders are designed to be standardized across sections and instructors with exclusive focus on essay writing and online feedback practices.

Following institutional policy, the course is planned and built by an instructional designer with a terminal degree in the field, who is the director of the EAP program, as well as by a team of EAP subject matter experts (SMEs) with more than 20 years of experience. All SMEs and faculty teaching the course have successfully completed institutional faculty development courses on online teaching and learning, with emphasis on backward design, assessment and feedback for learning, and learner-centered instruction.

The EAP blended course development process followed a backward design with course alignment (McTighe & Willis, 2019; Wiggins & McTighe, 2005). Long & Doughty's (2009) methodological principles of language teaching are applied to ensure that learning outcomes, assessments, and course learning activities are linked and contribute to student-centered learning and progress towards the course learning goals. The EAP blended course was designed to meet the Quality Matters (QM, 2023) and the Online Learning Consortium Course Design Review Scorecard (OLC OSCQR, 2021) for higher education standards for quality online and blended course design.

One particular feature of the course is the feedback design of the online component of the course: "Feedback is not something that happens after assessment has taken place; rather, it is designed into learning processes from the outset" (Winstone & Carless, 2020, p.9). The design promotes effective student use of feedback for learning, which is a vital skill for success in academic programs and autonomous and lifelong learning (QM, 2023; Stein & Graham, 2020). The feedback design is supported through detailed feed-up information as well as instructor feedback. This structure ensures that students receive clear, centralized guidance to enhance their writing skills. A previous qualitative study (Moni, 2023) conducted with content analysis of the feedback process of the online component of the EAP blended learning course in spring semester 2021 (52 students and 5 instructors) investigated how assessment and feedback design created several opportunities for feedback encounters and enabled student uptake of feedback. The Matrix of Feedback for Learning (Brooks et al., 2019) was used to investigate and code the feedback encounters generated in the course.

Findings (see Figure 2) showed that, in the online component of the course, online feedback from different instructors across the five sections of the EAP blended course was uniform and consistent. More specifically, online encounters with feed-up information e.g., weekly overviews with suggested dates and time pacing, instructions, prompts, scaffolds, exemplars, standards and criteria, among others (Brooks et al., 2019; Hattie, 2023; Hattie & Timperley, 2007; Henderson et al., 2019; QM, 2023), comprised 98% of all coded segments. Online feed-back and feed-forward instructor commentaries were at 77% and 23% respectively. With regard to the levels, feedback commentaries were mainly at task level (84%), whereas process level and self-regulatory were respectively at 13% and 3%. Uptake of feedback was at 74% and task resubmission rate leveled to 92%. The findings of the content analysis suggested that, in the online component of the course: a) learners had several opportunities for feedback encounters before, during, and after the assessment, b) learners encountered all three types and levels of feedback, c) feedback commentaries were mainly at task level with fewer encounters at process and self-regulatory levels, and d) students' uptake of feedback was satisfactory.

Figure 2

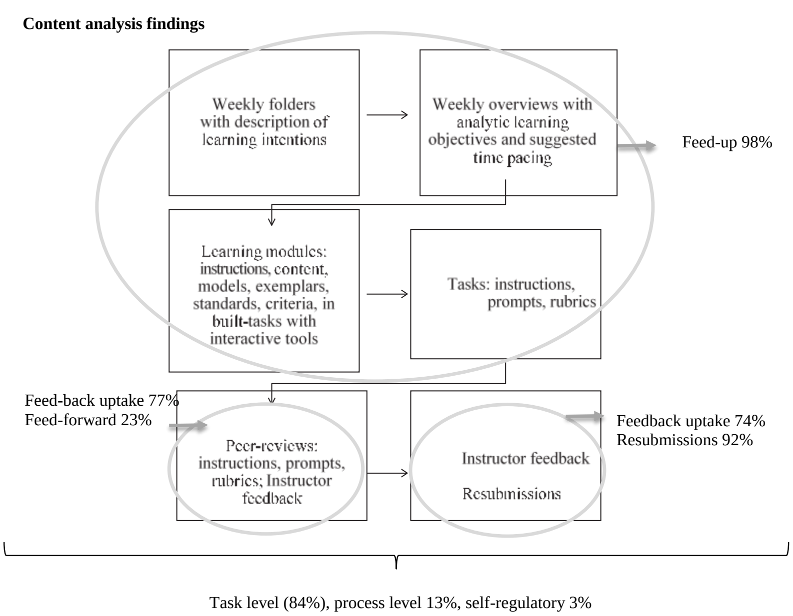
Content Analysis Findings from the Online Asynchronous Component of the Blended Course (Moni, 2023)

Participants

Sampling followed a "complete target population" (Patton, 2015, p. 284) with a total of 209 participants. A complete target population sample gave the possibility to take into consideration the voice of all students in relation to feedback in the online component of the course. The study expanded over the course of 3 college semesters (spring semester 2022 N=73, summer session 2022 N=15, and fall semester 2022 N=121) across 13 sections taught by seven different EAP instructors. The survey was administered in each section during the last two weeks of the semester, when students had completed all online activities and had received feedback already. A total of 135 (64.6%) undergraduate students completed and submitted the survey, 58.51% of which were female (see Appendix A). The vast majority of students (78.6%) were within the range of 18-20 years of age at the beginning of their college studies (89.7% had 0-30 college credits) who need to advance their knowledge in academic English before continuing with more advanced general education courses.

The Measurement Tool

The present self-constructed survey was designed to measure learner perceptions of the feedback process (Winstone, 2022) in the online component of the EAP undergraduate blended course. The survey construction was based on the alignment of constructs and items with the findings of Moni's (2023) study and the theory of the Matrix of Feedback for Learning (Brook et al., 2019). Emphasis was placed on the development of clear and understandable items, the use of clear and understandable language based on learners' experience with the course, and the use of unbiased questions (Harlacher, 2016).



The pilot survey was composed by 36 Likert-style questions, 4 multiple answers, and 1 yes-no question. The Likert scale was 5-point 1= strongly agree, 2=agree, 3=neither agree nor disagree, 4=disagree, and 5= strongly disagree (Harlacher, 2016). The survey was created with LimeSurvey (with institutional license) and was piloted at the beginning of 2022 (January), with a convenience sample of 51 students, registered for the EAP 1002 blended course during fall 2021. The vast majority of students (N= 37, 72.54%) completed the pilot survey. Ten of them also participated in informal interviews about the survey, regarding the length, duration, clarity of expression and purpose of items. Interviewees felt the survey length and submission deadline were appropriate, and the questions were clearly formulated; five items were removed on the basis of being repetitive or falling under subjective interpretation.

The final version of the survey consisted of 36 Likert-type questions (see Appendix B). Based on the findings of Moni's (2023) and the theory of the Matrix of Feedback for Learning (Brook et al., 2019), four survey constructs were identified: feed-up, feed-back, and feed-forward, and the overall personal experience with the feedback in the online setting. More specifically, the four-construct items that constituted the survey were:

1. Learner Perceptions on Feed-Up: items related to feed-up elements in the online components of the course. (10 items)
2. Learner Perceptions on Feed-Back: items related to the instructor feed-back type of commentaries students received. (9 items)
3. Learner Perception on Feed-Forward: items related to the instructor feed-forward type of commentaries students received. (9 items)
4. Learner Perceptions on the Feedback Process: items related to the overall learner experience with the feedback process. (5 items)

Cronbach's α measure of internal consistency and Confirmatory Factor Analysis were conducted to investigate the survey validity. Cronbach's alpha coefficient was computed to measure the internal consistency of the four survey constructs (with 36 Likert-scale items). Cronbach's alpha coefficients for constructs 1 to 4 (0.892, 0.924, 0.923, 0.884) indicated very good internal consistency: items consistently measured each of the four constructs (see Appendix C).

The preliminary confirmatory factor analysis (CFA) computed with Jasp (University of Amsterdam, open source license) was used to test whether the data collected supports a theoretical model. CFA confirmed that the 4-construct survey with Likert items is a good model:

1. The model is a rather good fit: both fit indices like CFI and TLI are above 0.900;
2. RMSEA values between 0.033 and 0.055 are good values;
3. Each set of items loaded positively: loading factor were above 0.700 and all p indicators were statistically significant, with $p < 0.01$.

These findings (see Appendix C) supported the four-dimension structure and provided evidence of good construct validity for the learner perceptions of feedback survey. The confirmatory factor analysis supported the relationships between items suggested by the theoretical framework of the Matrix of Feedback for Learning (feed up, back forward; task, process, level) (Brook et al., 2019).

Results

Analysis of variance (ANOVA) was initially used to explore the differences in learner perceptions among the three cohorts. More specifically, Tuckey Kramer analysis for different sample sizes was used. Value of p greater than 0.05 confirmed that no significant differences in learner perceptions across constructs and semesters was identified (see Appendix D).

A descriptive analysis of the 36-Likert-item survey was conducted. Table 1 shows the means and the standard deviations per construct and per semester (1, 2 and 3). For Construct 1, the respective mean values were M 1.436 (*SD* 0.601), 1.790 (*SD* 0.901) and 1.640 (*SD* 0.683). For Construct 2, M values were 1.838 (*SD* 0.854), 1.700 (*SD* 0.695) and 1.820 (*SD* 0.759) respectively. For Construct 3, the respective values were M 1.381 (*SD* 0.607), 1.680 (*SD* 0.704) and 1.500 (*SD* 0.646) respectively. For Construct 4, M values were 1.868 (*SD* 0.662), 1.630 (*SD* 0.654) and 1.510 (*SD* 0.618) respectively. The overall low means (minimum Mean 1.381-maximum Mean 1.868) and low standard deviations (minimum SD 0.601 and maximum SD 0.910) suggested that the students perceived highly the benefits of the feedback process in the online component of the course and that there was a lot of agreement about the responses across the three cohorts. The normal standard distribution of data showed that 68% of respondents agreed (strongly agree -Likert scale 1, agree -Likert scale 2) that the overall feedback process with feed-up, feed-back, feed-forward types were helpful to their learning.

Table 1

Mean Values and Standard Deviations per Construct and per Semester (N=135)

	Semester 1 (N=53)		Semester 2 (N=7)		Semester 3 (N=75)	
Constructs	M	SD	M	SD	M	SD
1. Learner Perceptions of Feed-Up (B1-B10)	1.436	0.601	1.790	0.910	1.640	0.683
2. Learner Perceptions of Feed-Back (C1-C9)	1.838	0.854	1.700	0.695	1.820	0.759
3. Learner Perceptions of Feed-Forward (D1-D9)	1.381	0.607	1.680	0.704	1.500	0.646
4: Learner Perceptions of the overall Feedback Process (E1-E5)	1.868	0.662	1.630	0.654	1.510	0.618

Construct 1: The Components of the Asynchronous Part of the Course

Table 2 shows the means and distributions (frequency and percentages) of responses of learner perceptions about the feed-up elements of the online asynchronous component of the course. Responses show that students strongly agreed and agreed that the following feed-up elements were helpful to their learning: weekly overviews to understand the learning purpose of each online week (B1, M 1.61), deadlines to organize their study time (B2, M 1.76) and to submit the online activities on time (B3, M 1.68), models and exemplars to complete the online activities on time (B4, M 1.71), rubrics which explained how the online activities will be evaluated (B5, M 1.77), questions and ideas to develop writing tasks (B6, 1.75), academic writing skills in support of the writing activities (B7, M 1.67), techniques to identify misconceptions and common language mistakes in support of academic writing (B8, M 1.79), suggested skills on how to avoid plagiarism (B9, M 1.76), instructions to organize the online work (B10, M 1.75). Table 2 also shows that middle point responses (Likert scale 3, neither agree nor disagree) moderately captured learners' attention whereas negative responses (Likert-scale 4 and 5, disagree and strongly disagree) were low rated.

Table 2

Construct 1: Mean Values (M), Frequency and Percentage (f-%) of Responses (N=135)

		Strongly agree (1)	**Agree (2)**	**Neither agree nor disagree (3)**	**Disagree (4)**	**Strongly disagree (5)**
Construct 1	**M**	**f -%**	**f-%**	**f-%**	**f-%**	**f-%**
B1	1.61	63-46.7	63-46.7	7-5.2	2-1.5	-
B2	1.76	66-48.9	44-32.6	19-14.1	3-2.2	3-2.2
B3	1.68	69-51.1	45-33.3	17-12.6	3-2.3	1-0.7
B4	1.71	59-43.7	58-43.0	17-12.6	-	1-0.7
B5	1.77	55-40.5	61-45.2	13-9.6	5-3.7	1-0.7
B6	1.75	55-40.7	60-44.4	19-14.1	1-0.7	-
B7	1.67	60-44.4	61-45.2	12-8.9	2-1.5	-
B8	1.79	55-40.7	61-45.2	13-9.6	5-3.7	1-0.7
B9	1.76	57-42.2	59-43.7	15-11.1	3-2.2	1-0.7
B10	1.75	57-42.2	56-41.5	21-15.6	1-0.7	-

Construct 2: Learner Perceptions of Instructor Feedback on How They Are Doing in the Asynchronous Part of the Course

Table 3 shows the means and distribution (frequency and percentages) of responses of learner perceptions about the feed-back commentaries they received in the online component of the course. Responses show that overall students strongly agreed and agreed that instructor feed-back commentaries were helpful when they focused on: correct and incorrect paragraph (C1, M 1.53); correct and incorrect paragraph and essay structure (C2, M 1.58); correct and incorrect use of citation (C3, M 1.71); the logic behind ideas in essay writing (C4, M 1.69); the writing process: drafting, revising and editing (C5, M 1.65); the correct or incorrect use of grammar; vocabulary and punctuation (C6, M 1.63); criteria for success listed in the rubrics (C7, M 1.60); progress made with the online work (C8, M 1.77); and progress in relation to the learning goals (C9, M 1.67). Table 3 further shows that midpoint responses (Likert scale 3, neither agree nor disagree) moderately captured learners' attention in all item questions (C1-C9). *Disagree* and *Strongly disagree* (Likert-scale 4 and 5) responses were extremely low rated (C8, C9).

Table 3

Construct 2: Mean Values (M), Frequency and Percentage (f-%) of Responses (N=135)

		Strongly agree (1)	**Agree (2)**	**Neither agree nor disagree (3)**	**Disagree (4)**	**Strongly disagree (5)**
Construct 2	**M**	**f-%**	**f-%**	**f-%**	**f-%**	**f-%**
C1	1.53	75-55.6	50-37.0	9-6.7	1-0.7	-
C2	1.58	71-52.6	51-37.8	12-8.9	1-0.7	-
C3	1.71	60-44.4	55-40.7	10-14.1	1-0.7	-
C4	1.69	59-43.7	59-43.7	17-12.6	-	-
C5	1.65	61-45.2	61-45.2	12-8.9	1-0.7	-
C6	1.63	69-51.1	50-37.0	13-9.6	3-2.2	-
C7	1.60	63-46.7	63-47.6	9-6.7	-	-
C8	1.77	59-43.7	54-40.0	18-13.3	2-1.5	2-1.5
C9	1.67	59-43.7	54-40.0	18-13.3	2-1.5	2-1.5

Construct 3: Learner Perceptions of Instructor Feedback on What They Have to Do Next to Improve in the Asynchronous Part of the Course

Table 4 shows the means and distribution (frequency and percentages) of responses of learner perceptions about the feed-forward commentaries they received in the online component of the course. Responses show that overall students strongly agreed and agreed that instructor feed-forward commentaries helped them: improve the structure of their paragraph (D1, M 1.56);improve their essay structure (D2, M 1.49); better organize ideas in their essay (D3, M 1.60); use the suggested prewriting, drafting, revising, and editing process (D4, M 1.67); improve the use of grammar, vocabulary, and punctuation (D5, M 1.67); further improve writing skills (D7, M 1.60); use rubrics to further improve writing (D7, M 1.73); use and implement instructor feedback to edit and improve their work (D8, M 1.56, D8); and make progress in relation to the learning goals (D9, M 1.61). Midpoint responses moderately captured learners' attention in questions D1 to D7. *Disagree* and *Strongly disagree* (Likert-scale 4 and 5) responses were extremely limited.

Table 4

Construct 3: Mean Values (M), Frequency and Percentage (F-%) of Responses (N=135)

		Strongly agree (1)	**Agree (2)**	**Neither agree nor disagree (3)**	**Disagree (4)**	**Strongly disagree (5)**
Construct 3	**M**	**f-%**	**f-%**	**f-%**	**f-%**	**f-%**
D1	1.56	73-54.1	52-38.5	7-5.2	2-1.5	1-0.7
D2	1.49	83-61.5	39-28.9	12-8.9	1-0.7	-
D3	1.61	69-51.1	52-38.5	12-8.9	2-1.5	-
D4	1.60	68-50.4	55-40.7	10-7.4	2-1.5	-
D5	1.67	63-46.7	59-43.7	9-6.7	2-1.5	2-1.5
D6	1.60	70-51.9	50-37.0	14-10.4	1-0.7	-
D7	1.73	57-42.2	60-44.4	17-12.6	1-0.7	-
D8	1.56	69-51.1	56-41.5	10-7.4	-	-
D9	1.61	69-51.1	56-41.5	10-7.4	-	-

Construct 4: Learner Perceptions of the Overall Feedback Process

Table 5 shows the means and distribution (frequency and percentages) of responses of learner perceptions about the overall feedback practices in the asynchronous part of the course. More specifically, students agreed/strongly agreed that feedback practices encouraged them to ask for instructor and peer-feedback (E1, M 1.56); self-assess their writing and activities before submission (E2, M 1.65); use feedback comments to resubmit an improved version of their writing activities (E3, M 1.81); and give peer feedback (E4, M 1.75). Overall, students felt satisfied/strongly satisfied with the feedback practices in the EAP 1002 asynchronous part of the course (E5, M 1.64). Midpoint responses (Likert scale 3, neither agree nor disagree) moderately captured learners' attention. *Disagree* and *Strongly disagree* received very limited attention in all items (E1-E5).

Table 5

Construct 4: Mean Values (M), Frequency and Percentage (F-%) of Responses (N=135)

		Strongly agree (1)	**Agree (2)**	**Neither agree nor disagree (3)**	**Disagree (4)**	**Strongly disagree (5)**
Construct 4	**M**	**f-%**	**f-%**	**f-%**	**f-%**	**f-%**
E1	1.56	75-55.6	46-34.1	12-8.9	2-1.5	-
E2	1.65	74-54.8	49-36.3	10-7.4	2-1.5	-
E3	1.81	47-34.8	70-51.9	15-1.1	3-2.2	-
E4	1.75	57-42.2	57-42.2	10-14.1	2-1.5	-
E5	1.64	69-51.1	50-37.0	12-8.9	3-2.2	1-0.7

Cross-tabulation analysis for midpoints and negative answers across the four constructs did not reveal any pattern in learners' perceptions.

Discussion

The present study aimed at examining the impact of the feedback design on learners' perceived benefits of the feedback process in the online component of an EAP blended course.

The findings offer evidence of the significant the impact of the feedback design on learners' perceptions and more importantly, learners' positive ratings corroborated the usefulness and effectiveness of the design. The application of the Matrix of Feedback for Learning by Brook et al. (2019) was instrumental in enhancing learners' experiences with the three types of feedback (up, back, and forward) across different levels (task, process, and self-regulatory) and learner stage, thereby substantiating the study's initial inquiry into the efficacy of feedback design in online learning environments. The discipline-specific feedback design mirrored previous research on the application of the specific feedback design and confirmed the following aspects of feedback design (Lipnevich & Panadero, 2022).

First, relations between different elements of the learning units which were planned up-front (Esterhazy, 2018) translated into designing instructional cycles where resources (e.g., instructions, prompts, content, scaffolds, criteria, etc.) are integrated with formative assessment (e.g., check for understandings, tasks, and activities) and with feedback encounters (Boud & Molloy, 2013; Esterhazy, 2019; Hattie & Clarke, 2018; Winstone & Carless, 2020). Second, the feedback process facilitated the interconnections between the three types and levels of feedback and opportunities to use feedback to improve and resubmit a revised version of one's work. Third, the specific feedback design supported several opportunities with regard to learner feedback agency: requesting feedback, generating feedback, making sense of feedback, self-assessment, and implementing feedback (Boud & Molloy, 2013; Esterhazy, 2019; Hattie & Clarke, 2018; Winstone & Carless, 2020). Fourth, frequent weekly feedback generated by different agents (e.g., automatic, peer, instructor, resources) supported the learners' progress (McTighe & Willis, 2019; Wiggins & McTighe, 2005).

In the next sections, we will discuss both learners' positive responses about the feedback process of the online component of the course (Likert scale 1 and 2) as well as the midpoint (Likert scale 3), and negative ratings (Likert scale 4 and 5). According to the literature, the latter responses (Likert scale 3, 4 and 5) could convey respectively learners' lack of knowledge, indifference, dilemmas, and ambivalence (Baka et al., 2012) or a problematic relationship between the learner and the feedback process. Learners could possibly dread it because of past negative experiences (Linnenbrink & Pintrich, 2002; Lipnevich & Smith, 2009).

Construct 1: The Asynchronous Part of the Course

Learners' recognition of the importance and the help provided by all feed-up information corroborated the need to embed and integrate learning materials with feed-up elements throughout the online component of the EAP blended course (see Figure 2). Consistent with prior research, weekly overviews with clear learning outcomes helped learners understand the learning purposes of each week and interact with the learning material (Brooks et al., 2019; Hattie, 2023; Hattie & Timperley, 2007; Henderson et al., 2019; QM, 2023). In line withBrooks et al. (2019), Hattie (2023), Hattie & Timperley (2007), Henderson et al. (2019), and QM (2023), deadlines for learning activities and writing facilitated study time organization and supported timely assignment submission had a positive impact on student self-regulation. In line with prior evidence, models and exemplars supported learners' challenge with new and unfamiliar writing tasks, and showed students what was expected of them and what would constitute high quality (Brooks et al. 2019; Carless et al., 2018; Hattie, 2023; Hattie & Timperley, 2007; Henderson et al., 2019; QM, 2023; Sadler, 2010).

According to Haw et al. (2017), learners find use of models and exemplars more helpful than rubrics, as they provide a worked example. Rubrics for each learning activity, helped learners explore, clarify, and internalize the requirements and success criteria while keeping them focused on the online tasks. The presence of models, worked exemplars, and rubrics helped increase the understanding of the writing tasks (Brooks et al. 2019; Carless et al., 2018; Haw et al., 2017; Hattie, 2023; Hattie & Timperley, 2007; Henderson et al., 2019; QM, 2023;). Prompting students with questions and ideas, connected to the specific learning outcomes, helped learners explore different point of views and move learning forward and supported writing tasks (Arts et al., 2021; Brooks et al. 2019; Carless & Boud, 2018). Academic writing skills information across the 13-week course helped learners' approach academic writing step-by-step.

Techniques helped learners identify misconceptions (Brooks et al., 2019; Carless, 2006; Hattie, 2023; Hattie & Clarke, 2018; Hattie & Timperley, 2007; QM, 2023) and common language mistakes related to prior-learning and modify them step-by-step through the use of specific techniques. Specific step-by-step instructions helped learners avoid plagiarism and commit to a correctly referenced essay. Overall and reiterated instructions to organize online work helped learners keep focused on the several activities required in each week (Esterhazy, 2019; Hattie & Clarke, 2018).

With regard to the leaners' midpoint and negative responses, difficulty to relate to feed-up information may be traced back to the fact that, in the online component of the course, feed-up information is not instructor-mediated but is provided as in-built component of the learning content which students have to view, read, and interpret by themselves. In agreement with Carless (2022), learner autonomy is a requisite skill.

Construct 2: Learner Perceptions of Instructor Feedback On How They Are Doing in the Asynchronous Part of the Course

In the online asynchronous component of the course, learners' perceptions confirmed the help provided by feed-back type commentaries at task, process, and self-regulatory levels. Conforming to earlier research, learners' responses substantiated the usefulness of instructors' task-level commentaries which pointed out correct and incorrect paragraph and essay structure, and correct and incorrect use of citation. Furthermore, they provided insights into correct or incorrect use of grammar, vocabulary and punctuation, and matched performance to success criteria listed in the rubrics (Brooks et al., 2019; Elder & Brooks, 1992; Hattie & Timperley, 2007; Kulhavy & Stock, 1989; Narciss & Huth, 2004). In line with Arts et al., 2021 Brooks et al., 2019; Carless & Boud, 2018; Hattie & Timperley, 2007). In agreement with Arts et al. (2021), Brooks et al. (2019), Carless & Boud (2018), Hattie & Timperley (2007), respondents also confirmed the helpfulness of process level commentaries when instructors focused on the logic behind ideas in essay writing, and drew attention to the use of the writing process: drafting, revising and editing (Arts et al., 2021; Brooks et al., 2019; Carless & Boud, 2018; Hattie & Timperley, 2007). Last, learners' responses verified the efficacy of self-regulatory level commentaries when instructors pointed out progress made with the online work (C8), and learners' progress in relation to the learning goals (Arts et al., 2021; Brooks et al., 2019; Deci & Ryan, 2000; Hattie & Timperley, 2007; Pintrich & De Groot, 1990).

Considered the interconnections of the three feedback types and levels (Brooks et al., 2019; Hattie & Timperley, 2007), the relatively few learners' midpoint and negative responses about instructors' feed-back commentaries could stem from difficulties encountered with one or more aspects of feed-up information: for example, inability to understand a task requirement might negatively impact learners' engagement with the correspondent instructor feed-back commentary (Carless, 2022).

Construct 3: Learner Perceptions of Instructor Feed-Forward on What They Have to Do Next to Improve in the Asynchronous Part of the Course

In the online asynchronous component of the course, learners' perceptions confirmed the usefulness of feed-forward type commentaries at task, process and self-regulatory levels and reflected practices suggested in the Matrix of Feedback for Learning (Brooks et al., 2019; Hounsell et al., 2008; Sadler, 2010; Sadler et al., 2023; Vardi, 2013). In specific, learners' responses verified the usefulness of task level commentaries (Hounsell et al., 2008; Sadler, 2010; Sadler et al., 2023; Vardi, 2013) which provided directions on how to improve the structure of paragraphs, how to improve an essay structure, how to improve the use of grammar, and vocabulary and punctuation (e.g., in paragraphs and essay writing). These commentaries encouraged learners to review rubrics to further improve writing (Brooks et al., 2019; Hattie & Timperley, 2007).

Responses also substantiated the use of process level commentaries (Arts et al., 2021; Brooks et al., 2019; Carless & Boud, 2018; Hattie & Timperley, 2007) when commentaries guided learners on how to improve the organization of ideas in their essay; encouraged learners to use prewriting, drafting, revising, and editing process; helped learners understand how to further improve writing skills; and encouraged learners to use and implement instructors' feedback to edit and improve their work (Brooks et al., 2019; Hattie & Timperley, 2007). Last, respondents acknowledged the use of self-regulatory level commentaries (Arts et al., 2021; Brooks et al., 2019; Deci & Ryan, 2000; Hattie & Timperley, 2007; Pintrich & De Groot, 1990) when information helped them make progress in relation to the learning goals. The few midpoint and negative responses on aspects of feed-forward commentaries could be attributed to learners' inability to relate with one or more aspects of feed-up information, feed-back commentaries (task requirements, meeting standards, correct/ incorrect answers, use of correct/ incorrect strategies etc.) as well as failure to see the relationships between the different types and levels of information and feedback provided (Brooks et al., 2019; Hattie & Timperley, 2007).

Construct 4: Learner Perceptions About the Feedback Practices in the Asynchronous Part of the Course

With regard to the overall feedback process, findings revealed learners' strong appreciation of the feedback process and the likelihood to ask for instructors' feedback, peer-feedback, self-assess one's writing and activities before submission, use feedback comments to resubmit an improved version of one's writing activities, and give peer feedback. These results confirmed previous findings, emphasizing central role of the feedback process in supporting students' agency on feedback as highlighted by Handley et al. (2011), Lipnevich et al. (2016), Nieminen et al., (2022), and Winstone et al. (2017). Additionally, commentaries corroborated learners' positive perception for a feedback process that stems from the interactions between the learners, the instructor, and the discipline-specific learning environment (Esterhazy, 2019). In fact, taken together the results showed that feed-up, feed-back, and feed-forward interacted with each other in a way that supported students' overall satisfaction with the feedback process.

Confirming Brooks et al.'s study (2019), learners' perception of the usefulness of the feedback process provided evidence of a strong and harmonious integration of the three types and levels of feedback. The few midpoint and negative answers may suggest students' limited ability to engage and act on feedback as well as failure to relate to the three types and levels of feedback. In line with Carless (2022), this may be explained by the fact that in the online component of the course there is less instructor mediation and more need for learning autonomy. In addition, the fact that EAP blended course learners are mostly novice undergraduate learners at the beginning of their studies and unfamiliar with certain feedback practices (Brooks et al. 2019) and feedback literacy (Carless, 2022) may impact learners' ability to understand how to relate to feedback.

Conclusions

This study confirmed the positive impact of the feedback design on learners' perceived benefits of the feedback process in the online component of an EAP blended course. Results highlighted the need and strength of a sound and mindful backward course design (McTighe & Willis, 2019; Wiggins & McTighe, 2005) to support the integration of feedback into the instructional process (Esterhazy et al., 2019; Winstone & Carless, 2020; OLC OSCQR, 2021; QM, 2023) and map out an instructional cycle with potential feedback encounters (Esterhazy et al., 2019) of different types and levels (Brooks et al., 2019). Understanding the intersection of the feedback process design into course design is crucial to enhance the overall learning experience (Esterhazy, 2019; Lipnevich & Panadero, 2021; Molloy & Boud, 2013; OLC OSCQR, 2021; QM, 2023; Stein & Graham, 2020).

Second, findings confirmed the need of a principled course alignment to strengthen the connection between course learning outcomes, assessment, learning activities, and all feed-"up" information in the online component of the blended course (McTighe & Willis, 2019; QM, 2023; Wiggins & McTighe, 2005). The cohesiveness of "feed-up" information with the several components of the online instruction is fundamental to orient learners towards purposeful actions. Third, the present findings confirmed the applicability of the Matrix of Feedback for Learning by Brooks et al. (2019), an evolution of the model by Hattie and Timperley (2007), applied in different learning settings, in our case undergraduate and blended learning environment and corroborated Moni's (2023) qualitative study on the EAP blended course design. Last, we agree with the need to embed interventions towards feedback literacy development (Carless, 2022; Carless & Boud, 2018; Malecka et al., 2020) to ensure a positive experience for all learners. The addition of instructor-mediated content (guiding and instructional audios/videos) (Chan, 2020), as well as scheduled Q&A online synchronous or face-to-face sessions with students about the specificities of the online component of the course may assist and support learners along the life of the course. According to Carless (2022) and Little et al. (2023), only by smoothly developing feedback literacy learners may take advantage of feedback opportunities.

Strengths, Limitations and Future Directions

The present study aimed at exploring learners' perceptions of feedback in an undergraduate college blended course. It was one of the unique attempts to combine all three types and levels of feedback, using a large sample, and drawing information from an undergraduate English for Academic Purposes course where feedback is crucial for future college success. Effort was also made to ensure item questions were of reasonable length, clearly phrased using language employed in the course, and directly related to learners' experience in the online component of the blended course.

In addressing the limitations of this study, it is important to highlight two primary concerns. First, the relatively small sample size used in the survey potentially constrains the generalization of the findings. Second, the study may be subject to social desirability effect, where students may feel inclined to answer what is considered to be socially accepted or normal. Statistical tendencies may be monitored and researchers may therefore treat results with caution. Also, Likert-type, close-ended questions by definition restrict the number of options respondents have, while promoting evaluation rather than elaboration or explanations of responses. In this case, future research could include opportunities for respondents to explain their answers.

In keeping with this line of research, future efforts (currently in progress) will focus on triangulation from a larger sample size. More specifically, content analysis of the feedback process, faculty and student perceptions of the feedback, institutional student course evaluations, and student academic achievement in the online component of the course will be compared with the purpose of forming a broader, valid understanding of the affordances and weaknesses of the feedback design to support learner agency on feedback and learner academic success.

Acknowledgment

My gratitude goes to the Deree – EAP instructors and director who consented to this research and to the students who willingly participated to the survey.

Disclosure Statement

No potential conflict.

References

Arts, J. G., Jaspers, M., & Joosten-ten Brinke, D. (2021). Enhancing written feedback: The use of a cover sheet influences feedback quality. *Cogent Education*, *8*(1), 1-18. https://doi.org/10.1080/2331186X.2021.1901641.

Ashford, S.J. (1986). Feedback-seeking in individual adaptation: A resource perspective. *Academy of Management Journal*, *29*, 465-487.

Ashford, S.J., Blatt R., & VandeWalle, D. (2003). Reflections on the looking glass: A review of research on feedback-seeking behavior in organizations. *Journal of Management*, *29*, 773-799.

Bacchus, R., Colvin, E., Bronwen Knight, E., & Ritter, L. (2019). When rubrics aren't enough: Exploring exemplars and student rubric co-construction. *Journal of Curriculum and Pedagogy, 17,* 1-14. https://doi.org/10.1080/15505170.2019.1627617

Baka, A., Figgou, L., & Triga, V. (2012). 'Neither agree, nor disagree': A critical analysis of the middle answer category in Voting Advice Applications. *International Journal of Electronic Governance, 5,* 244-263. https://doi.org/10.1504/IJEG.2012.051306

Beltran, J. (2021). Students' perception on the presence of effective feedback practices in online distance learning. [Master dissertation, Ateneo De Manila University]. Education Resources Information Center. https://doi.org/10.13140/RG.2.2.22342.40009

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability, 21*(1), 5–31. https://doi.org/10.1007/s11092-008-9068-5

Boud, D., & Molloy, E. (2013). Rethinking models of feedback for learning: The challenge of design. *Assessment & Evaluation in Higher Education*, *38*(6), 698–712. https://doi.org/10.1080/02602938.2012.691462

Brooks, C., Carroll, A., Gillies, R. M., & Hattie, J. (2019). A matrix of feedback for learning. *Australian Journal of Teacher Education, 44*(4)*,* 14–32. https://doi.org/10.14221/ajte.2018v44n4.2

Carless, D. (2006). Differing perceptions in the feedback process, *Studies in Higher Education, 31*(2), 219-233. https://doi.org/10.1080/03075070600572132

Carless, D. (2015). *Excellence in university assessment: Learning from award-winning practice (1st ed.).* Routledge. https://doi.org/10.4324/9781315740621

Carless, D., Chan, K., To, J., Lo, M.t & Barrett, E. (2018). Developing students' capacities for evaluative judgement through analyzing exemplars. In Boud, D., Ajjawi, R., Dawson, P. & Tai, J. (Eds), *Developing evaluative judgement in higher education: assessment for knowing and producing quality work*. Routledge. https://doi.org/10.4324/9781315109251-12

Carless, D. (2022). Feedback for student learning in higher education. In Tierney, R. Rizvi, F., Ercikan, K. & Smith, G. Eds), *International Encyclopedia of Education (4th Ed.)*. Elsevier. http://dx.doi.org/10.1016/b978-0-12-818630-5.14066-7

Carless, D., & Boud, D. (2018). The development of student feedback literacy: Enabling uptake of feedback. *Assessment & Evaluation in Higher Education, 43*(8), 1315–1325.

https://doi.org/10.1080/02602938.2018.1463354

Chan, Y.M. (2020). Video instructions as support for beyond classroom learning. *Procedia Social and Behavioral Sciences*, *9* (2010) 1313–1318. Elsevier

https://doi.org/10.1016/j.sbspro.2010.12.326

Clarke, S. (2008). *Active learning through formative assessment.* Hodder Education.

Dawson, S., Pardo, A., Kia, F.S. & Panadero, E. (2023). An integrated model of feedback and assessment: From fine grained to holistic programmatic review. In *13th International learning analytics and knowledge conference 2023 (pp.1-6).* https://doi.org/10.1145/3576050.3576074

Elder, B. L., & Brooks, D. W. (2008). Simple versus elaborate feedback in a nursing science course. *Journal of Science Education and Technology*, *17*(4), 334–340. https://doi.org/10.1007/s10956-008-9103-9

Esterhazy, R. (2018). *Productive feedback practices in higher education. Investigating social and epistemic relations in two undergraduate courses*. [Doctoral thesis, University of Oslo]

Esterhazy, R. (2019). Re-conceptualizing feedback through a sociocultural lens. In M. Henderson, R., Ajjawi, D. Boud, & E. Molloy (Eds.), *The impact of feedback in higher education*. Springer International Publishing.

Evans, C. (2013). Making sense of assessment feedback in higher education. *Review of Educational Research, 83*(1), 70–120. https://doi.org/10.3102/0034654312474350

Handley, K., Price, M., & Millar, J. (2011). Beyond "doing time": Investigating the concept of student engagement with feedback. *Oxford Review of Education, 37*, 543–560. https://doi.org/10.1080/03054985.2011.604951

Harlacher, J. (2016). *An educator's guide to questionnaire development* (REL 2016–108). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Central. https://ies.ed.gov/ncee/rel/regions/central/pdf/CE5.3.2-An-Educators-Guide-to-Questionnaire-Development.pdf

Harris, L. R., Brown, G. T. L., & Harnett, J. A. (2015). Analysis of New Zealand primary and secondary student peer- and self-assessment comments: Applying Hattie and Timperley's feedback model. *Assessment in Education: Principles, Policy & Practice, 22*(2), 265-281, https://doi.org/10.1080/0969594X.2014.976541

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement.* Routledge.

Hattie, J. (2023). *Visible learning: The sequel* (1st ed.). Taylor and Francis.

Hattie, J., & Anderman, E. (2019). *Visible learning guide to student achievement (1st ed.)*. Taylor & Francis.

Hattie, J., & Clarke, S. (2018). *Visible learning: Feedback (1st ed.)*. Taylor & Francis.

Hattie, J., Gan, M., & Brooks, C. (2017). Instruction based on feedback. In R. E. Mayer & P.A. Alexander (Eds.), *Handbook of research on learning and instruction (2nd ed.).* (pp.290-324). Routledge.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77* (1), 81–112. https://doi.org/10.3102/003465430298487

Hawe, E., Lightfoot, U. & Dixon, H. (2017). First-year students working with exemplars: promoting self-efficacy, self-monitoring and self-regulation. *Journal of Further and Higher Education*. 1-15. https://doi.org/10.1080/0309877X.2017.1349894.

Henderson, M., Ajjawi, R., Boud, D., & Molloy, E. (2019). *The impact of feedback in higher education.* Palgrave. https://doi.org/10.1007/978-3-030-25112-3

Hoidn, S. (2016). *Student-centered learning environments in higher education classrooms*. Palgrave Macmillan.

Hounsell, D., McCune, V., Hounsell, J., & Litjens, J. (2008). The quality of guidance and feedback to students. *Higher Education Research and Development,* 27(1), 55-67.

https://doi.org/10.1080/07294360701658765

Jonsson, A., & Panadero, E. (2018). Facilitating students' active engagement with feedback. In A. Lipnevich & J. Smith (Eds.), *The Cambridge handbook of instructional feedback* (pp. 531-553). Cambridge University Press. https://doi.org/10.1017/9781316832134.026

Kluger, A. N., & DeNisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin, 119*(2), 254-284. https://doi.org/10.1037/0033-2909.119.2.254

Kulhavy, R. W., & Stock, W. A. (1989). Feedback in written instruction: The place of response certitude. *Educational Psychology Review, 1*(4), 279–308. https://doi.org/10.1007/BF01320096

Linnenbrink, E. A., & Pintrich, P. R. (2002). Achievement goal theory and affect: An asymmetrical bidirectional model. *Educational Psychologist, 37*(2), 69–78. https://doi.org/10.1207/S15326985EP3702_2

Lipnevich, A. A., Berg, D., & Smith, J. K. (2016). "Toward a model of student response to feedback." In Brown, G.T.L., & Harris, L. (Eds.,), *Human factors and social conditions in assessment* (pp. 169–185). Routledge.

Lipnevich, A. A., McCallen, L. N., & Smith, J. K. (2013). Perceptions of the effectiveness of feedback: School leaders' perspectives. *Assessment Matters*, *5*, 74–93. https://doi.org/10.18296/am.0109

Lipnevich, A. A., & Panadero, E. (2021). A review of feedback models and theories: Descriptions, definitions, and conclusions. *Frontiers in Education*, (6), 720195. https://doi.org/10.3389/feduc.2021.720195

Lipnevich, A. A., & Panadero, E. (2022). A review of feedback models and typologies: Towards an integrative model of feedback elements. *Educational Research Review*, *35*, 1-22.

https://doi.org/10.1016/j.edurev.2021.100416

Lipnevich, A. A., & Smith, J. K. (2009). "I really need feedback to learn": Students' perspectives on the effectiveness of the differential feedback messages. *Educational Assessment, Evaluation and Accountability*, *21*(4), 347–367. https://doi.org/10.1007/s11092-009-9082-2

Lipnevich, A. A., & Smith, J. K. (Eds.) (2018). *The Cambridge handbook of instructional feedback.* Cambridge University Press.

Little, T., Dawson, P., Boud, D. & Tai, J. (2023). Can students' feedback literacy be improved? A scoping review of interventions. *Assessment & Evaluation in Higher Education*, 1-14. https://doi.org/10.1080/02602938.2023.2177613.

Long, M. H., & Doughty, C. (2009). *The handbook of language teaching.* Wiley & Blackwell

Lui, A. M., & Andrade, H.L. (2022). Inside the next black box: Examining students' responses to teacher feedback in a formative assessment context. *Frontiers in Education*. 7:751549. rhttps://doi.org/10.3389/feduc.2022.751549

Malecka, B., Boud, D., & Carless, D. (2020). Eliciting, processing and enacting feedback: Mechanisms for embedding student feedback literacy within the curriculum. *Teaching in Higher Education*, *27*(7), 908–922. https://doi.org/10.1080/13562517.2020.1754784

McTighe, J., & Willis, J. (2019). *Upgrade your teaching*. ASCD.

Moni, A. (2023). Enabling students' uptake of feedback. In A. Visvizi, M. D. Lytras, & H. J. Al-Lail (Eds.), *Moving Higher Education Beyond Covid-19: Innovative and technology-enhanced approaches to teaching and learning* (Emerald Studies in Higher Education, Innovation and Technology) (pp. 129-145). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80382-517-520231008.

Nicol, D. J., & MacFarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education, 31*, 199–218. https://doi.org/10.1080/03075070600572090

Nieminen, J. H., Tai, J., Boud, D., & Henderson, M. (2022). Student agency in feedback: Beyond the individual. *Assessment & Evaluation in Higher Education*, *47*(1), 95–108. https://doi.org/10.1080/02602938.2021.1887080

Panadero, E., & Lipnevich, A. A. (2023). A review of feedback models and typologies: Towards an integrative model of feedback elements, *Educational Research Review, 35*, 100416.

https://doi.org/10.1016/j.edurev.2021.100416

Patton, M. (2015). *Qualitative research and evaluation methods (4th ed.).* Sage.

Pokorny, H., & Pickford, P. (2010). Complexity, cues and relationships: Student perceptions of feedback. *Active Learning in Higher Education*, *11*(1), 21–30. https://doi.org/10.1177/1469787409355872

Online learning consortium course design review scorecard (OLC OSCQR), (2021)**.** https://onlinelearningconsortium.org/consult/oscqr-course-design-review/

Quality matters higher education rubric (QM), (2023). https://www.qualitymatters.org/qa-resources/rubric-standards/higher-ed-rubric

Sadler, D. R. (2010). Feedback: developing student capability in complex appraisal. *Assessment & Evaluation in Higher Education*, *35* (5): 535-550. https://doi.org/10.1080/02602930903541015

Sadler I., Reimann N., Sambell K. (2022). Feedforward practices: a systematic review of the literature. *Assessement and Evaluation in Higher Education, 47*(1), 1–16. https://doi.org/10.1080/02602938.2022.2073434

Sharma, R. (2011). A step-by-step guide to students: How to avoid plagiarism. *International Journal of Ethics, 7*(1), 9-18.

Scherer R., Nilsen T., & Jansen M, (2016). Evaluating individual students' perceptions of instructional quality: An investigation of their factor structure, measurement invariance, and relations to educational outcomes. *Frontiers in Psychology*, *7*, 110. https://doi.org/10.3389/fpsyg.2016.00110

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research*, *78*(1), 153-189. https://doi.org/10.3102/0034654307313795

Stein, J., & Graham, C. R. (2020). *Essentials for blended learning. A standards-based guide (2nd ed.).* Routledge.

Van der Kleij, F.M., Lipnevich, A.A. (2021). Student perceptions of assessment feedback: a critical scoping review and call for research. *Educational Assessment, Evaluation and Accountability 33*, 345–373. https://doi.org/10.1007/s11092-020-09331-x

Vardi, I. (2013). Effectively feeding forward from one written assessment task to the next. *Assessment and Evaluation in Higher Education*, *38*(5), 599–610. https://doi.org/10.1080/02602938.2012.670197

Wang, T., & Li, L. Y. (2011). 'Tell me what to do' vs. 'guide me through it': Feedback experiences of international doctoral students. *Active Learning in Higher Education*, *12*(2), 101–112. https://doi.org/10.1177/ 1469787411402438

Wiggins, G. (1996). What is a rubric? A dialogue on design and use. In: R. E. Blum and J. A. Arter (Eds), *Student Performance assessment in an era of restructuring* (pp. 1-13). Association for Supervision and Curriculum

Wiggins, G., & McTighe, J. (2005). *Understanding by design*. ASCD.

Winstone, N.E. (2022). Characterizing feedback cultures in higher education: An analysis of strategy documents from 134 UK universities. *Higher Education, 84*, 1107–1125. https://doi.org/10.1007/s10734-022-00818-8

Winstone, N., & Carless, D. (2020). *Designing effective feedback processes in higher education: A learning-focused approach (1st ed.)*. Routledge. https://doi.org/doi.org/10.4324/9781351115940

Winstone, N. E., Nash, R. A., Parker, M., & Rowntree, J. (2017). Supporting learners' agentic engagement with feedback: a systematic review and a taxonomy of recipience processes. *Educational Psychologist, 52*, 17–37. https://doi.org/10.1080/00461520.2016.1207538

The Effects of Short Online Pedagogical Courses on University Teachers' Conceptions of Learning and Engaging Students During Lectures

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Abstract

Pedagogical training is considered an efficient tool to train university teachers to understand and foster active learning. In Finland, pedagogical training courses are organized periodically at universities, and university teachers participate voluntarily to improve pedagogical knowledge and skills for teaching in higher education settings. This study aims to examine the effects of short online pedagogical training courses on the development of university teachers' conceptions of active learning from two perspectives: the role of prior knowledge and engaging their students during lectures. The effects of the training were measured through self-reported questionnaires completed by teachers at a Finnish university before and after the pedagogical course (N = 108). The results showed an increase in participants' perceptions of the importance of prior knowledge in the learning process, and a decrease in the idea of learning as remembering. Additionally, the awareness of developing engaging lectures increased by the end of the courses. These outcomes indicate the benefits of short pedagogical courses for pedagogical development, especially for university teachers who have not had any prior training in pedagogy.

Keywords: Short online pedagogical training, active learning, engaging lectures, prior knowledge, higher education

Nguyen, T., Vilppu, H., Södervik, I., Murtonen, M. (2024). The effects of short online pedagogical courses on university teachers' conceptions of learning and engaging students during lectures, *Online Learning*, *Volume 28*(2), (385-404). DOI: 10.24059/olj.v28i2.3695

The Effects of Short Online Pedagogical Courses on University Teachers' Conceptions of Learning and Engaging Students During Lectures

Universities worldwide strive for high-quality teaching, but pedagogical training is not yet available for all university teachers. One reason for this is the high cost of such training, especially if course duration is long. The question is, therefore, whether short courses can have any effect on teachers or future teachers, specifically on the pedagogical development of doctoral students. The goal of this study is to examine solutions for improving the quality of teaching in higher education through short pedagogical training courses. It focuses on exploring the effects of a short online pedagogical training course on two central aspects of active learning in higher education: teachers' understanding of their students' learning in terms of the importance of prior knowledge in the learning process, and teachers' readiness to use teaching methods that engage students in their lessons and lectures. In this study, "lecture" refers to all teaching situations led by a teacher.

Several studies have suggested that instructors' conceptions of learning and teaching affect the way they teach (Berliner, 2001; Blömeke et al., 2015; Donche & Van Petegem, 2011; Heinonen et al., (2023); Norton et al., 2005; Postareff et al., 2007). According to Vilppu et al. (2019), teachers' view of teaching ranges from transmitting facts to supporting students' knowledge creation. These attitudes mirror the perception of teachers of how learning can occur by remembering facts or by revising prior knowledge to generate new ones. Hence, the solution to improving active learning in university classes should start with raising awareness of teachers' conceptions of how learning occurs and how to engage students during lectures (Murtonen et al., 2022; 2024; Södervik et al., 2022)

In pedagogical training, the instructional knowledge and skills of teachers can be profoundly improved by starting with their conceptions of teaching and learning rather than merely employing new teaching techniques (Murtonen et al., 2024; Teräs, 2016). Prior knowledge is one of the most crucial aspects of the active learning of students; however, this is poorly understood by teachers (Meyer, 2004). Thus, pedagogical training should support university teachers' understanding of the nature of learning and teaching—for example, their conception of the role of prior knowledge—which, in turn, affects their approaches to teaching and teaching practices (Entz, 2007; Vermunt & Endedijk, 2011). When teachers recognize the role of prior knowledge in student learning, they tend to consider employing more engaging teaching methods (Lonka & Ketonen, 2012; Murtonen et al., 2022; Södervik et al., 2022).

The role of pedagogical training and its effectiveness in higher education has received increased scholarly attention; however, most research has been conducted on relatively long training programs on pedagogy (Gibbs & Coffey, 2004; Postareff et al., 2007; Postareff & Lindblom-Ylänne, 2008; Robinson & Hope, 2013). In addition to the high costs for the faculty, the problem with these long training sessions is that teachers do not have the time and resources to participate, and not all teachers are accepted into the courses (Murtonen & Vilppu, 2020). Thus, a short online pedagogical training course could offer an alternative for faculty members. The findings from this study could provide items for consideration as well as suggestions for the development of short pedagogical training programs to make them effective, accessible, and meaningful to academic staff.

This article presents a brief review of the literature on the importance of teachers' awareness of the role of prior knowledge in the learning process and of providing engaging lectures in university classrooms. These two aspects are crucial in fostering active learning and, therefore, they are the focus of pedagogical development of university teachers. In this study, university staff participated in short online pedagogical training courses. The methodology section shows the study design used to evaluate before-and-after effects of short pedagogical training courses on teachers' conceptions of learning and of engaging students in lectures. The results reveal the effects of the courses as well as which groups of participants, based on their teaching experience and prior pedagogical knowledge, could benefit most from the training. Following the results, we discuss our findings, consider the limitations of the study, and provide suggestions for future research on short online pedagogy courses.

Review of the Literature

Teacher pedagogical development is expected to focus on how teachers can support the active learning of students, and this primarily requires teachers to possess a comprehensive understanding of learning processes (Hodges, 2020). Therefore, teachers need to improve their conceptions of learning, with an emphasis on the role of prior knowledge in the learning process as well as knowledge about the importance of engaging lectures. These concepts are at the center of teacher pedagogical education, which can be developed through training programs for teachers and educators in higher education.

Teachers' Conceptions of Learning and the Role of Prior Knowledge in Learning

Prior knowledge plays a crucial role in the learning process (Bransford et al., 2000). This is particularly true when learners encounter new learning circumstances; when the new information does not conflict with the existing one, new knowledge may be created by adding new facts to the previous understanding structure or complementing incomplete prior knowledge (Chi, 2008, p. 61). By contrast, if new information conflicts with prior knowledge, an adjustment is required to accommodate existing knowledge with new context (Chi, 2008, p. 61). In other words, to construct new knowledge, it is crucial to activate and connect prior knowledge with the new context and to rearrange and revise incorrect prior understanding to comport with the current one.

Although prior knowledge is considered perhaps the most important factor in learning, teachers' attitudes regarding the role of prior knowledge in the learning process is not uniform (Meyer, 2004). For university teachers, this challenge of prior knowledge exists on two levels: first, that their students may have naive prior conceptions concerning the substance to be learned, and second, that teachers themselves may have misconceptions regarding learning and teaching (Murtonen et al., 2022; Södervik et al., 2022). Both levels may influence the extent to which teachers can support the active learning of their students. Naive conceptions of learning as a remembering skill may lead to teacher's focus on students' retention skill in teaching–learning situations (Ritter et al., 2013, p. 131).

According to O'Donnell and Dansereau (2000), appropriate consideration of the role of prior knowledge is essential for effectively utilizing suitable sources for teaching and designing learning activities. As Bolhuis and Voeten (2004) pointed out, teacher's shift from in a view of teaching as a transmission of facts to the facilitation of knowledge construction influences the way students are expected to learn. The shift in the teaching view can encourage learners to transition from a passive to an engaged, active learning approach. Whereas passive learners accept and remember taught facts, active learners practice independent critical thinking, reasoning, exploring, and problem-solving to acquire meaningful learning (Bolhuis & Voeten, 2004). Similarly, Lee et al. (2019) proposed that teachers may demonstrate three types of teaching (i.e., progressing, reviewing, and recalling) which are associated with their perception of the role of prior knowledge in learning. According to the authors, when teachers consider prior knowledge to be a concept to develop, they use the progressing teaching method. With this method, teachers leverage potential components of tasks to activate the prior understanding of learners and connect the prior knowledge to new contexts to develop comprehensive knowledge. By contrast, if teachers do not find prior knowledge as a concept that can be developed, they will focus on recalling or reviewing previous information, a process that demands the retention skill of students without exploring students' understanding to develop it in the newer learning context (Lee et al., 2019).

In summary, the way teachers conceive of learning and the role of prior knowledge in learning may relate to the efforts teachers make to create suitable learning tasks in the classroom to enhance students' active learning.

Improving Active Learning Through Engaging Students

Teachers' conceptions of learning are linked to their approaches to teaching and their expectations of student learning (Bolhuis & Voeten, 2004). Given that learning is a social process and learners actively construct knowledge rather than receive facts passively (Bolhuis & Voeten, 2004; Chi & Wylie, 2014), students benefit from what they are taught when teachers encourage them to engage with lectures and learning activities. This implies a need for teachers to increase their interactions with students to strengthen the connection between learners and what they are learning.

An engaging lecture is viewed as an interactive and shared process between teachers and students (Lonka & Ketonen, 2012). Thus, teachers do not solely provide knowledge, and students are not passive receivers. In contrast to traditional didactic lectures, engaging lectures enhance deep and effective learning processes (Jones, 2007). The engaging lecture represents teachers' adoption of the learning/student-centered focused approach to teaching. The student-focused approach encourages learners to engage in constructing deeper understandings, reflections, and insights through the guidance of the teacher (Donche & Van Petegem, 2011; Vilppu et al., 2019). Thus, boosting the active participation of students in lectures may contribute to the enrichment of the content topics. In this paper, the word "lecture" means the same as a lesson—that is, it is taught by a university teacher, either online or in a classroom. Engaging lectures are interactive or effective teaching aimed at supporting students' active learning (deWinstanley & Bjork, 2002; Lenz et al., 2015; Miller et al., 2013). Engaging lessons are designed with interactive learning activities that hold the attention of participants (deWinstanley & Bjork, 2002; Kaur, 2011; Lenz et al., 2015). Engaging lessons may involve interactive elements, such as discussions or hands-on activities, and they may be delivered in a dynamic and energetic style. The goal of an engaging lesson is to keep learners interested and involved in the material being presented to maintain a learner-centered learning environment (Lenz et al., 2015). Engaging lectures can support students immensely to develop their competencies and nourish their motivation to learn (Lonka & Ketonen, 2012).

To facilitate the active learning of students through engaging lectures, teachers may need to increase their interactions with students. The effort teachers make to interact with students depends on the extent to which teachers change their priorities from transmitting content to providing students with opportunities for better learning and understanding. This effort becomes obvious when teachers consider their role as facilitators of the learning process of their students by creating meaningful learning activities, motivating students to participate, providing feedback, and helping students to reflect and think critically about the learning tasks (Fernandes et al., 2014). According to Rob and Rob (2018), teachers' facilitation of students' collaborative learning is crucial in engaging lectures to increase interactions among learners and encourage the sharing of knowledge, because these activities help to create meaningful conversations among participants.

Nevertheless, researchers have found that teachers encounter obstacles (e.g., time constraints and curriculum demands) that may interfere with the implementation of engaging lessons (Atjonen et al., 2011), or they may simply prefer to continue using traditional didactic lectures (Konopka et al., 2015). Importantly, the extent to which teachers perceive these obstacles as affecting the implementation of engaging lectures could reflect how teachers perceive the nature of teaching and learning. For example, Martin et al. (2000) found that when teachers shift their focus from delivering the target content to the learning process of students, they make more effort to engage students in lectures. This shift enhances the effort of teachers to connect students with the content of lectures and relevant meaningful practices (Postareff & Lindblom-Ylänne, 2008). Such teachers are more willing to spend extra time with their students to explain questions and scaffold students' development of comprehensive knowledge. By contrast, when teachers focus on lesson content, they may perceive this as a demand that they deliver all the content materials in a given period. Fobes and Kaufman (2008) explained that this is because such teachers find themselves in the position of intellectual authority in the classroom, which might prevent an "invitation" to students to be "co-teachers" (p. 28).

Pedagogical Development of University Teachers by Pedagogical Training Programs

In the past two decades, pedagogical education has drawn attention to its essential value for improving the professional development of instructors regarding teaching in universities (Murtonen et al., 2019; 2022; Södervik et al., 2022; Entz, 2007; Rienties et al., 2013; Rivetta et al., 2018). Professional development for novice and senior teachers occurs through accumulating teaching experience but can be supported at any time by pedagogical training. However, teachers may have a misunderstanding of the concepts of learning and teaching, which could also affect their professional development and the learning process of students. For example, whereas some teachers might know about constructivist epistemology from their teacher training courses, their counterparts who have not had prior pedagogical training might lack an awareness of the nature of learning, which could result in negative influences on the potential to support the active learning of students (Vosniadou et al., 2020). In other words, concepts of learning and teaching can vary among prospective, new, and experienced teachers (Meyer, 2004), and reducing any discrepancies is necessary to enhance educational quality. Thus, pedagogical training programs could be an essential solution to preventing gaps in university pedagogy among instructors, and online pedagogical courses could be an effective choice (Murtonen et al., 2019). As online teaching has become more popular at universities around the world, online pedagogical training programs should be adopted more widely to prepare and develop teachers' knowledge and skills in teaching and making pedagogical decisions, especially for novice teachers and those who are new to online pedagogy (Mohr & Shelton, 2017; Northcote et al., 2019).

Online pedagogical training programs can support teachers regarding their professional development and be tailored to the needs of university teachers (Mohr & Shelton, 2017). To make online pedagogical training effective, it is necessary to consider target participants, duration, content, and cost of the design of a course. For example, when designing a pedagogical training course for university teachers, a pertinent question would be whether experienced teachers would be interested in the pedagogical training program or how to make the course beneficial for both novice and senior teachers. For example, Laato et al. (2018) suggested that one of the benefits of an online course is its easy accessibility and the variety of available sources of materials for all learners, such as visual and auditory materials, publications, and quizzes. In addition, online courses can be updated and maintained regularly, and both teachers and learners can contribute to the content. The authors highlighted the flexibility, convenience, and cost-efficiency of these online training courses as a solution to concerns about the locations of participants or their schedules. These online courses are innovative compared to traditional courses in terms of the teaching and learning methods used during the courses.

Online courses can be operated with multiple instructional languages and have the capability of providing immediate feedback for learners. Utilizing digital tools, online training courses include learning activities that can enhance both individual and collaborative learning through reflective and interactive tasks or peer-reviewing tasks (Laato et al. (2018). These activities provide participants with opportunities to develop their understanding of the concepts of pedagogy and reflect their actual teaching experience on learning theories. Moreover, concern about the disadvantages of online training programs compared to traditional training programs (face-to-face) regarding the emotional connection among learners in online classes seems to be no longer relevant (Wasserman & Migdal, 2019). Wasserman and Migdal (2019) found evidence for the feeling of personal connection and the atmosphere of the classroom with teacher–student and student–student communication in online courses despite a lack of the direct physical interaction in a traditional class. Based on prior research about the benefits of online pedagogical training programs, Murtonen et al. (2019) suggested comprehensive guidelines for building online pedagogy courses from both technical and pedagogical perspectives, encompassing factors such as the learning environment, learning materials, learning activities, and language setting.

The effects of pedagogical training programs have been described in various empirical studies over the past two decades. Some studies have demonstrated their positive impacts on the professional development of university teachers (Gibbs & Coffey, 2004; Gold, 2001; Murtonen et al., 2022; Postareff et al., 2007; Robinson & Hope, 2013; Ödalen et al., 2019; Vilppu et al., 2019). For example, Gibbs and Coffey (2004) and Postareff et al. (2007) conducted a pedagogical course for university teachers over 4–18 months which showed the positive effects of the training on the approaches to teaching that teachers used to support the learning of their students. However, Postareff et al. (2007) raised concerns that the process of perceptual change among teachers might require a long-term training period, and that the impact of the training varied among different groups of teachers in terms of their teaching experience. By contrast, Vilppu et al. (2019), Murtonen et al. (2022) and Ödalen et al. (2019) reported positive outcomes on the effectiveness of a short pedagogical training course on teachers' perceptions of teaching, at least among relatively novice teachers. Given these contradictory findings concerning the effectiveness of pedagogical training, more research is needed, especially on the potential of short online courses.

Purpose of the Study and Research Questions

The purpose of this study was to explore the effect of a short online pedagogical course on the professional development of university teachers from two aspects of active learning: engaging lectures and conceptions of learning that highlight the role of prior knowledge in learning. By investigating the degree to which teachers have shown any change in measured concepts, the study also expected to discover which sub-groups of teachers, in terms of their teaching experience and prior pedagogical training, benefitted most from the short online course.

To solve the main research problems, the study design posed the following questions:

1. How did the views of teachers develop after a short online course in pedagogy regarding the role of prior knowledge and providing engaging lectures?
2. Which groups of teachers with respect to their teaching experience and prior pedagogical training benefitted most from the short online pedagogical course?

Methods

Participants

Participants in this study were university teachers and doctoral students at a Finnish university, including both native and non-native Finnish speakers. They enrolled in short online pedagogical courses that utilized the learning platform UNIPS (University Pedagogical Support). The term "teachers" is used to refer to the participants for the rest of the paper. A total of 233 teachers responded to all the questionnaires in the registration survey (pretest), and 108 also completed the same questionnaires after finishing the courses (posttest). This reduction was due to the withdrawal of teachers during the courses or because the teachers did not complete all the study questionnaires. Registration and participation in the courses were voluntary, and teachers could cancel their enrollment without any harm. All teachers who registered for the courses they preferred provided their consent and received information about the research. The sample size for this study was collected from those teachers who gave their consent for their responses to be used in relevant research. All participants were coded as anonymous. Ethical approval for the study was granted by the Ethics Committee for Human Sciences of the focus university.

The sub-sample of 108 teachers who responded to both the pretest and the posttest was used for the analyses of the effect of the course. Of the 108 teachers, 62.62% did not have any previous pedagogical training (e.g., pedagogy in their bachelor's or master's degree programs or additional courses or workshops in pedagogy or education). In this research, teachers who had no previous pedagogical training were grouped as untrained teachers and those who had prior training in pedagogy were grouped as trained teachers. Of the sub-sample, 56.07% had less than two years of teaching experience. Teachers who had less than two years of teaching experience were considered beginners and those who had more than two years of experience in teaching were called experienced teachers. Both teaching experience and previous training in pedagogy were used to determine the background of the teachers. Considering this background, the sample (N = 108) was divided into four groups (Table 1).

Table 1

Grouping Based on Teachers' Background

Groups	Previous pedagogical training	Teaching experience	N
Untrained beginner teachers	No	less than 2 years	46
Untrained experienced teachers	No	more than 2 years	21
Trained beginner teachers	Yes	less than 2 years	23
Trained experienced teachers	Yes	more than 2 years	17

Context and Procedure

The current study examined the effects of short online pedagogical courses based on UNIPS modules. UNIPS is an online learning platform developed from a collaborative project of eight Finnish universities that provides various free learning modules about university pedagogy (Laato et al., 2018). The primary objective of UNIPS is to enhance the pedagogical knowledge and skills of university teachers to facilitate their teaching duties in higher education (Laato et al., 2018; Murtonen et al., 2019). UNIPS has been evaluated as having the potential to increase opportunities for pedagogy training among a large diversity of non-native Finnish-speaking teachers, doctoral students in Finnish universities, and other university staff (Murtonen et al., 2019).

The study utilized a pretest–posttest design based on enrollment in online pedagogical courses. The pretest was the survey used in the registration, and the posttest was the final survey after the teachers finished the courses. The same questionnaires about conceptions of learning and engaging lectures were used in both the pretest and posttest. Teachers were also asked about their teaching experience in higher education and whether they had participated in any previous pedagogical training before enrolling in these UNIPS modules.

The online pedagogical courses used learning activities and learning materials from the UNIPS platform and operated on the university's Moodle platform. Three short online courses were offered based on three UNIPS modules: "Becoming a Teacher," "How to Plan My Teaching," and "Lecturing and Expertise." All three courses were designed and operated in the English language. The module "Becoming a Teacher" introduces teachers to the fundamental concepts of learning and approaches to teaching, and the basic elements necessary for high-quality teaching and learning, such as reflection, metacognition, and regulation, to support their students' learning. The module "How to Plan My Teaching" supports ideas about a learning-focused approach to teaching constructively. The module "Lecturing and Expertise" emphasizes how to build up pedagogical expertise and conduct engaging lectures. Learners engage in asynchronous learning by utilizing instructions and materials (e.g., explanatory videos, referenced literature) provided in each module within a given time to work on relevant assignments.

There are two periods in each module with different assignments: an individual learning period and a teamwork learning period. Communication among the instructor–learner and learner–learner groups is conducted via email and Moodle messages. Additionally, participants complete teamwork learning in groups, which involves reading their teammates' essays and providing comments. Participants can respond to feedback from their teammates. This activity provided communication and collaborative learning among participants. Upon finishing a module, participants are granted one credit. The total time for completing a module is about six weeks.

The data for the current study were collected from the three modules, which were organized in different semesters throughout 2018–2019: spring 2018, autumn 2018, spring 2019, and autumn 2019. As a participant could enroll in the course multiple times, the data chosen for this research were from the first enrollment.

Instruments

To measure teachers' concepts of learning as well as their perception of engaging lectures, new instruments were developed for this study. Six statements were designed to measure teachers' perceptions of engaging lectures. These statements were designed based on the literature about constructivism, in which a teacher is considered to play the role of a facilitator for students' learning, contrary to the traditional view of teachers as information transmitters (Murtonen et al., 2022; Södervik et al., 2022). A pool of 12 items was developed by Murtonen et al. (2022) and Södervik et al. (2022) to measure teachers' conceptions of learning. This tool was designed based on the important role of prior knowledge as a precondition for new learning to occur, recognizing that learning is not solely represented by recalling what is learned (Murtonen et al., 2022; Södervik et al., 2022). In total, 18 statements were used in the pretest and posttest. Teachers' responses can indicate the level of agreement or disagreement with the statements. The levels ranged from 1 to 5: 1 (totally disagree), 2 (somewhat disagree), 3 (neutral), 4 (somewhat agree), and 5 (totally agree).

Data Analysis

The analyses were performed using SPSS27. The validity of the instrument used was tested by exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). To explore the underlying factors provided by all 18 items, EFA was computed on the pretest sample (N = 233), using the maximum likelihood method of extraction with a Promax rotation (Fabrigar et al., 1999, p. 277) based on normality and an expectation of the interaction of each factor with one another. Kaiser-Meyer-Olkin test (KMO) was .695, Bartlett χ^2 [78] = 553.8, and $p < .001$ indicate an adequate sample size with substantial correlation. Four factors were extracted with eigenvalues greater than 1 (Field, 2018, p. 810), explaining a total of 58.54% of variance, and corresponding items with a factor loading greater than .4 or lower than -.4 were chosen under each factor (Stevens, 2012, p. 331). The four recognized factors are the importance of prior knowledge (PK), learning as remembering (LR), effort in engaging students in lectures (EL), and challenges in engaging students (CL) (see Appendix). Subsequently, the construct was confirmed by CFA using AMOS26. The model parameters were estimated by employing a bootstrap maximum likelihood method with 2000 bootstrap samples and 95% bias-corrected confidence intervals (CIs) (Preacher & Hayes, 2008). Modification indices were checked to detect any misspecifications in the model. The goodness-of-fit of the model ($\chi2$ =100.59, df =61, p = .001, $\chi2$/df = 1.65, CFI = .92, IFI = .92, GFI =.94, RMSEA =. 053, SRMR = .068) was evaluated with established indices and considered to be an adequate fit (Hu & Bentler, 1999). Standardized regression weights of items with the corresponding factors ranged from .48 to .80, at significant levels with $p < .001$ (Figure 1). Based on Cronbach's alpha values, the internal consistency of the scales in both the pretest and posttest (Table 2) proved moderately reliable (Hinton et al., 2014,

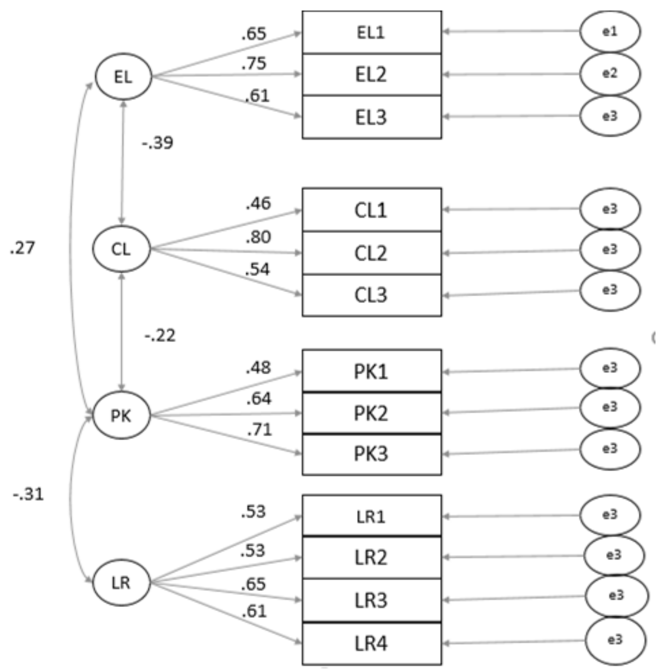
p. 356). Therefore, both the validity and reliability tests can ensure the use of four scales—PK, LR, EL, and CL—in the further analysis of this study.

To answer the first research question, the study examined the development of teachers during the training on a sub-sample of N = 108 respondents. Preliminarily, the data had a normal distribution and showed a range of skewness of [-2.2; 1.3] and a range of kurtosis of [-1.1; 6.4]. To observe the change in teachers' views on the measured concepts, a paired t-test was used and considered with an estimate of the effect size by checking Cohen's *d* with three categories: *d* = 0.2 (small effect), *d* = 0.5 (medium effect), and *d* = 0.8 (large effect) (Cohen, 1998).

To evaluate the groups of teachers who benefited most from the courses, separate paired t-tests were applied to each group to observe their changes in studied perceptions from the pretest to the posttest. The *p* value was adjusted to .0125 because four groups were allocated from the original sample (Table 1).

Figure 1

Measurement Model with Four Constructs: The Importance of Prior Knowledge (PK), Learning as Remembering (LR), Effort in Engaging Students in Lectures (EL), and Challenges in Engaging Students (CL)



Results

The Development of Teachers' Pedagogical Ideas after a Short Online Course in Pedagogy

The teachers (N = 108) all showed increasing agreement with the idea of prior knowledge having an important role and an increasing awareness of the necessity of conducting engaging lectures. We observed that the scores for the importance of prior knowledge were higher than for learning as a remembering skill, and the awareness of engaging lectures was higher than its challenges in both the pretest and posttest (Table 2). The results of the paired t-tests revealed some significant changes in teachers' perceptions of pedagogical ideas. In particular, teachers significantly increased their agreement with the idea of creating engaging lectures and the importance of prior knowledge; they also decreased their agreement with learning as remembering (Table 2). These changes were obtained with a small effect size. However, their views on the challenges of creating engaging lectures showed a decrease over time but not a significant change, with a small effect size.

Table 2

Descriptive Statistics and the Changes in Teachers' Agreement on the Scales Used

	Cronbach's alpha		Mean (SD)		t_{107}	*p*	Cohen's *d*
	Pretest	Posttest	Pretest	Posttest			
Prior knowledge is important	.64	.50	4.41 (.55)	4.63 (.47)	-4.55	<.001	.44
Learning as remembering	.67	.64	3.02 (.76)	2.68 (.68)	4.31	<.001	.42
Engaging lectures	.71	.72	3.98 (.65)	4.12(.72)	-2.46	.016	.24
Challenges in engaging lectures	.60	.62	2.19 (.71)	2.15(.77)	.592	n.s.	.06

n.s. : non-significant (p > .05)

The Effect of the Short Online Pedagogical Course on Groups of Teachers in Relation to Their Background

The results of a paired t-test on each group showed that the two groups of untrained teachers increased their agreement significantly with the idea of the important role of prior knowledge in creating engaging lectures, and this change had a small to medium effect size (Table 3). Additionally, only the group of untrained beginner teachers disagreed significantly with the idea of learning as a remembering skill from the pretest to the posttest. The two groups of trained teachers did not show any significant changes during the course ($p > .0125$). Perceptions about the challenges of giving engaging lectures did not change significantly in any of the four groups. Figure 2 shows the changes in each group for the four measured perceptions during the course and the potential effects of the training on the two untrained teacher groups.

Table 3

Paired T-test Showing the Development of the Untrained Teacher Groups by Their Scores on the Measured Concepts

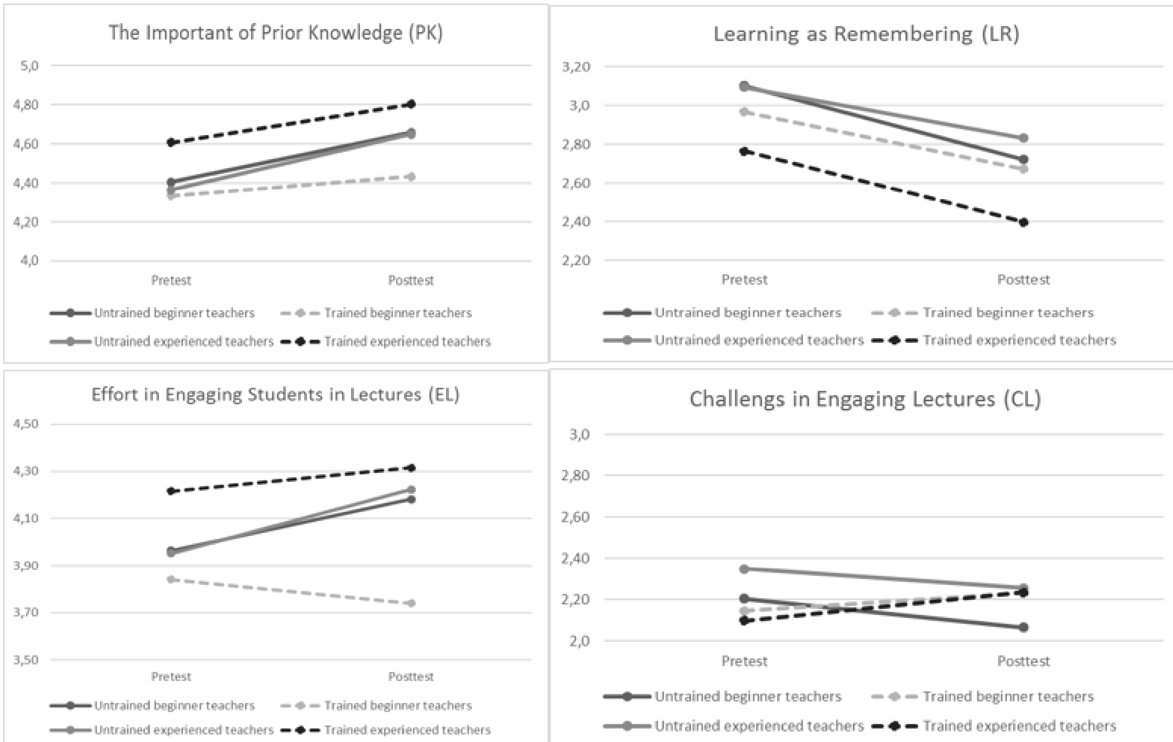
	Pretest	Posttest	t	*p*

		Mean (SD)	Mean (SD)			Cohen's *d*
Untrained beginner teachers	Prior knowledge is important	4.41 (0.62)	4.66 (0.43)	-3.24	<.01	.50
	Learning as remembering	3.1 (0.78)	2.72 (0.65)	2.80	<.01	41
	Engaging lectures	3.96 (0.58)	4.18 (0.58)	-2.18	<.01	.30
	Challenges in engaging lectures	2.2 (0.67)	2.07 (0.71)	1.28	n.s	.18
Untrained experienced teachers	Prior knowledge is important	4.37 (0.6)	4.65 (0.49)	-2.9	<.01	.60
	Learning as remembering	3.1 (0.5)	2.83 (0.65)	1.79	n.s	.39
	Engaging lectures	3.95 (0.64)	4.22 (0.6)	-2.4	<.01	.50
	Challenges in engaging lectures	2.35 (0.86)	2.25 (1.03)	0.55	n.s	.12

n.s: non-significant, p> .0125

Figure 2

Changes in Each Group for the Four Measured Perceptions



Discussion

This study investigated the effects of short online pedagogical training courses on two aspects of active learning: the role of prior knowledge and engaging lectures. These effects were examined through self-report questionnaires that teachers answered in the pretest and posttest and analyzed to demonstrate the extent to which their perceptions changed throughout the course. Moreover, the effects of the course were also examined by considering the backgrounds of the teachers regarding teaching experience and previous pedagogical training. The findings can support the idea of the essence of constructing pedagogical training programs for teachers in higher education as well as who should be the targets for these programs.

Notably, the study found a promising effect of the short online pedagogical courses on the development of teachers' conceptions of learning and creating engaging lectures. The improvement in teachers' views of the role of prior knowledge met the expectations of the course. Teachers developed an understanding of the importance of prior knowledge, which reduced their perception of learning as a remembering skill. Meyer (2004) highlighted the importance of this change, stating that it is essential that teachers have sufficient knowledge about the nature of learning and a correct understanding of the role of prior knowledge to support students with a constructive learning process. According to Ritter et al. (2013, p. 131), naive conceptions of learning as a remembering skill could be detrimental to the potential of enhancing the active learning of students; thus, when teachers became less convinced about this idea at the end of the training, it was considered as a confirmation of the success of the course.

In this study, the development in teachers' conceptions of learning expected to strengthen a further shift in teachers' perceptions of the nature of teaching from teaching as a transmission of facts to the facilitation of knowledge construction. This shift was reflected by teachers' perception of the need to make an effort to engage students in lectures. These effects supported previous research about the relationship between teachers' conceptions of learning and the way they teach (Bolhuis &Voeten, 2004; Lee et al., 2019; Murtonen et al., 2022; Södervik et al., 2022). According to Fobes and Kaufman (2008), awareness of the need to increase teacher–student interactions represents the point where teachers understand the role of students as active agents in their learning and that teachers do not possess an exclusive authority to transmit information in their classes. These findings suggest a potential for change in teachers' conceptions of learning and, thus, a modification of their teaching practices, which is in line with the findings of Vilppu et al. (2019). Although teachers' perceptions of the challenges in engaging students did not change much during the short course in this study, the current findings proved a parallel development in the understanding of teachers of the important role of prior knowledge in creating engaging lectures. According to Murtonen et al. (2022) and Södervik et al. (2022), this parallel development is crucial across disciplines in supporting teachers to perceive the essence of teaching, the role of teachers as facilitators, and of students as active agents in their learning.

The positive effect of the short course in this study can be explained by the appropriate learning environment designed for the three modules (Become a Teacher, How to Plan My Teaching, and Lecturing and Expertise). The online learning environment with the learning materials and learning activities in these modules seemed to work effectively to activate reflection by the teachers on their situations, help them relate to new concepts from the course, and integrate these with their prior perceptions. Therefore, the effect seemed to be immediate when the information provided was interesting or related. Given that learning is a social process (Chi & Wylie, 2014), the learning progress of teachers during the short course was supported both by individual and collaborative learning. The collaborative learning activity ensured connections and communication among learners in the courses through their engagement in the task. This design proved that online pedagogical training could be utilized as an effective method for professional development without direct meetings in a physical space (Wasserman & Migdal, 2019). In essence, the course was constructed based on the fundamentals of pedagogy and, as Teräs (2016) suggested, to support the pedagogical development of teachers by providing them with a holistic understanding of the concepts of teaching and learning.

Regarding the second research question, the findings revealed that the two groups of untrained teachers, regardless of their teaching experience, benefitted most from the course. Both groups presented significant developments in their conceptions of learning and their awareness of providing engaging lectures; the group of untrained beginner teachers seemed to gain the most benefit. Changes in the groups of trained teachers were not significant; this might be explained by their existing knowledge of the concepts measured in this study which they might have obtained through their prior studies. The observed tendencies in the groups of untrained teachers could explained by their willingness to embrace new learning in pedagogy. This finding aligns with the results of Vilppu et al. (2019) and Murtonen and Vilppu (2020), which reveal that novice teachers benefit most from short pedagogical courses and may need this training the most. Thus, a short basic course in pedagogy can be effective in providing fundamental pedagogical concepts to new academics and can be an essential tool for sustaining teachers' pedagogical knowledge over time. Therefore, the effect of the training can be beneficial to all university teachers by enhancing their pedagogical knowledge. This result also suggests the necessity of supporting the opportunity for new or prospective teachers to access these short basic pedagogical courses.

This current study has a few limitations that could be addressed in further research. The sample size was modest; therefore, a future study needs to have a larger sample to sustain the analysis findings. To draw a stronger conclusion about the effects of the training, future research should include a control group. As Norton et al. (2005) argued, the written self-reports of teachers may not match teaching practices; therefore, a future study should have observations to detect changes in the teaching practices of participant teachers. Such observations would help researchers to understand the extent to which the outcomes reflect the actual changes in concepts generated by the courses. Ödalen et al. (2019) addressed concerns about the immediate effect of pedagogical training courses by suggesting that future studies could use interview methods during recruitment and follow-up surveys to assess how teachers reflect their knowledge in their teaching practice.

In conclusion, a six-week online UNIPS pedagogical course successfully enhanced teachers' understanding of the important role of prior knowledge in the learning process and their determination to increase the number of engaging activities undertaken with students during lectures. This result conforms with those of Vilppu et al. (2019), Murtonen and Vilppu (2020), and Ödalen et al. (2019) and contributes to promising solutions for enhancing the pedagogical expertise of academic staff through short training programs. Short online pedagogical training programs for university teachers can be an effective and efficient solution contributing to the development of active learning of students in higher education.

Declarations

The authors declare that they have no conflict of interest.

Acknowledgement

The research was funded by University of Turku – Finland.

References

Atjonen, P., Korkeakoski, E., & Mehtäläinen, J. (2011). Key pedagogical principles and their major obstacles as perceived by comprehensive school teachers. *Teachers and Teaching*, *17*(3), 273–288.

Berliner, D. C., (2001). Learning about and learning from expert teachers. *International Journal of Educational Research*, *35* (5), 463–482.

Blömeke, S., Gustafsson, J.-E., & Shavelson, R. J. (2015). Beyond dichotomies: Competence viewed as a continuum. *Zeitschrift für Psychologie*, *223*(1), 3–13.

Bolhuis, S., & Voeten, M. J. M. (2004). Teachers' conceptions of student learning and own learning. *Teachers and Teaching*, *10*(1), 77–98. Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school*. National Academy Press.

Chi, M. T. (2009). Three types of conceptual change: Belief revision, mental model transformation, and categorical shift. In *International handbook of research on conceptual change* (pp. 89-110). Routledge.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.

deWinstanley, P. A., & Bjork, R. A. (2002). Successful lecturing: Presenting information in ways that engage effective processing. *New Directions for Teaching and Learning*, *2002*(89), 19–31.

Donche, V., & Van Petegem, P. (2011). Teacher educators' conceptions of learning to teach and related teaching strategies. *Research Papers in Education*, *26*(2), 207-222.

Entz, S. (2007). Why pedagogy matters: The importance of teaching in a standards-based environment. *Forum on Public Policy: A Journal of the Oxford Round Table*, *2007*(2).

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, *4*(3), 272.

Fernandes, S., Mesquita, D., Flores, M. A., & Lima, R. M. (2014). Engaging students in learning: findings from a study of project-led education. *European Journal of Engineering Education*, *39*(1), 55-67.

Field, A. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). Sage Publications.

Fobes, C., & Kaufman, P. (2008). Critical pedagogy in the sociology classroom: Challenges and concerns. *Teaching Sociology*, *36*(1), 26-33.

Gibbs, G., & Coffey, M. (2004). The impact of training of university teachers on their teaching skills, their approach to teaching and the approach to learning of their students. *Active Learning in Higher Education*, *5*(1), 87–100.

Gold, S. (2001). A constructivist approach to online training for online teachers. *Journal of Asynchronous Learning Networks*, *5*(1), 35-57.

Heinonen, N., Katajavuori, N. & Södervik, I. (2023). University teachers' professional vision with respect to their conceptions of teaching and learning: findings from an eye-tracking study. *Frontiers in Education*, 8, 1232273.

Hinton, P. R., McMurray, I., & Brownlow, C. (2014). *SPSS explained*. Routledge.

Hodges, L. C. (2020). Student engagement in active learning classes. In *Active learning in college science: The case for evidence-based practice*, 27-41.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55.

Jones, S. E. (2007). Reflections on the lecture: Outmoded medium or instrument of inspiration? *Journal of Further and Higher Education*, *31*(4), 397–406.

Kaur, G. (2011). Study and analysis of lecture model of teaching. *International Journal of Educational Planning & Administration*, *1*(1), 9-13.

Konopka, C. L., Adaime, M. B., & Mosele, P. H. (2015). Active teaching and learning methodologies: Some considerations. *Creative Education*, *06*(14), 1536–1545.

Lee, H. S., Coomes, J., & Yim, J. (2019). Teachers' conceptions of prior knowledge and the potential of a task in teaching practice. *Journal of Mathematics Teacher Education*, *22*(2), 129-151.

Laato, S., Salmento, H., & Murtonen, M. (2018). Development of an Online Learning Platform for University Pedagogical Studies-Case Study. *In CSEDU* (2) (pp. 481-488).

Lenz, P. H., McCallister, J. W., Luks, A. M., Le, T. T., & Fessler, H. E. (2015). Practical strategies for effective lectures. *Annals of the American Thoracic Society*, *12*(4), 561-566.

Lonka, K., & Ketonen, E. (2012). How to make a lecture course an engaging learning experience? *Studies for the Learning Society*, *2*(2-3).

Martin, E., Prosser, M., Trigwell, K., Ramsden, P., & Benjamin, J. (2000). What university teachers teach and how they teach it. *Instructional Science*, *28*(5), 387-412.

Meyer, H. (2004). Novice and expert teachers' conceptions of learners' prior knowledge. *Science Education*, *88*(6), 970-983.

Miller, C. J., McNear, J., & Metz, M. J. (2013). A comparison of traditional and engaging lecture methods in a large, professional-level course. *Advances in Physiology Education*, *37*(4), 347-355.

Mohr, S., & Shelton, K. (2017). Best practices framework for online faculty professional development: A Delphi study. *Online Learning*, *21*(4), 123-140. https://www.learntechlib.org/p/183780/

Murtonen, M., Anto, E., Laakkonen, E., & Vilppu, H. (2022). University teachers' focus on students: examining the relationships between visual attention, conceptions of teaching and pedagogical training. *Frontline Learning Research*, *10*(2), 64-85.

Murtonen, M., Aldahdouh, T. Z., Vilppu, H., Trang, N. T. T., Riekkinen, J., & Vermunt, J. D. (2024). Importance of regulation and the quality of teacher learning in student-centred teaching. *Teacher Development*, 1-19.

Murtonen, M., Laato, S., Lipponen, E., Salmento, H., Vilppu, H., Maikkola, M.,& Skaniakos, T. (2019). Creating a national digital learning environment for enhancing university teachers' pedagogical expertise: The Case of UNIPS. *International Journal of Learning, Teaching and Educational Research*, *18*(13).

Murtonen, M., & Vilppu, H. (2020). Change in university pedagogical culture–The impact of increased pedagogical training on first teaching experiences. *International Journal of Learning, Teaching and Educational Research, 19*(3), 367-383.

Northcote, M., Gosselin, K.P., Kilgour, P., Reynaud, D., & McLoughlin, C. (2019). A professional learning program for novice online teachers using threshold concepts. *Online Learning*, *23*(4), 336-353. http://dx.doi.org/10.24059/olj.v23i4.1573

Norton, L., Richardson, T. E., Hartley, J., Newstead, S., & Mayes, J. (2005). Teachers' beliefs and intentions concerning teaching in higher education. *Higher Education*, *50*(4), 537-571.

Ödalen, J., Brommesson, D., Erlingsson, G. Ó., Schaffer, J. K., & Fogelgren, M. (2019). Teaching university teachers to become better teachers: the effects of pedagogical training courses at six Swedish universities. *Higher Education Research & Development*, *38*(2), 339-353.

O'Donnell, A. M., & Dansereau, D. F. (2000). Interactive effects of prior knowledge and material format on cooperative teaching. *The Journal of Experimental Education*, *68*(2), 101-118.

Postareff, L., & Lindblom-Ylänne, S. (2008). Variation in teachers' descriptions of teaching: Broadening the understanding of teaching in higher education. *Learning and Instruction*, *18*(2), 109-120.

Postareff, L., Lindblom-Ylänne, S., & Nevgi, A. (2007). The effect of pedagogical training on teaching in higher education. *Teaching and Teacher Education*, *23*(5), 557-571.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*(3), 879-891.

Rienties, B., Brouwer, N., & Lygo-Baker, S. (2013). The effects of online professional development on higher education teachers' beliefs and intentions towards learning facilitation and technology. *Teaching and Teacher Education*, 29, 122-131.

Ritter, F. E., Baxter, G., Kim, J. W., & Srinivasmurthy, S. (2013). Learning and retention. *The Oxford Handbook of Cognitive Engineering*, 125-142.

Rivetta, M. S., Rodríguez-Conde, M. J., & Migueláñez, S. O. (2018). European higher education: a comparative analysis to evaluate the pedagogical training of professors and to investigate the different models developed by universities. In *Proceedings of the Sixth International Conference on Technological Ecosystems for Enhancing Multiculturality*, 1021-1026.

Rob, M., & Rob, F. (2018). Dilemma between constructivism and constructionism: Leading to the development of a teaching-learning framework for student engagement and learning. *Journal of International Education in Business*, *11*(2), 273-290.

Robinson, T. E., & Hope, W. C. (2013). Teaching in higher education: Is there a need for training in pedagogy in graduate degree programs? *Research in Higher Education Journal*, 21.

Stevens, J. P. (2012). *Applied Multivariate Statistics for the Social Sciences (5th ed*.) Routledge.

Södervik, I., Vilppu, H., Boshuizen, H. E., & Murtonen, M. (2022). Development of university teachers' professional vision of students' prior knowledge during a short pedagogical training. *International Journal of Teaching and Learning in Higher Education*. 34, 1, 7–24.

Teräs, H. (2016). Collaborative online professional development for teachers in higher education. *Professional Development in Education*, *42*(2), 258-275

Vermunt, J. D., & Endedijk, M. D. (2011). Patterns in teacher learning in different phases of the professional career. *Learning and Individual Differences*, *21*(3), 294-302.

Vilppu, H., Södervik, I., Postareff, L., & Murtonen, M. (2019). The effect of short online pedagogical training on university teachers' interpretations of teaching–learning situations. *Instructional Science, 47*(6), 679-709.

Vosniadou, S., Lawson, M. J., Wyra, M., Van Deur, P., Jeffries, D., & Ngurah, D. I. G. (2020). Pre-service teachers' beliefs about learning and teaching and about the self-regulation of learning: A conceptual change perspective. *International Journal of Educational Research*, 99, 101495.

Wasserman, E., & Migdal, R. (2019). Professional development: Teachers' attitudes in online and traditional training course. *Online Learning*, *23*(1), 132-143. doi:10.24059/olj.v23i1.1299

Appendix 1

Factor loading of items on each factor

	PK	LR	EL	CL
PK1. Learning requires connecting of aspects to be learned into one's previous knowledge.	.491			
PK2. Students' previous knowledge plays hardly any role in their university studies.(R)	.679			
PK3. There is no need to activate students' previous knowledge, since everyone needs to learn the same things.(R)	.679			
LR1. Learning means that students adopt course material in detail.		.491		
LR2. If students are able to remember things that the teacher explained, they have learned.		.528		
LR3. As a result of a successful learning situation, the student is able to repeat the teacher's main message.		.721		
LR4. A skilled teacher can transmit exact knowledge for students effectively.		.598		
EL1. In my teaching, I have used teaching approaches in which students are actively involved			.642	
EL2. I often activate my students to discuss about the topic.			.779	
EL3. In my teaching, I use a lot of time to discuss with the students based on the ideas and questions that they brought up.			.605	
CL1. I would like to dedicate time for discussions or activating teaching methods but I'm not able to, because there is so much content to be taught in the course.				.490
CL2. My students could have some interesting questions, but usually we don't have time to go them through.				.779
CL3. If a student asks a question during a lecture, I would prefer answering it at the end of the lecture.				.551

Multifaceted Challenges and Opportunities: Concurrent Mixed Methods Research to Investigate Chinese Exchange Students' Experiences in the U.S. Transnational Online Learning Ecology

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Abstract

Transnational online education has become an emerging trend in promoting academic collaboration and exchange in higher education during and after the pandemic. Guided by the learning ecology framework, we conducted concurrent mixed methods research by distributing an online survey to Chinese students (N=51) to collect quantitative and qualitative data. This helped us deeply understand their experiences and perceptions of a cross-cultural online learning environment in the United States. We applied multiple regression and thematic analysis to analyze the data. The merging of both types of data analysis indicated the confirmation of the importance of discipline-based English learning environments, the transformation of online learning practices, the insufficiency of student-to-instructor interactions, discordance of technological self-efficacy and the disadvantages of technology-assisted instruction, and discordance between the usefulness and difficulties of learning activities and assessments. We further discussed appropriate strategies and techniques to promote online teaching and learning excellence in transnational distance education.

Keywords: Academic contradictions, academic adjustments, Chinese students, collaborative exchange program, online learning ecology, transnational online education

Ren, X. and Zhou, Y. (2024). Multifaceted challenges and opportunities: Concurrent mixed methods research to investigate Chinese exchange students' experiences in the U.S. transnational online learning ecology. *Online Learning, Volume 28*(2), (405-426). DOI: 10.24059/olj.v28i2.4090

Transnational education refers to various types of higher education services, courses, and programs from institutions that locate outside the home country (Hu et al., 2019; Yang, 2008). Owing to the influence of the pandemic, international traveling was banned, which suspended and prevented the mobility of students and instructors in transnational contexts (Phan, 2023; Stewart & Kim, 2021). Alternatively, the distance delivery model was adopted to continue intercultural learning and exchange experiences in various circumstances during and after the pandemic (Bentata, 2020; Liao et al., 2020; Whatley et al., 2022). However, transnational distance education is a relatively new and complicated area (Stewart, 2019). Exchange students' learning experiences in such learning contexts remained under-researched (Dai & Garcia, 2019; Qin & Te, 2016; Stewart, 2019). Mixed methods research (MMR) is a research method to collect both quantitative and qualitative data to increase the trustworthiness and comprehensiveness of research findings (Creswell, 2014; Creswell & Plano Clark, 2018). Because of the complexity of transnational distance education, MMR is a good fit to explore what exchange students have experienced in the learning context to better inform policies or promote social change (Krpec et al., 2017; Molina-Azorin & Fetters, 2019). For instance, transnational education has been mainly used to internationalize and enhance higher education curricula in China for the past decades (Feng, 2013; Hu et al., 2019). Because of the pandemic, many Chinese exchange students had to stay in their home country to experience online and distance instruction in a transnational context for the first time. In terms of the emerging need of delivering transnational distance instruction in this context, the purpose of this MMR was to investigate Chinese exchange students' perceptions and experiences in transnational distance education offered by a university in the United States (U.S.). The research contributes to the body of knowledge in the field of transnational distance education. The findings will indicate the challenges and opportunities faced by Chinese exchange students in the program, which can be beneficial to raising instructors' and administrators' awareness of improving existing teaching practices and support services to promote the quality of transnational distance education.

Literature Review

Transnational Online Education

Transnational education, also known as borderless or international education, is defined as various types of educational services and programs provided by overseas higher education institutions to benefit local students (Bovill et al., 2015; Hu et al., 2019; Knight, 2016; Wilkins & Juusola, 2018). It has become increasingly prevalent to promote intercultural experiences and competency among students in higher education worldwide (Dai et al., 2020b; Moufahim & Lim, 2015; Wilkins & Juusola, 2018; Yu, 2021). Exchange or international students refer to the students who study abroad to gain intercultural learning experiences in a host country within a short time (Newsome & Cooper, 2016). For instance, Chinese exchange students anticipated Western-oriented learning environments to gain international experiences, as indicated in foreign language learning, advanced curricula, and innovative teaching approaches (Willis, 2010; Yu, 2021). However, others argued that transnational education has been used as a profit-generation tool or soft power to reinforce stereotyped ideologies or even neocolonialism in cross-cultural contexts (Aquino et al., 2023; Moufahim & Lim, 2015; O'Dowd, 2021; Wilkins & Juusola, 2018; Yu, 2021). Given the influence of the COVID-19 pandemic, there was a growing phenomenon of developing transnational online education, such as virtual exchange and study abroad programs, to temporarily replace in-person intercultural learning experiences (Bowen et al., 2021; Liu & Shirley, 2021). On the one hand, the advancement of technology and adaptive delivery methods could strengthen international connections and collaborations in virtual environments (Aquino et al., 2023; Han & Resta, 2020; Henderson et al., 2017; Howard et al., 2017). Taking a global health virtual exchange program as an example, students in the U.S. had the opportunity to further understand the issues and conditions related to Syrian refugee camps through virtual reality (Bowen et al., 2021). Howard et al. (2017) also discussed the use of video conferencing tools to deliver live study abroad experiences for students both in Italy and U.S. On the other hand, the adoption of virtual learning approaches might limit students' personal interactions and immersion in local cultural and social contexts (Bovill et al., 2015; Liu & Shirley, 2021). Chinese students had little online learning experience before the pandemic (Fang et al., 2023). Without sufficient training, they encountered various challenges during the transition, such as technical difficulties, anxiety, social isolation, and information overload (Chen et al., 2020; Lin, 2022). As a result, it is highly possible that Chinese exchange students would experience dual barriers in transnational online education (Ren & Zhou, 2022).

Academic Contradictions and Adjustments in Transnational Education

The change of learning contexts could lead to a significant impact on students' learning identities and experiences, as indicated by academic, cultural, social, psychological, and emotional adjustments (Dai & Garcia, 2019; Wilczewski et al., 2022). On the one hand, the collaborative programs with overseas institutions accommodated the needs of exchange students and enriched their intercultural learning experiences through offering advanced curricula, international course materials, innovative teaching strategies, and emerging technologies (Hu et al., 2019; Moufahim & Lim, 2015; Yu, 2021). On the other hand, academic contradiction was one of the critical barriers faced by students in a transnational distance learning context. For example, teaching practices in China tended to be instructor-centered and lecture-focused (Dai et al., 2020a; Wang et al., 2018; Yu, 2021). These were different from student-centered and discussion-based learning environments in an American classroom (Jackson & Chen, 2018; Safipour et al., 2017). In terms of assessment approaches, Chinese students experienced the transition from textbook-based, high-stakes exams to diverse, contextualized, and formative assessments in American academic culture (Dai & Garcia, 2019; Dai et al., 2020a). Moreover, instructors increased the use of web-based instructional resources and Internet-based technologies in online courses. Other contradictions included course structure, international course materials, classroom policies, grading criteria, and expected learning outcomes (Dai et al., 2020b; Hu et al., 2019; Luyt, 2013; Safipour et al., 2017; Yang, 2008). Academic adjustment refers to "the degree to which a student fits in the academic context of studying in the university and how comfortable they feel in that context" (Wilczewski et al., 2022, p. 698). Accordingly, Chinese exchange students needed to change their learning agency and practices while navigating cross-system differences, such as from dependent to independent and from passive to active learners (Dai & Garcia, 2019).

Chinese Exchange Students' Virtual Learning Experiences

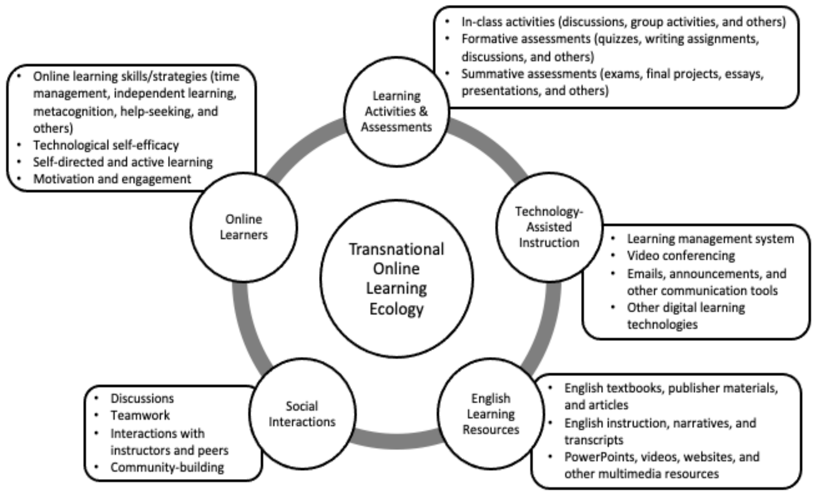
Online or virtual learning is different from face-to-face instruction, which often required more effort from instructors and students. As the Community of Inquiry (CoI) framework implied, the interrelationships among social, cognitive, and instructor presence could influence the effectiveness of online learning experiences (Garrison et al., 2000). The integration of remote and distance instruction further complicated the process of transnational education and students' cross-cultural learning experiences (Chen et al., 2020; Gemmell & Harrison, 2017; Stewart, 2019). Some researchers have studied international students' experiences and perceptions of online learning during the pandemic, which showed ambivalent findings (Stewart & Lowenthal, 2021; Wilczewski et al., 2022). On the one hand, the flexibility and accessibility of online education make transnational education operative during and after the pandemic. On the other hand, many international students reported the lack of guidance or preparation during the unexpected transition to online instruction (Alaklabi et al., 2021). The disadvantages of online education made international students face additional challenges, such as social isolation, the lack of instructor presence, and disorientation. Other researchers investigated Chinese students' expectations of online learning environments, which showed that Chinese students highly valued various levels of instructor presence and technology integration, such as instructors' technological competency, online teaching experience, emotional support, and effective communication (Lin, 2022; Fang et al., 2023). Some researchers focused on the benefits, faculty perceptions, and systematic considerations of virtual exchange programs in higher education during the pandemic (Lee et al., 2022; Weaver et al., 2022). However, limited research has been conducted to investigate the experiences of Chinese exchange students who enrolled in a transnational distance education program. For instance, guided by the CoI framework, one quantitative research showed cognitive and instructor presence, as indicated in student-to-content and student-to-instructor interactions, were two strong predictors of Chinese students' learning satisfaction in a cross-cultural online learning environment (Ren & Zhou, 2022). Further research is needed to explore Chinese exchange students' perceptions and experiences before targeting appropriate support resources and services to improve the effectiveness of transnational distance teaching and learning.

Theoretical Framework

Learning ecology (LE) is defined as a model to indicate essential components needed to achieve learning in physical, virtual, formal, or informal spaces, including learning activities, instructional resources, and interactions and relationship building (Barron, 2006; Barron et al., 2007; Soszynski, 2022). In this research, based on the academic contradictions and adjustments discussed before, we adapted a cross-cultural online LE model from the LE theory to reflect the specialty of transnational education in a distance context. The newly developed model contains (see Figure 1) learning activities/assessments, technology-assisted instruction, English learning resources, social interactions, and online learners.

Figure 1

Adapted Model of Learning Ecology in a Transnational Distance Context



Guided by the adapted model of transnational online LE, the mixed methods research (MMR) aimed to address the following research questions:

RQ1: How did transnational online learning ecology influence Chinese exchange students' learning satisfaction (as indicated in learning activities/assessments, technology-assisted instruction, English learning resources, social interactions, and online learners)?

RQ2: What have Chinese exchange students experienced in the transnational distance program?

Methodology

Research Setting

A university in the U.S. established a partnership with a Chinese university to develop a public administration exchange program. Before the pandemic, there was a requirement for Chinese students to only enroll in in-person programs offered at foreign institutions for accreditation purposes. In the Fall of 2022, because of the remaining restrictions on international travel, the faculty of the U.S. institution designed and delivered the courses in synchronous and asynchronous online sessions to students in China. The research was conducted on a group of Chinese undergraduate students (N=80) who enrolled in the online exchange program. The purpose of the research was to understand their experiences and perceptions of the transnational distance learning context.

Research Design

MMR is often used as a third research methodology to collect multiple sources of quantitative and qualitative data to comprehensively explore a phenomenon, with an aim to increase the validity of the research findings (Creswell & Plano Clark, 2018; Krpec et al., 2017; Molina-Azorin & Fetters, 2019). Concurrent MMR is a research method that collects and analyzes qualitative and quantitative data simultaneously (Creswell, 2014). In the research, we used an online survey containing closed and open-ended questions to collect both types of data from a large number of participants.

Data Collection

Guided by the adapted LE model, we developed an online survey to collect quantitative and qualitative data to explore students' experiences and perceptions of transnational distance instruction within one phase (see Figure 2). The online survey consisted of three sections: three demographic questions, a 19-item survey rated by a 4-point Likert scale, and four open-ended questions. The 19item component of the survey measured students' perceptions of teaching and learning practices in transnational distance education; the scale ranged from 1 = strongly disagree to 4 = strongly agree. For instance, to measure students' perceptions of English learning recourses, one of the statements included "English course materials helped me achieve the learning objectives." To measure online learner readiness, we used four statements, such as "I was able to effectively manage my time to meet the course deadlines" and "I was able to ask for help from my instructors and classmates."

Four open-ended questions were included, to encourage students to describe their experiences in the transnational distance exchange program, such as advantages, limitations, challenges, and suggestions. For example, one of the questions was, "What were the things that benefited you from the program, and why?" We first created the online survey in English, translated it into Chinese, and invited two bilingual researchers to cross-check the accuracy of the translation. Students responded to the open-ended questions in Chinese, and we translated their responses from Chinese to English and invited two bilingual researchers to cross-verify the accuracy of the translation. We also conducted a pilot study with 30 participants to test the reliability of this survey. The Cronbach's Alpha was 0.96, which indicated an excellent reliability for a survey instrument (Taber, 2018). We used an online questionnaire platform, Wenjuanxing, to distribute the online survey to the target population. A total of 51 students completed the survey, with a 64% response rate.

Data Analysis

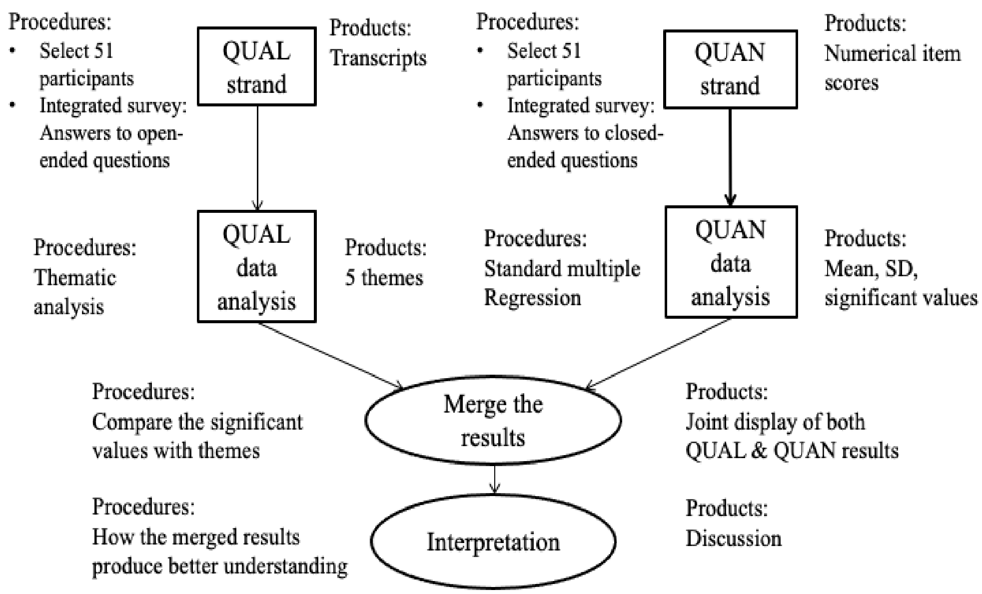
In the data analysis phase, we analyzed qualitative and quantitative data within one phase. For quantitative data analysis, we used the IBM SPSS Statistics for Windows, version 24, 2016 (IBM Corp., Armonk, N.Y., USA) to run descriptive statistics and conduct multiple regression to measure the relationships between the variables of transnational online learning ecology and students' learning satisfaction. In terms of qualitative data analysis, we used thematic analysis to interpret and categorize students' responses to open-ended questions (Braun & Clarke, 2012). Then, we compared and merged the results of quantitative and qualitative data analysis to draw a comprehensive picture of Chinese exchange students' perceptions and experiences in the transnational distance program. The integration analysis was guided by the principles of confirmation, expansion, and discordance (Fetters et al., 2013). Confirmation refers to the consistent conclusions from both types of data. Expansion means the data divergence enriches insights into a phenomenon. Discordance indicates the inconsistency and contradiction between two types of data results. Inspired by Bustamante's idea (2019), we further developed a joint display, a visualized mixture combining the side-by-side display and comparison of results to represent data integration in MMR, to capture insights from the merging of data in this study (Fetters et al., 2013; Guetterman et al., 2015).

Quantitative Results

According to the demographic information of the participants (*N*=51), 41% of them were male students, and 59% of them were female students. Amongst these participants, a majority of them (86%) reported that their English proficiency was equal to or higher than the level of CET-4, an official college English test used in Chinese higher education to assess students' English skills, while seven students had limited English proficiency compared to their classmates.

Figure 2

A Diagram for the Concurrent Mixed Methods Research Design



In the study, students' perception of learning activities/assessments (LA) was measured by two Likert-scale items, including "in-class learning activities enhanced my understanding of main concepts, and assignments helped me achieve the learning objectives." Technology-assisted instruction (TAI) referred to the use of digital technologies to deliver online instruction, containing a learning management system (LMS), video conferencing software, social networking tools, emails, and publisher platforms. Students' perception of TAI was measured by two items, including "I was proficient in using the needed digital technologies to complete online courses, and the adoption of digital technologies enhanced my learning outcomes in online courses." English learning resources (ELR) was assessed by items such as "I could easily understand the content of English instructional materials; I could easily understand the English instruction delivered by U.S. instructors, and English course materials helped me achieve the learning objectives." Social interaction (SI) was measured by students' perceptions of interaction with classmates, interaction with instructors, collaboration with classmates to complete team projects, and participation in group discussions. Online learners (OL) implied learners' characteristics and their readiness for online instruction was measured by online learning skills (time management and help-seeking), self-directed learning, and emotional engagement. Students' learning satisfaction (LS) was evaluated by three scale items, including "I enjoyed American academic culture in the online environment; my learning experiences of the transnational distance education met my expectations, and I was satisfied with my learning outcomes in the program."

Preliminary data screening included examinations of the histograms of all five variables' scores and the scatter plots for all pairs of variables. Univariate distributions were reasonably normal with no extreme outliers. Bivariate relations were fairly linear. All slopes had the expected signs, and there was no bivariate outlier. Therefore, we conducted standard multiple regression to measure the relationships among TAI, SI, OL, ELR, and LA with LS in the program. As shown in Table 1, the standard multiple regression was statistically significant: R = .86, R^2 = .74, adjusted R^2 = .72, $F(5, 45) = 26.11$, $p < .001$. This meant students' LS was well predicted from this set of five variables, with approximately 74% of the variance in students' learning satisfaction accounted for by the regression. Amongst these five predictors, OL and ELR were significantly predictive of students' LS: OL $t(45) = 2.49$, $p < .05$; ELR $t(45) = 3.74$, p = .001. The proportions of variance uniquely explained by these two predictors were: sr^2 = .04 for OL and sr^2 = .08 for ELR. According to the descriptive statistics of closed-ended questions, the scores for several items were relatively lower than others, including interaction between students and instructors (M = 2.57, SD = 0.67), online group discussions (M = 2.61, SD = 0.64), help-seeking outside the classroom (M = 2.55, SD = 0.67), communication in English (M = 2.49, SD = 0.70), American academic culture (M = 2.57, SD = 0.78), and transnational distance learning experience (M= 2.59, SD = 0.78).

Table 1

Standard Multiple Regression to Predict Students' Learning Satisfaction (LS) from Technology-Assisted Instruction (TAI), Social Interactions (SI), Online Learners (OL), English Learning Resources (ELR), and Learning Activities/Assessments (LA)

	LS	TAI	SI	OL	ELR	LA	b	β	sr^2_{unique}
TAI	.59						.045	.027	.0004
SI	.741	.634					.152	.146	.007
OL	.770	.619	.777				.289	.331**	.035
ELR	.790	.569	.694	.658			.436	.431***	.080
LA	.579	.486	.503	.603	.583		.097	.042	.001
						Intercept=	-2.649		
Mean	7.92	6.06	11.22	10.94	11.10	6.04			

SD	2.028	1.223	1.942	2.327	2.003	.871
						R^2= .744
						R^2_{adj}=.715
						R= .862***

Note. *** p = .001, ** p < .05

Qualitative Findings

We first translated students’ responses to the open-ended questions from Chinese to English. Guided by the transnational online LE model, we applied thematic analysis to interpret and identify the data with five themes: the usefulness of discipline-based English learning environments, the challenges of technology-assisted instruction, the adjustment of online learning practices, the lack of interaction with instructors, and the difficulties of completing learning activities and assessments.

Theme One: The Usefulness of Discipline-Based English Learning Environments

In the exchange program, Chinese students believed that the use of English learning resources effectively fostered their learning experiences. About half of the students expressed their positive attitudes about the use of English instructional materials to increase their English skills in a discipline-immersed language learning environment. For instance, a student wrote: “while reading English textbooks, I could learn about a large number of terminologies in English, which was helpful to enhance my English reading skills.” Others mentioned that “the program provided us with an atmosphere where we could learn English in a more practical manner, such as reading materials in English, taking synchronous online courses, and communicating with foreign faculty.” A student pointed out that “faculty shared new knowledge, such as international cases and practices, with us. These were very interesting and broadened my horizon and enriched my learning experiences.” Although some students with limited English proficiency encountered challenges and difficulties in understanding subject knowledge in English, especially during synchronous online courses, the adoption of English instruction and learning resources created a discipline-based immersive language learning environment. Chinese students could increase their English skills in an authentic context and gain intercultural learning experiences to develop cross-cultural competence in a situated manner.

Theme Two: The Challenges in Technology-Assisted Instruction

The success of transnational distance teaching and learning highly relied on the affordances of the Internet and technology. Chinese students with limited e-learning experiences faced difficulties while navigating technology-assisted instruction. In the U.S., Internet-based instruction had been widely applied in higher education before the pandemic, unlike Chinese universities. To continue the transnational exchange program, the faculty of the U.S. university utilized multiple technologies to deliver the courses in both synchronous and asynchronous online manners, including a learning management system (LMS), video conferencing applications, publisher websites, communication tools, and online proctoring software. As a result, almost every exchange student expressed their negative feelings toward the use of technology-assisted instruction. For instance, they experienced "unstable Internet issues" during synchronous online sessions and "bugs" (some students used this word in English in their responses) while taking exams on the LMS or reviewing course content on the publisher's website. Some students mentioned "because of unstable connections, sometimes, the online sessions were frozen, or I was kicked out of the meeting. Since we were taking courses in English, it was so easy for me to get lost, which was a terrible experience." Owing to Internet censorship in China, some technologies based in overseas countries were blocked. The servers of these technologies selected by the faculty were located in the U.S., which often caused unstable connections for students in China. Thus, some students wrote, "some URLs and website addresses crashed to prevent us from accessing the content when needed." Other students also stated that "we preferred print textbooks to electronic learning materials. The online system was not very effective or user-friendly." Many students even suggested the instructors consider applying some technologies based in China. Some of the students acknowledged the benefits of technology-assisted instruction in promoting their learning experiences, as indicated in the flexibility, convenience, and accessibility. However, with limited experience in using educational technologies and the lack of stable Internet connections, Chinese students often felt frustrated while taking Internet-based courses in a transnational learning context.

Theme Three: The Adjustment to Online Learning Practices

In the transnational distance program, students faced various difficulties and had to adjust their learning practices while experiencing American academic culture and online education at the same time. Some students mentioned that the learning experiences helped them develop independent and active learning skills. For instance, a student stated, "to better comprehend the content delivered in the classroom or in the textbook, I took time to search information on the Internet after class." Other students mentioned, "I was able to develop an effective study plan, such as watching instructional videos, reviewing notes, and completing assignments; I used translation software a lot to increase my understanding of terminologies or main concepts." Meanwhile, others said that they were able to develop online learning skills, as indicated in time management ("effectively managing my time," "completing assignments in a timely manner," and "catching up with a tight program schedule"), motivation and persistence ("excited to learn new knowledge in different socioeconomic contexts" and "engaged in English instruction"), self-discipline ("preparing and reviewing the course notes to complete the assignments"), collaboration ("communicating and studying with my classmates"), and help-seeking (asking for help from my classmates and instructors). Therefore, on the one hand, the complexity of transnational distance education enriched students' cross-cultural learning experiences. On the other hand, students were "forced" to transform their learning practices to adapt to contradictions between Chinese and American educational systems as well as traditional classroom teaching and online instruction.

Theme Four: The Lack of Interaction with Instructors

In the transnational distance program, due to time differences, linguistic barriers, and other factors, the interactions between Chinese students and American faculty were very limited. For instance, some students mentioned that "because of the lack of in-person connections in the class, we could not feel the learning atmosphere, which had a negative impact on our learning experiences and outcomes." Although the faculty provided two synchronous online sessions each week, "we still had very limited opportunity to interact with them during the class. When we had questions, we could not communicate with the faculty in a timely manner; similarly, the faculty could not provide us with immediate feedback via emails or other methods to solve our problems." A student said "I sent emails to faculty but never received their responses. I was anxious while waiting for their responses to address my problems. This definitely was not a pleasant experience." Most of the time, they had to solve the problems by themselves or ask for help from their classmates. Other students also mentioned, "we still preferred in-person instruction and face-to-face communication with American faculty and hoped that the pandemic could end soon." As a result, the lack of synchronous and asynchronous online interactions with instructors had a negative impact on students' intercultural learning experiences.

Theme Five: The Difficulties of Completing Learning Activities and Assessments

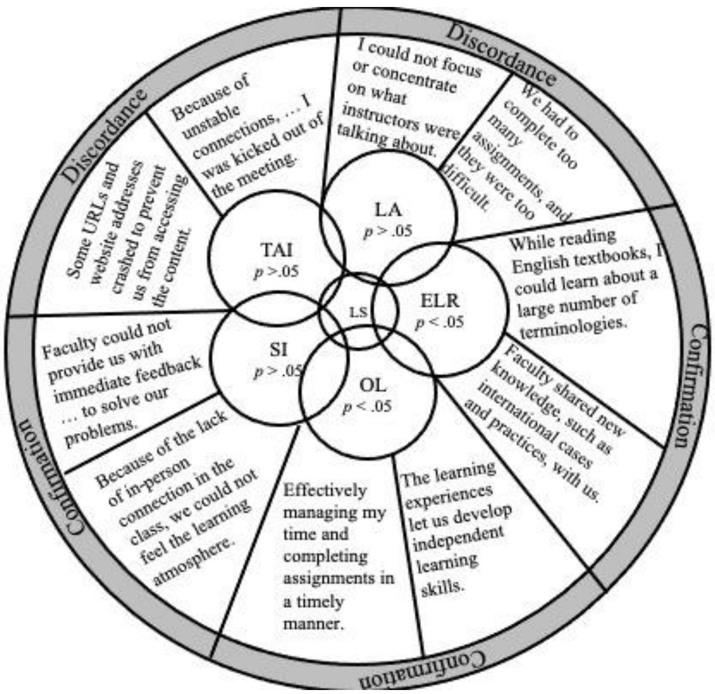
Finally, due to intensive course loads within the exchange program, Chinese students encountered various difficulties while completing learning activities and assessments. For instance, these students were not native English speakers, and they had to spend longer time understanding and digesting the subject knowledge in English before completing their assignments. For instance, many students said that "during the synchronous online courses, instructors were talking too fast, and I could not focus or concentrate on what instructors were talking about. It did not give me enough time to understand, and it was so easy for me to get lost." Because of fast-paced synchronous online courses, sometimes, instructors could not upload recorded lectures immediately after each class, which prevented the students from reviewing the course materials to finish the assignments. Some students also complained that "we had to complete too many assignments, and they were too difficult" and suggested faculty "decrease the number of team projects and tests, make assessments easy, and allow multiple attempts." Some students mentioned what they have learned in the class was often not helpful for them to complete the assessments. Because of limited online sessions, there was no time for instructors to discuss each question in detail in the class. Too often, these students had to ask their classmates for correct answers. Therefore, they hoped to have "tutoring services to help them understand the course content and complete assignments." Due to a tight program schedule and unfamiliarity with the course content, students often felt overwhelmed and even disengaged while participating in learning activities and assessments.

Discussions and Implications

Based on the integration principles of confirmation, expansion, and discordance suggested by Fetters et al. (2013), we further merged the results from both types of data and used PowerPoint® (http://office.microsoft.com) to develop a joint display to visualize the relationships between qualitative and quantitative results (see Figure 3) (Bustamante, 2019). The integration of both types of data analysis enriched and enhanced the interpretation of complicated learning experiences among Chinese students in a U.S. transnational exchange program. We summarized five findings that emerged from the integration, including confirmation of the importance of discipline-based English learning environments, confirmation of the transformation of online learning practices, confirmation of the insufficiency of student-to-instructor interaction, discordance between technological self-efficacy and the challenges faced in technology-assisted instruction, and discordance between usefulness and difficulties of learning activities and assessments. These themes provided a comprehensive picture to describe multifaceted opportunities and challenges experienced by Chinese students while negotiating academic contradictions and difficulties in the U.S. transnational online learning context.

Figure 3

Joint Display: The Integration of Qualitative and Quantitative Data



Confirmation: The Importance of Discipline-Based English Learning Environments

The results of multiple regression and qualitative findings confirmed the importance of discipline-based English learning environments in enhancing students' intercultural learning experiences. In the multiple regression, the variable of English learning resources (ELR) was one of the strong predictors of students' online learning satisfaction ($t(45) = 3.74$, $p = .001$). The proportion of variance uniquely explained by this predictor was: $sr^2 = .08$. Similarly, in qualitative findings, students reported that the adoption of English learning resources and instruction allowed them to learn about new subject knowledge and experience an immersive language learning environment. They were able to increase their English skills in a discipline-based context through reading articles and textbooks in English, writing assignments in English, and participating in online discussions with instructors and classmates in English. Meanwhile, the use of English learning resources also gave students opportunities to develop cross-cultural competence in a transnational context.

This finding is consistent with previous literature that students who enrolled in transnational programs benefited from international resources in increasing their English skills and gaining meaningful intercultural learning experiences (Moufahim & Lim, 2015; Willis, 2010; Yu, 2021). However, in China, English language teaching is often separate from subject knowledge training. Chinese exchange students are more likely to experience linguistic barriers and learning gaps while learning about discipline knowledge in English (Dai et al., 2020b; Liao & Wei, 2014; Senyshyn, 2019). Therefore, the institution could consider providing language support resources and services to promote their learning outcomes, such as short-term English language programs, bilingual tutoring services, live closed captions during synchronous online courses, and a glossary of terminologies and definitions in the subject knowledge (Moussa, 2021).

Confirmation: The Transformation of Online Learning Practices

The merging of quantitative and qualitative findings also validated Chinese exchange students and transformed their online learning practices to achieve learning excellence in transnational distance education. For instance, the multiple regression showed the variable of online learning practices was another strong predictor of students' online learning satisfaction with $sr^2 = .04$ ($t(45) = 2.49$, $p < .05$). Likewise, in qualitative findings, students mentioned they had to adjust their learning practices to adapt to a different academic culture and online instruction. Because of the difficulty in understanding English instruction or the lack of immediate feedback from instructors, they developed independent and active learning skills to comprehend subject knowledge, as indicated in information searching, course preparation, and notes review.

The finding conforms with previous literature that the change in learning contexts had an impact on students' learning behaviors and identities (Dai & Garcia, 2019; Heng, 2018). For example, students changed their learning practices to adapt to a different academic culture. Meanwhile, Chinese students were able to improve online learning skills while transitioning to distance education, such as time management skills, self-discipline, collaboration, and help-seeking. However, without sufficient support and guidance, students often encountered many challenges while transforming their learning practices to adjust to cross-cultural online instruction (Alaklabi et al., 2021; Heng, 2018). Therefore, there is a need for institutions to provide online learning readiness evaluation and training, orientations, and seminar courses, as well as social and emotional support for students to decrease their anxiety and stress while transitioning to the special learning context (Senyshyn, 2019).

Confirmation: The Insufficiency of Student-to-Instructor Interaction

The integration of descriptive statistics and qualitative findings further verified the insufficiency of student-to-instructor interaction in the online delivery model. Although the item of social interactions was not a strong predictor of students' learning satisfaction in the multiple regression (SI $t(45) = 1.09$, $p > .05$), the scores for student-to-instructor interaction (M = 2.57, SD = 0.67) and help-seeking outside the classroom (M = 2.55, SD = 0.67) were relatively low compared to other scale items. This result was also consistent with the qualitative findings that expressed students' dissatisfaction with the fully online delivery model applied in the program. They believed that online instruction had a negative impact on their learning experiences and outcomes, especially in the lack of interpersonal connections and timely feedback from instructors. Moreover, in the qualitative findings, some students mentioned they were afraid to ask questions because of lack of confidence in speaking English. This was concordant with the low score for the item of communication in English (M = 2.49, SD = 0.70) on the Likert scale.

The finding is also consistent with previous research that Chinese students were dissatisfied with their online learning experiences because of social isolation, disengagement, and the lack of instructor presence (Ren & Zhou, 2022; Tang et al., 2021; Zhang et al., 2020). Especially, exchange students with limited English proficiency often had fewer interactions with overseas instructors (Senyshyn, 2019). Therefore, instructors need to take Chinese exchange students' voices into consideration while designing and delivering online courses. For instance, instructor social presence could make a positive impact on learner engagement, satisfaction, and success in online instruction (Oyarzun et al., 2018; Watson et al., 2016). Accordingly, instructors could consider applying various strategies and techniques to increase their social presence in online courses, such as synchronous online office hours, contributions to group discussions, prompt responses to emails, joining class conversations on social media, frequent feedback, and online facilitation. Instructors can also integrate WeChat (the most popular social networking software among Chinese youth) as the main tool to communicate with Chinese students in the exchange program (Luo & Yang, 2022; Zhang, 2022). Institutions can further improve their learner support services to alleviate students' isolated learning experiences by providing bilingual mentors or teaching assistants and hosting virtual social events.

Discordance: Technological Self-Efficacy and the Challenges in Technology-Assisted Instruction

The merging of quantitative and qualitative data analysis showed a conflict in the perceptions of adopting technology-assisted instruction in transnational distance education. In the multiple regression, technology-assisted instruction was not a strong predictor of students' learning satisfaction (TAI $t(45) = 0.26$, $p > .05$). The descriptive statistics also indicated relatively satisfactory scores for the items of academic technology access (M = 2.94, SD = 0.71) and usage (M = 3.12, SD = 0.59). However, in qualitative findings, almost every student mentioned that they experienced multiple technical difficulties while studying in the technology-supported cross-cultural learning environment. For instance, many students reported they experienced technical issues while "taking synchronous online courses and navigating on the LMS, such as unstable Internet connections, login issues, firewalls, and server crashes." A possible explanation for the discrepancies between qualitative and quantitative data analysis is the wording of the scale items. The scale items focused on students' technological proficiency instead of on the efficiency of infrastructure and the usability of academic technologies, such as hardware, software, and facilities. As a result, students believed they were technology savvy and confident in accessing and using technologies for learning. However, because of some external factors, such as the imperfection of infrastructure, unstable Internet connections, Internet censorship, and firewall issues, students often experienced technological frustrations while using technologies selected by the American faculty. Similarly, the score for the item of electronic instructional materials (M = 2.94, SD =0.65) was relatively satisfactory. However, in qualitative findings, some students reported they faced many challenges while using electronic resources, especially online publisher materials, and preferred print learning materials.

These findings are also confirmed by previous research that students with limited online learning experiences often encountered technical difficulties and frustrations in a web-based learning environment (Chen et al., 2020; Dai et al., 2020b; Lin & Gao, 2020; Zhang et al., 2020). The challenges faced in technology-assisted instruction also had harmful effects on Chinese students' cognitive presence (Ren & Zhou, 2022). Accordingly, institutions need to improve their infrastructure and support resources to minimize students' anxiety and enhance their transnational online learning effectiveness, such as stable Internet connections, well-designed online learning systems, the availability of help desk services, and proactive support plans. Most importantly, institutions need to take ethical issues into consideration to better accommodate Chinese learners' needs and preferences. For example, they can conduct contextual and learner analyses before selecting the most appropriate, accessible, and user-friendly technologies to foster student engagement and success in a transnational distance context.

Discordance: Usefulness and Difficulties of Learning Activities and Assessments

The integration of data analysis revealed a discordance in learner perceptions of learning activities and assessments in transnational distance education. In the multiple regression, the variable of learning activities and assessments was not a strong predictor of students' learning satisfaction (LA $t(45) = 0.42$, $p > .05$). However, the scores for the items, such as assignments and assessments (M = 3.08, SD = 0.39) and in-class learning activities (M = 2.94, SD = 0.51), were relatively high compared to other items. This was inconsistent with qualitative findings. In qualitative findings, students faced various challenges while completing these activities and assignments due to the intensive program schedule, limited discipline knowledge, low English proficiency, and the lack of transnational learning experiences. For instance, some students stated the courses were taught too fast, which did not give them enough time to digest the new knowledge before completing assignments. In fast-paced synchronous online courses, instructors did not have time to address students' questions about assignments. Many of them also complained they had to complete too many difficult assessments within a limited time period. One possible explanation for the contradictions is the wording of the existing scale items that exclusively focused on the usefulness of assignments and learning activities. Students agreed with the affordance of learning activities and assignments in increasing their learning outcomes. However, what students mentioned in the qualitative responses indicated their unpleasant perceptions and stressful experiences while dealing with challenging learning activities and assessments. Especially, they could not receive timely academic support and assistance to address these difficulties.

The finding is also consistent with previous research that students often had difficulty in following up with the instruction in synchronous online courses and experienced stress and anxiety because of academic demands in the transnational program (Dai & Garcia, 2019; Liao & Wei, 2014; Willis, 2010; Yu, 2021). Hence, it is critical for institutions to reconsider the program schedule to decrease course overload and provide effective and immediate tutoring services to alleviate academic stress and maintain student engagement. Instructors can also collaborate with instructional designers to first conduct a learner analysis to better understand students' prior knowledge, experiences, and preferences. For instance, they could develop aligned learning activities and assessments and well-designed course presentation to support students' completion of predefined learning objectives in online courses. Moreover, instructors are expected to provide immediate feedback, prompt responses, and online office hours to address students' questions and concerns about assessments.

Limitations and Future Research Directions

The research also has limitations in various aspects, as indicated in sample sizes, context, and instrument. For instance, we applied the convenience sampling to recruit the participants from a public administration exchange program in a Chinese university, and only 51 students completed the online survey. This indicated a limitation to generalize the findings to the larger populations in other scenarios. Therefore, other researchers could consider collecting data from larger sample sizes in different disciplines, educational settings, institutions, and countries to contribute to a more comprehensive picture of transnational distance education. Moreover, because of the limitations of wording used in the Likert scale, to further elaborate on students' learning experiences, there is a need to redesign and redevelop the Likert scale items to better measure and enrich the insights of the phenomenon, such as the effectiveness of instructional strategies and teaching practices, the perceptions of learning activities and assessments, the desirability of course design and delivery, and the usability of academic technologies.

Further research can focus on analyzing the predictive power of other factors in influencing students' cross-cultural online learning satisfaction, such as social networking, institutional support, academic stress, and mental health. Other researchers could consider conducting qualitative studies to better understand the transformation and adaptation of learning practices and behaviors in transnational distance education. Future research is also needed to better understand students' perceptions and expectations of the delivery models implemented in the transnational distance program for further improvements. These research findings are expected to better inform future practices and interventions to foster the efficiency of transnational distance teaching and learning and contribute to the knowledge in the field.

Conclusion

In conclusion, Chinese exchange students experienced multifaceted positives and negatives in the cross-cultural online learning context. On the one hand, they viewed Western-style teaching practices as legitimate to gain intercultural learning experiences and develop intercultural competency. For instance, they were able to increase their English proficiency and change their learning practices to become active and independent learners. On the other hand, they experienced various challenges and obstacles, such as linguistic barriers, academic stresses, technical difficulties, and social isolation. To some extent, academic contradictions were regarded as the "charm" to enrich students' learning experiences (Dai et al., 2020b). Therefore, instead of simply removing these differences, institutions need to improve their learner support services and resources to help exchange students transition to and negotiate with a new learning environment, such as seminar courses, orientations, language support, and tutoring services. Instructors also need to apply effective course design and delivery strategies and techniques to promote online teaching and learning excellence in a transnational context, such as instructor social presence, technology integration, emotional support, well-designed learning activities and assessments, and ethical considerations.

Transnational distance education has become an emerging phenomenon during and after the pandemic. The research findings enriched and expanded the understanding of the phenomenon and contributed to the knowledge in the field of transnational distance education. However, owing to the limitations of this study, other researchers could explore the phenomenon in different contexts or redevelop the Likert scale to measure the significance of additional factors in influencing students' perceptions and experiences in the transnational distance program, such as the usability of academic technologies, the desirability of course design, and the efficiency of course delivery model. The research also aimed to raise scholars' attention to this unique group of students in the U.S. higher education and encourage more researchers to investigate the effectiveness of online teaching and learning practices in transnational contexts.

Compliance with Ethical Standards

All procedures performed in the study involving human participants were in accordance with the ethical standards of the institution research committee.

Data Availability Statement

The dataset used and analyzed during the current study is not publicly available but can be shared upon reasonable request.

Declaration of Interest Statement

The authors declare that there is no conflict of interest pertaining to this research, and no funding was received for conducting this study.

References

Alaklabi, M., Alaklabi, J., & Almuhlafi, A. (2021). Impacts of COVID-19 on international students in the U.S. *Higher Education Studies, 11*(3), 37-42.

Aquino, K. C., Tobin, E., & Sloan, S. (2023). Remote global learning: The role and use of virtual exchange for U.S. and Irish graduate students. *Online Learning, 27*(2), 208-222. https://doi.org/10.24059/olj.v27i2.3380

Barron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspectives. *Human Development, 49*(4), 193-224.

Barron, B., Martin, C. K., & Roberts, E. (2007). Sparking self-sustained learning: Report on a design experiment to build technological fluency and bridge divides. *International Journal of Technology and Design Education, 17*(1), 75-105.

Bentata, Y. (2020). The COVID-19 pandemic and international federation of medical students' association exchanges: Thousands of students deprived of their clinical and research exchanges. *Medical Education Online, 25*, 1-3.

Bowen, K., Barry, M., Jowell, A., Maddah, D., & Alami, N. H. (2021). Virtual exchange in global health: An innovative educational approach to foster socially responsible overseas collaboration. *International Journal of Educational Technology in Higher Education, 18*. https://doi.org/10.1186/s41239-021-00266-x

Bovill, C., Jordan, L., & Watters, N. (2015). Transnational approaches to teaching and learning in higher education: Challenges and possible guiding principles. *Teaching in Higher Education, 20*(1), 12-23. https://doi.org/10.1080/13562517.2014.945162

Braun, V., & Clarke, V. (2012). Thematic analysis. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology, Vol. 2. Research designs: Quantitative, qualitative, neuropsychological, and biological* (pp. 57–71). American Psychological Association.

Bustamante, C. (2019). TPACK and teachers of Spanish: Development of a theory-based joint display in a mixed methods research case study. *Journal of Mixed Methods Research, 13*(2), 163-178.

Chen, S., Basma, D., Ju, J., & Ng, K. (2020). Opportunities and challenges of multicultural and international online education. *The Professional Counselor, 10*(1), 120-132.

Creswell, J. W. (2014). *A concise introduction to mixed methods research*. Sage.

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research*. Sage.

Dai, K., & Garcia, J. (2019). Intercultural learning in transnational articulation programs: The hidden agenda of Chinese students' experiences. *Journal of International Students, 9*(2), 362-383. https://doi.org/10.32674/jis.v9i2.677

Dai, K., Matthews, K. E., & Reyes, V. (2020a). Chinese students' assessment and learning experiences in a transnational higher education programme. *Assessment & Evaluation in Higher Education, 45*(1), 70-81. https://doi.org/10.1080/02602938.2019.1608907

Dai, K., Matthews, K. E., & Renshaw, P. (2020b). Crossing the 'bridges' and navigating the 'learning gaps': Chinese students learning across two systems in a transnational higher education programme, *Higher Education Research & Development, 39*(6), 1140-1154.

Fang, S., Lu, Y., & Zhang, G. (2023). External and internal predictors of student satisfaction with online learning achievement. *Online Learning, 27*(3), 339-362.

Feng, Y. (2013). University of Nottingham Ningbo China and Xi'an Jiaotong-Liverpool University: Globalization of higher education in China. *Higher Education, 65*, 471-485.

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs – Principles and practices. *Health Services Research, 48*(6), 2134-2156.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education model. *The Internet and Higher Education, 2*(2–3), 87–105. doi:10.1016/S1096-7516(00)00016-6

Gemmell, I., & Harrison, R. (2017). A comparison between national and transnational students' access of online learning support materials and experience of technical difficulties on a fully online distance learning Master of Public Health programme. *Open Learning, 32*(1), 66-80.

Guetterman, T., Creswell, J. W., & Kuckartz, U. (2015). Using joint displays and MAXQDA software to represent the results of mixed methods research. In M. T. McCrudden, G. Schraw, & C. Buckendahl (Eds.), *Use of visual displays in research and testing: Coding, interpreting, and reporting data* (pp. 145–175). Information Age Publishing.

Han, S., & Resta, P. E. (2020). Virtually authentic: Graduate students' perspective changes toward authentic learning while collaborating in a virtual world. *Online Learning, 24*(4), 5 -27. https://doi.org/10.24059/olj.v24i4.2326

Heng, T. T. (2018). Coping strategies of Chinese international undergraduates in response to challenges in U.S. colleges. *Teachers College Record, 120*(2), 1-42. Retrieved from http://www.tcrecord.org/Content.asp?ContentId=21989

Hu, M., Eisenchlas, S. A., & Trevaskes, S. (2019). Factors affecting the quality of transnational higher education in China: A qualitative content analysis on Chinese host universities' self-appraisal reports. *Journal of Higher Education Policy and Management, 41*(3), 306-321.

Howard, W., Perrotte, G., Lee, M., & Frisone, J. (2017). A formative case evaluation for the design of an online delivery model providing access to study abroad activities. *Online Learning, 21*(3), 115-134. doi: 10.24059/olj.v21i3.1234

IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.

Jackson, J., & Chen, X. (2018). Discussion-based pedagogy through the eyes of Chinese international exchange students. *Pedagogies: An International Journal*, *13*(4), 289-307.

Jiang, H., Atiquil Islam, A. Y. M., Gu, X., & Spector, J. M. (2021). Online learning satisfaction in higher education during the COVID-19 pandemic: A regional comparison between Eastern and Western Chinese universities. *Education and Information Technologies*. https://doi.org/10.1007/s10639-021-10519-x

Knight, J. (2016). Transnational education remodelled: Towards a common TNE framework and definitions. *Journal of Studies in International Education, 20*(1), 34-47.

Krpec, O., Ocelík, P., & Smekal, H. (2017). Narrowing the divide: Perspectives on the future of mixed methods report from central and eastern Europe. *Journal of Mixed Methods Research, 11*(1), 14-16.

Lee, J., Leibowitz, J., Rezek, J., Millea, M., & Saffo, G. (2022). The impact of international virtual exchange on student success. *Journal of International Students, 12*(S3), 77-95. https://doi.org/10.32674/jis.v12iS3.4593

Liao, K. Y., & Wei, M. (2014). Academic stress and positive affect: Asian value and self-worth contingency as moderators among Chinese international students. *Cultural Diversity and Ethnic Minority Psychology, 20*(1), 107-115.

Liao, W., Prejean, E., & Parker, C. (2020). Relying on agile management to develop an international exchange and dual degree program and navigate the COVID-19 pandemic. *Journal of Phi Beta Delta Honor Society for International Scholars, 9*(2), 1-19.

Lin, X., & Gao, L. (2020). Students' sense of community and perspectives of taking synchronous and asynchronous online courses. *Asian Journal of Distance Education, 15*(1), 169-179.

Lin, X. (2022). First-time Chinese online students' expectations of their instructors in fully online learning environments. *Online Learning, 26*(4), 347-368. https://doi.org/10.24059/olj.v26i4.3117

Liu, Y., & Shirley, T. (2021). Without crossing a border: Exploring the impact of shifting study abroad online on students' learning and intercultural competence development during the COVID-19 pandemic. *Online Learning, 25*(1), 182-194. https://doi.org/10.24059/olj.v25i1.2471

Luo, H., & Yang, C. (2022). Pedagogical benefits of Chinese–American virtual exchange: A study of student perceptions. *ReCALL, 34*(1), 37-50.

Luyt, I. (2013). Bridging spaces: Cross-cultural perspectives on promoting positive online learning experiences. *Journal of Educational Technology Systems, 42*(1), 3-20.

Molina-Azorin, J. F., & Fetters, M. D. (2019). Building a better world through mixed methods research. *Journal of Mixed Methods Research, 13*(3), 275-281.

Moufahim, M., & Lim, M. (2015). The other voices of international higher education: An empirical study of students' perceptions of British university education in China. *Globalisation, Societies and Education, 13*(4), 437-454.

Moussa, N. M. (2021). International students' achievements and adaptation to the United States' culture. *Qualitative Research Journal, 21*(4), 498-512.

Newsome, L. K., & Cooper, P. (2016). International students' cultural and social experiences in a British university: "Such a hard life [it] is here." *Journal of International Students, 6*(1), 195-215.

O'Dowd, R. (2021). What do students learn in virtual exchange? A qualitative content analysis of learning outcomes across multiple exchanges. *International Journal of Educational Research, 109*. https://doi.org/10.1016/j.ijer.2021.101804

Oyarzun, B., Barreto, D., & Conklin, S. (2018). Instructor social presence effects on learner social presence, achievement, and satisfaction. *TechTrends, 62*, 625-634.

Phan, A. (2023). Immobility in mobility during COVID-19: Reflections on "being stuck" in the home country of an international doctoral student. *Journal of International Students, 13*(1), 85-93.

Qin, Y. Y., & Te, A. Y. C. (2016). Cross-border higher education in China: How the field of research has developed. *Chinese Education & Society, 49,* 303–323. doi:10.1080/10611932.2016.1237851

Ren, X., & Zhou, Y. (2022). Chinese undergraduate students' learning experiences in a transnational distance education program in the United States. *American Journal of Distance Education*. https://doi.org/10.1080/08923647.2022.2119019

Safipour, J., Wenneberg, S., & Hadziabdic, E. (2017). Experience of education in the international classroom: A systematic literature review. *Journal of International Students, 7*(3), 806-824.

Senyshyn, R. M. (2019). A first-year seminar course that supports the transition of international students to higher education and fosters the development of intercultural communication competence. *Journal of Intercultural Communication Research, 48*(2), 150-170.

Soszynski, P. (2022). Learning ecology of music teachers' TPACK. *Technology, Pedagogy, and Education, 31*(1), 85-102. https://doi.org/10.1080/1475939X.2021.1968943

Stewart, W. H. (2019). The complexity of transnational distance students: A review of the literature. *Open Praxis, 11*(1), 23-39.

Stewart, W. H., & Kim, B. (2021). Commitment to academic exchanges in the age of COVID-19: A case study of arrival and quarantine experiences from the Republic of Korea. *Journal of International Students, 11*(S2), 77-93.

Stewart, W. H., & Lowenthal, P. R. (2021). Experiences and perceptions of exchange students learning online during the COVID-19 pandemic in the Republic of Korea: An exploratory descriptive study. *Asian Journal of Distance Education, 16*(1), 119-140.

Taber, K. S. (2018). The use of Cronbach's Alpha when developing and reporting research instruments in science education. *Research in Science Education, 48*, 1273-1296.

Tang, Y. M., Chen, P. C., Law, K. M. Y., Wu, C. H., Lau, Y., Guan, J., He, D., & Ho, G. T. S. (2021). Comparative analysis of student's live online learning readiness during the coronavirus (COVID-19) pandemic in the higher education sector. *Computers & Education, 168*. https://doi.org/10.1016/j.compedu.2021.104211

Wang, Y., Liu, X., & Zhang, Z. (2018). An overview of e-learning in China: History, challenges, and opportunities. *Research in Comparative & International Education, 13*(1), 195-210.

Watson, S. L., Watson, W. R., Richardson, J., & Loizzo, J. (2016). Instructor's use of social presence, teaching presence, and attitudinal dissonance: A case study of an attitudinal change MOOC. *International Review of Research in Open and Distributed Learning, 17*(3), 54-74.

Weaver, G. C., Hiltebrand, G., Ngai, G., & Chan, S. (2022). Faculty perceptions of building collaborative teaching capacities within a transnational virtual exchange: A collaborative autoethnography. *Journal of International Students, 12*(S3), 135-148.

Wilczewski, M., Gorbaniuk, O., Mughan, T., & Wilczewska, E. (2022). The effects of online learning experience during the COVID-19 pandemic on students' satisfaction, adjustment, performance, and loyalty. *Journal of International Students, 12*(3), 694-715.

Wilkins, S., & Juusola, K. (2018). The benefits & drawbacks of transnational higher education: Myths and realities. *Australian Universities' Review, 60*(2), 68-76.

Willis, M. (2010). Reaching out to the west: An assessment of Chinese students' views regarding foreign-delivered university programs in China. *Journal of Teaching in International Business, 21*, 53-68.

Yang, R. (2008). Transnational higher education in China: Contexts, characteristics, and concerns. *Australian Journal of Education, 52*(3), 272-286.

Yu, J. (2021). Consuming UK transnational higher education in China: A Bourdieusian approach to Chinese students' perceptions and experiences. *Sociological Research Online, 26*(1), 222-239.

Zhang, M. (2022). Using WeChat to communicate with Chinese exchange students. *China Media Research, 18*(1), 84-100.

Zhang, W., Wang, Y., Yang, L., & Wang, C. (2020). Suspending classes without stopping learning: China's education emergency management policy in the COVID-19 outbreak. *Journal of Risk and Financial Management, 13*(3). https://www.mdpi.com/1911-8074/13/3/55

A Systematic Literature Review of Online Academic Student Support in Higher Education

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Abstract
COVID-19 led to an increase in online higher education courses. With this increase in demand, there needs to be online support to foster students' academic success. Online academic student support is often provided to students to assist them in developing the skills and knowledge to successfully complete their courses. However, it remains unclear whether online academic student support in higher education is successful, and if so, what makes it successful. This systematic literature review seeks to provide an overview of research on online academic student support in higher education. Out of 5385 initially identified publications from 2013 to 2022, 12 papers were included for review; seven studies were quantitative and five were mixed-methods studies. The synthesis of the findings reported outcomes on students' improved engagement, access to support and usage patterns, satisfaction, academic performance, motivation, creativity, self-efficacy, retention or course completion, and social benefits. This range creates a challenge for higher education providers who consider implementing best practice in the provision of online academic student support due to the diversity of approaches. Future research that is methodologically strong is needed to demonstrate the impact of online academic student support detailing how higher education providers can improve the quality, learning outcomes, and retention of students.

Keywords: Online higher education, online academic student support, systematic review

Walsh, C., Bragg, L.A., Heyeres, M., Yap, A., & Ratcliff, M. (2024). A Systematic Literature Review of Online Academic Student Support in Higher Education. *Online Learning, Volume 28*(2), (427-450). DOI: 10.24059/olj.v28i2.3954

The rapid, global pivot to online educational delivery in higher education because of the COVID-19 pandemic was both abrupt and unprecedented (Dhawan, 2020; Hume & Griffin, 2022; Lee et al., 2022; Martin, 2020; Organisation for Economic Co-operation and Development, 2020). Critically, this pivot happened at a time when many providers were struggling to deliver high-quality online educational experiences to students and experiencing higher attrition rates for online courses compared to on-campus (Delnoij et al., 2020; Roddy et al., 2017). The scale of the rapid change and the need to digitise teaching, learning, and vocational training has transformed these sectors for the foreseeable future (García-Morales et al., 2021; Hume & Griffin, 2021; Lockee, 2021). Post-COVID-19, the widespread acceptance of online study has led providers to reimagine how online teaching and learning can be delivered (Croucher & Locke, 2020) with new models of personalised and responsive academic student support available at a point of need (Rotar, 2022; Walsh et al., 2020).

Globally, higher education providers have struggled to provide high-quality online education that incorporates instructional and experimental design features (Chen et al., 2021; Morris & König, 2020) that lead to positive student-level outcomes, including constructive student interpersonal interactions with academics and other students, personalised learning environments, and highly responsive student support (Bernard et al., 2009; Jaggars & Xu, 2016; Kim & Thayne, 2015; Thistoll & Yates, 2016; Walsh et al., 2020). As a result, high attrition (Haydarov et al., 2013; Moore & Greenland, 2017; Oregon et al., 2018; Patterson & McFadden, 2009; Simpson, 2012) and low student completion rates (Li & Wong, 2019) remain a challenge for the sector.

Historically and currently, attrition rates are high for online students when compared to on-campus students across higher education (Billett et al., 2020; Boton & Gregory, 2015; Grau-Valldosera et al., 2018; Greenland & Moore, 2014; Hall & Harvey, 2021; Kember et al., 2023; Moore & Greenland, 2017; Nieuwoudt, 2020). High attrition rates represent a substantial revenue loss for providers (Greenland & Moore, 2022) and providers face an adaptive and transformative challenge to better understand how to provide effective practices of facilitating online academic student support that improves student academic outcomes and leads to a reduction in attrition rates. To facilitate a timely and responsive approach to the successful delivery of online academic student support in higher education, this systematic literature review synthesises research over the last ten years on the effectiveness of online academic student support and provides an evidence-based overview of reported practices that result in productive learning outcomes in online higher education and new directions for future research.

The paper is structured as follows. The background provides an overview of online academic student support, of its need and value, and of the theoretical constructs that justify this review. The methods section describes the procedure for conducting this review, including the data selection process and the methodological steps followed to analyse the quality of the selected papers. The results section is structured according to the research questions to present the findings, categorisations, and analysis of data. The discussion summarizes evidence and identifies research gaps and limitations, and the conclusion makes suggestions for future research that explores new ways to incorporate online academic student support into the provision of higher education.

Background

An extensive desktop scoping search was conducted to establish whether a systematic literature review on online academic student support in higher education, including vocational education, was warranted. Existing literature reviews of online academic student support vary in terms of methodology and focus. Ardekani et al. (2021) conducted a literature review on academic and mental health support systems for undergraduate medical students during the COVID-19 pandemic. While students and faculty members seemed receptive to new systems of support, most of the ten included studies provided program descriptions rather than evaluations. A systematic review by Gray and Crosta (2019) on best practices in online doctoral supervision identified the following three themes that affected the perceived quality of supervision: enculturation, emancipation, and healthy relationships. The perspectives were mined from 100+ studies of online and face-to-face supervision and included varying qualitative and quantitative study designs and 16 literature reviews. Muljana and Luo's (2019) "systematic literature review investigated the underlying factors that influenced the gap between the popularity of online learning and its completion rate" (p. 19). Their findings revealed several aspects of online learning experiences that affected retention. The student retention strategies Muljana and Luo put forth included "early interventions, at-all-times support for students, effective communication, support for faculty teaching online classes, high-quality instructional feedback and strategies, guidance to foster positive behavioural characteristics, and collaboration" (p. 20). A scoping review by Tan et al. (2021) examined 61 articles for student perspectives towards online instruction and found that students' positive and negative perceptions were strongly related to "quality instruction, online interaction, and instructional and technical support" (p. 1). Other reviews focused on artificial intelligence (AI) application in higher education (Zawacki-Richter et al., 2019) or learning analytics benefits, challenges, and efficacy (Knobbout & Van Der Stappen, 2020; Sønderlund et al., 2019).

Methodologically, some of these reviews lacked scientific rigour. Critically, none of the reviews included a thorough quality appraisal with validated appraisal tools to ensure conclusions were drawn from high-quality scientific research. Given the findings of our scoping search and the scale and speed with which higher education courses moved online because of the COVID-19 pandemic—caught many educational institutions off guard—this systematic review is warranted because it provides an overview of the most recent best-practice evidence on online academic student support in higher education settings. Further, it provides an appraisal of the quality of the included studies to ensure conclusions were drawn only from methodologically sound studies. The following research questions were asked:

RQ1. What are the key characteristics of the studies included in the review?

RQ2. What student outcomes are reported across the studies included in this review, and how do they vary across different types of student support?

RQ3. What is the methodological design quality of the included studies as assessed by the Critical Appraisal Skills Programme (CASP) and the Effective Public Health Practice Project (EPHPP) quality appraisal tools?

Definition and Scope of Online Academic Student Support in Online Higher Education

In this systematic literature review, online higher education is defined as post-secondary education provided by universities (undergraduate and postgraduate levels), vocational education providers (certificate, diploma, and bachelor's degree levels), and other education providers (e.g., business schools and niche providers that offer accredited courses). Online academic student support, for the purpose of this review, is tightly focused on online academic support services. Our definition of online academic student support is grounded in an e-learning systems theory framework (Aparicio et al., 2016)) that identifies people, technologies, and services. "Services are considered here as the main output, as they operationalize instructional strategies and several pedagogical models" (p. 302) Online academic support services are designed to assist students with their assignments, facilitate their learning, guide them in finding study resources, and help them develop new skills. While these online services can complement the learning support already embedded in the curriculum, they can be delivered both synchronously (in real-time) and asynchronously (not in real-time, such as through pre-recorded materials or resources). Other approaches to supporting students may come from mechanisms such as heuristics in the Customer Relationship Management (CRM) systems that use learning analytics to prompt academics to reach out to students (Walsh et al., 2020), learning management systems (LMS), and artificial intelligence (AI).

Methods

Before commencing the systematic review, a research protocol was established, circulated among all authors, and discussed until consensus was achieved. The inclusion / exclusion criteria as described in the protocol were adjusted in February 2023 to better manage the large volume of search results. The refined criteria are described in the next section.

Inclusion Criteria

Included were peer-reviewed journal articles that focused on models of student support in higher education settings, published between 2013 and 2022, in the English language. We included publications on educational trials, program/intervention evaluations, case studies, and research reports. Papers with student and teacher outcomes were included where the predominant focus was on students. Papers on student experiences were included where they focused on the online support received and not general online learning experiences. Support provided via social networking sites was included if the support was formalised through the higher education provider.

Exclusion Criteria

Papers were excluded if their focus was on informal learning groups, computer-assisted learning (CAL), blended learning, hybrid learning, flipped classroom, or exclusively face-to-face learning support. Theoretical and descriptive papers were excluded due to the absence of data and tangible real-world outcomes. This decision ensures that our analysis remains methodologically consistent and directly applicable to higher education settings, thereby enhancing the robustness and relevance of our findings. Exclusion criteria were carefully chosen to prioritise data-driven evidence and to maintain the study's practicality.

Search Strategy

The Population, Intervention, Comparison and Outcomes (PICO) tool (Methley et al., 2014) was utilised to establish and organise the main concepts underpinning the research questions and, together with an expert librarian in the field of education, we meticulously developed a comprehensive and well-structured search strategy. This strategy was designed to ensure that our literature search would be thorough, effective, and aligned with the identified research questions.

Sources for the national and international peer-reviewed literature included Emerald Insight, Academic Search Elite, ERIC ProQuest, Informit A+ Education, SAGE, Scopus, Web of Science, EBSCO, and Google Scholar. Databases were searched with the terms below. Search strings consisted of these terms in different variations to accommodate database specific requirements and sensitivities:

- higher education OR vocational education OR adult education OR adult learning
- online support OR online student support OR online learning support OR online student learning support OR online support models OR online academic support
- responsive OR responsive learning environments OR online higher education learning environments
- learning analytics OR artificial intelligence (AI) OR learning management system OR LMS

Sources for grey literature included government and non-government organisations, and education service provider websites. To complete the exploration, a hand search of reference lists of relevant literature was performed. Initial searches were completed in May 2022 and updated in February 2023.

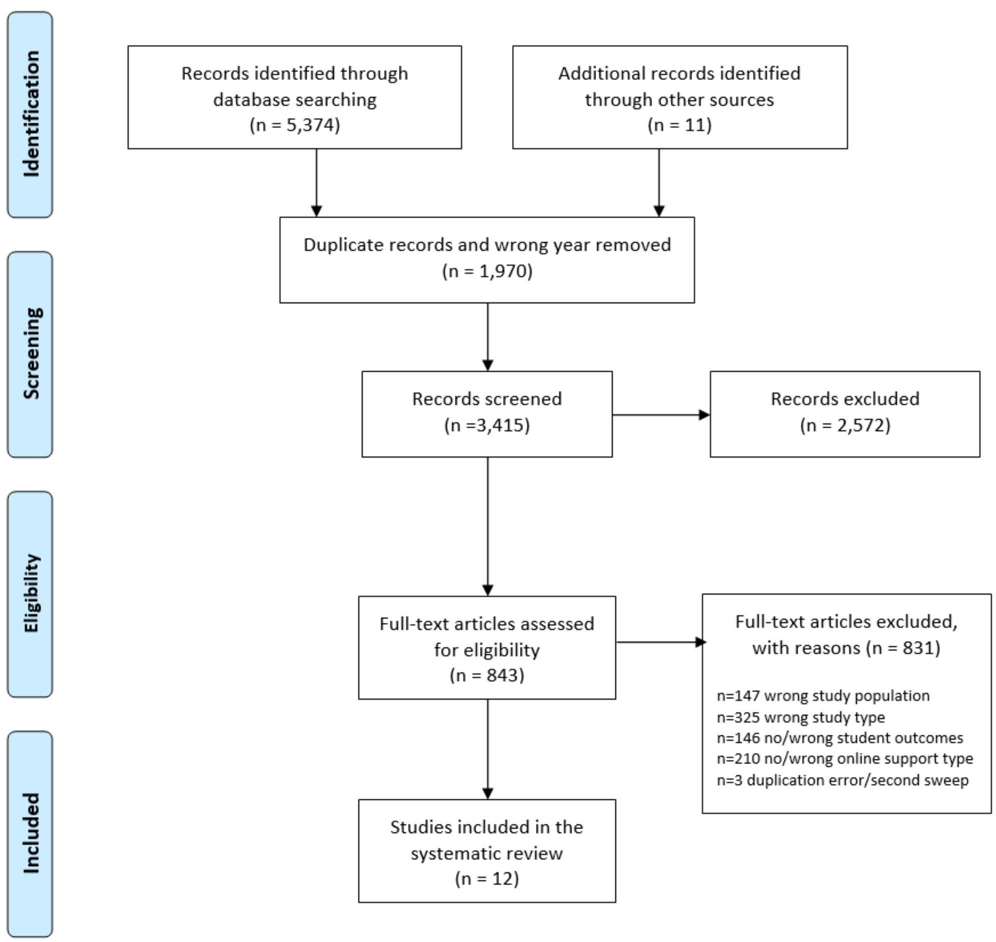
Figure 1 *Preferred Reporting Items for Systematic Reviews and Meta-Analyses [PRISMA] Flow Diagram*

Data Management

One author performed all searches and exported the results into the referencing management software program, EndNote X9. Duplicates and any papers published outside the range of years were removed. All steps of this process were documented in an Excel spreadsheet to ensure transparency and replicability. Once this process was completed, all items were exported into SysRev, a web-based data curation platform (Bozada Jr et al., 2021) to begin the collaborative processes of screening and data extraction.

Study Selection

The process used for the study selection is detailed in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses [PRISMA] Flow Diagram (Figure 1) (Page et al., 2021). The same author who undertook all searches assumed the first step of the study selection process, which comprised the screening of titles and, if necessary, abstracts, to determine relevance. The remaining papers were divided equally among the five authors. The second step of the screening process was strictly guided by a list of pre-defined inclusion criteria. Each item was independently screened by two different reviewers to determine eligibility against the inclusion



criteria. Any conflicts were resolved through discussion among the authors until consensus was achieved. In a small number of cases, a third author was consulted to arbitrate.

Data Extraction and Analysis

Time and resource constraints necessitated that data extraction be largely conducted by one author; however, to ensure high-quality systematic review practices, we satisfied the Cochrane Collaboration recommendations in these circumstances (Higgins et al., 2022) by having the data of the reported outcomes extracted by two independent reviewers. In cases where results differed, a discussion followed until consensus was achieved. The study characteristics are presented and described in tabular form (Appendix 1) followed by thematic analysis.

Study Quality Appraisal

Two different tools were utilised to assess the methodological quality of the quantitative and mixed methods studies. All studies were assessed with the Effective Public Health Practice Project (2009) (EPHPP) Quality Assessment Tool for Quantitative Studies. While initially developed for the evaluation of studies in health research, this tool (plus its accompanying dictionary) was chosen for its comprehensive set of design components which are equally relevant in education research studies: selection bias, study design, confounders, blinding, data collection methods, withdrawals and dropouts, intervention integrity, and analyses. The qualitative components of the mixed-methods studies were subjected to the Critical Appraisal Skills Programme (2018) (CASP) Qualitative Research Checklist. The CASP tool assesses the applicability, reliability, and validity of published qualitative research, according to a series of ten questions concerned with the aim of the research, methodology, research design, recruitment strategy, data collection, relationships between researcher and participants, ethical considerations, data analysis, findings, and the value of the research. The methodological quality of the included studies was independently assessed by all five authors; each study was assessed by two reviewers. Results were compared and discussed until consensus was achieved.

Results

Combined searches yielded a total of 5385 records. After the removal of duplicates and irrelevant items, 839 records remained for full-text assessment, of which 12 studies met the inclusion criteria. Reasons for exclusion included studies focused on the wrong study population (teachers, wrong age group, primary or secondary students, etc.) (n=147), wrong study type (conference papers and reports without student outcomes, opinion pieces, news articles, program descriptions, conceptual papers, papers on course design, etc.) (n=325), reported no or the wrong student outcomes (papers on support seeking behaviour, perceptions about online social presence, needs analyses, etc.) (n=146) either did not focus on online support or focused on the wrong support type (online learning material offered, informal learning groups, support offered in blended learning or flipped classroom mode, etc.) (n=210), (n=3) and a second sweep for duplication errors.

RQ1. What are the key characteristics of the studies included in the review?

Study Characteristics

The study characteristics included the first author, year, country of origin, study aims, sample size, population, study settings, data collection methods, type of analysis, study design, type and details of online academic student support provided, and the reported outcomes (Appendix 1).

Year Published and Country of Origin

The number of published studies increased after 2017, with five studies published in 2021, three in 2020, followed by two studies in 2019 and one study each in 2017 and 2016. Four studies originated from the US, two from China, and one each from South Africa, Hungary, UK, West Indies, Indonesia, and Thailand.

Study Aims

Five studies investigated the extent to which online academic student support provided achieved measurable outcomes, including student performance, grades, or achievements (Table 1). Improved content knowledge or learning was the focus of two of these five studies. Five studies collected student views on their experiences and their satisfaction with the institutional support provided. Three studies investigated the effects of student support on student engagement (n=1), retention (n=1), or social integration (n=1). Other studies collected information on student perceptions of self-efficacy (n=1), and preferences between face-to-face and online support (n=1). Note: three papers had more than one aim; therefore, the total number of aims exceeds the number of papers.

Table 1

Study Aims and Authors

Aims	Number of studies and first author
Online academic student support provided achieved measurable outcomes (e.g., student performance, grades, achievements, or learning)	5 = Bognár; Luo; Oluwafolakemi; Park; Richardson
Satisfaction and perceptions of institution support	5 = Mulyono; Trespalacios; Ulla; van Wyk; Walters-Archie
Student engagement	1 = He
Retention	1 = Eaton
Social integration	1 = Eaton
Student perceptions of self-efficacy	1 = Trespalacios
Preferences between face-to-face and online support	1 = Richardson

Sample

The smallest sample size was 33 and the largest comprised over 60,000 students. Three studies fell in the category of 0-99 participants, five studies between 100-499, two studies between 1,000-5,000, and two studies > 10,000 students.

Study Setting and Population

All studies were concerned with online support provided to either undergraduate students, postgraduate students, or a combination of both enrolled in university courses. No studies were concerned with students enrolled in vocational courses. Of these population groups, students were taking courses in Humanities (n=1), English language (n=2), Education/Adult Education (n=3), Statistics or Research Methods (n=3), and 20th Century Literature (n=1), and academic/scientific reading and writing (n=2).

Data Collection

Five of the studies collected data from multiple sources and seven from a singular source. The type of data sources included independent web-based online platforms (n=2), LMS data (n=5), surveys (n=5), questionnaires (n=4), and interviews (n=2).

Study Design and Type of Analysis

Seven studies were quantitative and the rest (n=5) were mixed-methods studies. Descriptive statistics were the most frequently used type of analysis (n=9) for quantitative data, followed by statistical tests (n=5); some studies used both methods. The most used analysis for qualitative data included thematic analysis (n=5), and content analysis (n=1). Control groups were reported in three studies.

Type and Details of Online Support

Student support was either provided asynchronously (n=9) or both synchronously and asynchronously (n=3). While all studies provided varying forms of academic support, two of them provided pre-course support during student orientation. Online academic student support investigated across all studies made use of learning management systems such as Moodle or Blackboard to provide a variety of support tools. Quizzes to enhance student reflection and success were discussed in one study and made available through the institution's LMS. Communication tools included discussion forums (n=4), social media (n=5), messaging (n=3), email (n=3), videos (n=2), conferencing tool (n=2), chatbot (n=1), phone calls (n=1), shared database (n=1), open education resources (n=1), blogs (n=1), announcements (n=1), academic advising (n=1), and dynamic summative material (n=1).

RQ2. What student outcomes are reported across the studies included in this review, and how do they vary across different types of student support?

Outcomes

Outcomes were reported across the studies and varied significantly across the types in the areas of engagement (n=6), student support access or usage patterns (n=5), satisfaction (n=4), academic performance (n=2), motivation (n=1), creativity (n=1), self-efficacy, including the ability to navigate online technology (n=3), retention or course completion (n=2), and social benefits (n=3). These reported outcomes are detailed below.

<u>Engagement and Motivation</u>

He et al. (2019) found a significant positive correlation between the use of online learning support (OLS), service types (LMS messages, chatbot for after-hours, and dynamically updated weekly summaries), and student engagement. However, when the number of OLS services used exceeded a certain range, there was no correlation in terms of video utilisation.

Oluwafolakemi et al. (2021) reported that students in Harbin found their peer-to-peer learning activities—facilitated by social media—did support their online learning. Compared with Blackboard discussion forums, Luo et al. (2019) confirmed that Twitter was an effective support to engage students. Trespalacios et al. (2021) reported high levels of student self-efficacy in interacting academically with classmates and instructors. WhatsApp and Facebook groups were perceived as useful forms of learning support types (Mulyono et al., 2021; Ulla & Perales, 2021) as they increased feelings of connectedness with peers, were seen as source of motivation, and fostered creativity and independent learning.

Access and Usage Patterns

Bognár et al. (2021) and He et al. (2019) found that students tended to access online academic student support (quizzes and other online learning services) more frequently closer to module exams with a sharp drop in usage after (He et al., 2019). Oluwafolakemi et al. (2021) noted that approximately 60% of the participants used social media for peer-to-peer learning interactions daily within their peer-assisted learning cluster before the transition. Peers at The Federal University of Technology, Akure (FUTA) in Nigeria used a variety of types of student support in their peer-to-peer learning interaction, while those in universities in Harpin (China) mainly used social media. There was a stark increase in the frequency of learning interaction among students in universities in Harpin but students in FUTA could not make this quick transition due to institutional and infrastructural challenges (Oluwafolakemi et al., 2021). According to Luo et al. (2019), students who used Twitter for peer-to-peer learning participated more actively through this support type than in the Blackboard discussion forums. Most students published their tweets in response to question prompts while searching and reading their peers' tweets (Luo et al., 2019). Comparing online with face-to-face support, Richardson (2016) found that students with and without disabilities were equally likely to choose online support rather than face-to-face support.

Student Satisfaction

Luo et al. (2019) reported students that used Twitter rated the application highly across all domains of their perceived learning experience. Similarly, students that accessed WhatsApp and Facebook types of student support reported high levels of satisfaction (Mulyono et al., 2021; Ulla & Perales, 2021). van Wyk (2020) found that student teachers were satisfied and experienced the academic support tools accessed through the LMS as positively applied to their online learning. The discussion forum was rated as the most appropriate academic support e-tool in the course during the COVID-19 lockdown. Walters-Archie (2017) reported that 80% of students were aware of the support services being provided. The first three phases of the online orientation were seen to be the most beneficial (94%). Tips posted by course delivery assistants (CDAs) were considered useful types of support by 56% of the students, and excellent by 36% of the students. Over half of the students found types of email support (60%) and Skype support (65%) to be good and a smaller percentage (22% and 9% respectively), excellent (Walters-Archie, 2017). Student feedback collected by Trespalacios et al. (2021) illustrated that most students (83%) rated program-specific academic advising as an important type of support with most of them (76%) being satisfied with the information provided. Other feedback pertained to an increased feeling of safety during the COVID-19 pandemic as the Facebook group prevented students from the possibility of catching the virus, and its convenience of accessing the learning support (Ulla & Perales, 2021).

Academic Performance

Compared to students who accessed types of online support, excluding quizzes, Bognár et al. (2021) reported that the more frequently and more often students self-quizzed when approaching graded tests, the higher the grades they achieved. Students who received excellent grades self-quizzed 2-3 times more than those who received satisfactory grades and these students self-quizzed 2-3 times more than those who failed. Time and energy invested in self-quizzing are reflected in the results achieved at the end of the learning period with the best results using self-quizzing and self-reflection, regardless of baseline abilities (Bognár et al., 2021). In a performance analysis course, Park and Robinson (2021) reported "the average score of students was higher when students received more feedback and comments from an academic coach than less feedback and comments in the performance analysis course. Students who had an academic coach in the adult education class performed better than those who did not have a coach" (p. 70). Richardson (2016) reported no differences in grades and course completion in students, with and without disabilities, who selected face-to-face or online support types. "There was a non-significant tendency for students with disabilities to achieve a lower pass rate than students without disabilities with face-to-face support, whereas with online support their pass rate was marginally higher than that of students without disabilities" (Richardson, 2016, p. 83). Luo et al. (2019) reported "students perceived Twitter to be helpful in articulating their understanding of the course material and in enhancing critical thinking. They also reported that they had fun using Twitter as a discussion tool for reflective learning." (p. 40).

Retention and Course Completion

Bognár et al. (2021) reported that most full-time students who completed the quizzes 100 to 150 times achieved the 70 points required to complete the course while there was many correspondence students (even though they had 500 attempts and more) who did not achieve course completion. According to Eaton and Cates (2020), student engagement with the university-sponsored types of social media including Facebook, Yammer, and Blackboard was significantly associated with higher scores in student retention.

Social Benefits

In terms of social benefits, three studies reported types of support that increased students' sense of community: belonging (Eaton & Cates, 2020), social interaction with classmates, and connectedness with peers (Mulyono et al., 2021; Trespalacios et al., 2021).

Navigation of Online Technology

An increased ability to navigate technology was described by two studies. Compared to the Blackboard discussion forums, students found academic support from Twitter (now X) easier and faster to follow conversations and find others' opinions to review and discuss (Luo et al., 2019). Trespalacios et al. (2021) reported on students' increased ability to complete an online course and specifically handle LMS tools.

RQ3. What is the methodological design quality of the included studies as assessed by the CASP and EPHPP quality appraisal tools?

Study Quality Appraisal

All 12 included studies were assessed with the EPHPP tool and the qualitative components of five were assessed with the CASP tool to determine the methodological design quality of the 12 included studies.

Quantitative Studies

Seven of the 12 included studies were fully quantitative and therefore assessed only with the EPHPP tool. The final rating of all quantitative studies was weak. However, in the individual domain of selection bias, three of these papers showed moderate adherence to this section, which meant that participants were seen to be somewhat likely to represent the target population and between 60% and 79% of the selected individuals agreed to participate in the study (He et al., 2019; Oluwafolakemi et al., 2021; van Wyk, 2020). Data collection methods were another area where five of the weak papers achieved strong results, as the authors described these methods to be valid and/or reliable (Eaton & Cates, 2020; Luo et al., 2019; Mulyono et al., 2021; Trespalacios et al., 2021; van Wyk, 2020).

Mixed-Methods Studies

The remaining five papers were mixed-methods studies. While assessments of quantitative data with the EPHPP tool resulted in final weak ratings, results of the CASP assessment of the qualitative components of these studies resulted in four strong ratings (Luo et al., 2019; Trespalacios et al., 2021; Ulla & Perales, 2021; van Wyk, 2020), and one moderate rating (Walters-Archie, 2017). Walters-Archie (2018) did not achieve a strong CASP rating because too little information was provided on the recruitment strategy and the value of the research.

Discussion

The purpose of this review was to systematically examine the literature on effective practices of facilitating online academic student support in online higher education with particular attention paid to the studies' characteristics, reported outcomes, and methodological quality. In the following section, we discuss and summarize evidence and limitations followed by a conclusion that provides an interpretation of the results. Three broad research questions were specified in relation to our study objectives.

Summary of Evidence

RQ1 investigated the key characteristics of studies included in the review. Study characteristics were described and presented in tabular form and included the first author, year, country of origin, study aims, sample size, population, study setting, data collection methods, type of analysis, study design, type and details of online academic student support provided, and reported outcomes (Appendix 1). Despite an exhaustive search, our literature review did not uncover studies of the use of online academic student support in vocational education settings.

RQ2 explored student outcomes as reported across the studies included in this review, and how they vary across different types of student support. Student outcomes across these studies and support types included improved academic outcomes (Bognár et al., 2021; Luo et al., 2019; Park & Robinson, 2021; Richardson, 2016), student satisfaction with the institutional resources and general support (Luo et al., 2019; Trespalacios et al., 2021; van Wyk, 2020; Walters-Archie, 2017), greater student engagement and retention (Bognár et al., 2021; Eaton &

Cates, 2020; He et al., 2019; Luo et al., 2019; Oluwafolakemi et al., 2021; Trespalacios et al., 2021), social benefits (Eaton & Cates, 2020; Mulyono et al., 2021; Trespalacios et al., 2021; Ulla & Perales, 2021), increased student motivation and self-efficacy (Luo et al., 2019; Mulyono et al., 2021; Trespalacios et al., 2021; Ulla & Perales, 2021), improved creativity and independent learning (Ulla & Perales, 2021) and a determination of students' support preferences (Bognár et al., 2021; He et al., 2019; Luo et al., 2019; Oluwafolakemi et al., 2021; Richardson, 2016). WhatsApp and Facebook groups were perceived as useful types of learning support because they fostered a sense of connectedness, enhanced students' creativity, and provided a space for free exploration and motivation to learn independently (Mulyono et al., 2021; Ulla & Perales, 2021). Other feedback pertained to an increased feeling of safety during the COVID-19 pandemic, as the Facebook group prevented students from the possibility of catching the virus, and its convenience of accessing the online learning support (Ulla & Perales, 2021).

Unsurprisingly, with such diverse outcomes across these studies, the types of student support differed in their approach to addressing online students' needs. The results illustrate that one type of student support cannot cater to the multifaceted needs of higher education students and their institutions. Online academic student support is multidimensional and higher education and vocational education providers must define desired outcomes of student support before implementing online academic student support practices.

What is clear from the systematic review is that online academic student support makes a tangible difference regardless of the type of support when it comes to improved academic outcomes and student satisfaction. Given that improved academic outcomes, student satisfaction, and increased engagement often lead to lower attrition rates for a delivery mode that is historically plagued by high attrition rates, it is timely for higher education providers to rethink the provision of online academic student support, given the increasing enrolments into fully online programs globally (Albert et al., 2021; Morris et al., 2020). Considering so many higher education students are already using social media and multiplatform messaging apps, our findings suggest these types of academic student support may be an advantageous starting point for higher education providers when considering implementing online academic student support (McLaughlin & Sillence, 2023).

RQ3 investigated the methodological design quality of the included studies as assessed by the CASP and EPHPP quality appraisal tools. Methodologically, all seven quantitative studies rated weak, as were the quantitative part of the remaining five mixed-methods studies. However, the qualitative part of four mixed-method studies was rated strong and one moderate (Table 2). This suggests that the five mixed-method studies better conceptualized, designed, and executed their qualitative research aspects. The four strong and one moderate ratings are indicative of well-defined research questions, suitable sampling methods, rigorous data collection procedures, and in-depth analysis of the qualitative elements. Nonetheless, the utilization of the EPHPP tool, specifically tailored for quantitative research, revealed a consistent "weak" rating across all twelve studies assessed. This uniform result raises significant concerns about the methodological rigor of these studies. Such a consistent trend suggests potential systemic issues in the way educational research is conducted within the domain of online student support. The findings emphasize an urgent need for heightened scrutiny and a call for enhanced methodological designs in future quantitative inquiries in the field of online academic student support.

Table 2

Study Quality Appraisal

Publication	Research type	Total score EPHPP	Total score CASP
Bognár	Quantitative	weak	N/A
Eaton	Quantitative	weak	N/A
He	Quantitative	weak	N/A
Mulyono	Quantitative	weak	N/A
Oluwafolakemi	Quantitative	weak	N/A
Park	Quantitative	weak	N/A
Richardson	Quantitative	weak	N/A
Luo	Mixed methods	weak	strong
Trespalacios	Mixed methods	weak	strong
Ulla	Mixed methods	weak	strong
Van Wyck	Mixed methods	weak	strong
Walters- Archie	Mixed methods	weak	moderate

Commonalities in student support practices (Table 3) were noted in that all studies reported support embedded within the LMS, though five were linked to external social media platforms (Eaton & Cates, 2020; Luo et al., 2019; Mulyono et al., 2021; Oluwafolakemi et al., 2021; Ulla & Perales, 2021). All support practices were delivered asynchronously with only three of the 12 studies making use of both synchronous and asynchronous support practices (Trespalacios et al., 2021; van Wyk, 2020; Walters-Archie, 2017). Asynchronous student support practices reflect the rise, and possibly the acceptance, of online delivery of courses. The rapid shift to online delivery because of the COVID-19 pandemic is an expected trend that will stay in higher education for the foreseeable future, thus requiring a reimagining of online delivery (Croucher & Locke, 2020). Going forward, asynchronous support will be essential to cater for online teaching and learning to meet the students' support demands at their point of need. Studies have shown that regular structured support for learners increases program satisfaction (Gregori et al., 2018; Pélissier, 2019).

Table 3

Online Student Support Practices

	Online student support provided			
	via LMS	External social media platforms	Asynchronously	Synchronously and asynchronously
Bognár	x		x	
Eaton	x	x	x	
He	x		x	
Luo	x	x	x	
Mulyono	x	x	x	

Oluwafolakemi	x	x	x	
Park	x		x	
Richardson	x		x	
Trespalacios	x		x	x
Ulla		x	x	
Van Wyck	x		x	x
Walters- Archie	x		x	x

Limitations

The systematic literature review's validity may be compromised at both the study and outcome levels. This review's selection criteria included a quality appraisal of the methodology at the study level. The quality appraisal revealed that the research on facilitating student support in higher education courses examined in this study were not methodologically strong. There was a complete absence of papers focusing on online academic support in vocational education that matched our inclusion criteria. Consequently, 12 studies were selected for this review. The selection criteria were comprehensive and the validity of the review's reported conclusions regarding the outcomes reflect the design of methodologically rigorous studies. A limitation in the outcomes is that eight of the 12 reported outcomes (Bognár et al., 2021; Eaton & Cates, 2020; Mulyono et al., 2021; Oluwafolakemi et al., 2021; Park & Robinson, 2021; Trespalacios et al., 2021; Ulla & Perales, 2021; van Wyk, 2020) were published from studies after 2020 when a rapid shift enforced an unplanned change to online education as a result of the COVID-19 pandemic.

Identified Research Gaps

While this review yielded significant findings, it did have several drawbacks. Previous studies that were systematically reviewed explained student outcomes without a thorough quality appraisal with validated appraisal tools to ensure that conclusions were drawn from high-quality scientific research. Future research on online academic student support that is methodologically strong can provide greater insight to educational providers who are considering implementing academic support to improve aspects of the online higher educational provision. Online teaching and academic student support in vocational education are insufficiently researched, yet there has been a steady increase in online vocational education offerings by polytechnic institutes, dual-sector universities, and registered training organisations. Like online higher education students, online vocational education students experience high attrition rates when compared to on-campus students (Billett et al., 2020; Boton & Gregory, 2015; Grau-Valldosera et al., 2018; Greenland & Moore, 2014; Hall & Harvey, 2021; Moore & Greenland, 2017; Nieuwoudt, 2020).

Conclusion

This systematic review of the literature is the first to evaluate the effective practices of facilitating online academic student support in higher education, including vocational education. We identified a sizable body of research that had not been formally evaluated systematically to understand and draw conclusions on best practices in online academic student support with a particular focus on student outcomes. Outcomes reported are significant for the higher education sector because they lead to students' improved access to support, engagement, satisfaction, academic performance, motivation, creativity, self-efficacy including one's ability to navigate technology, retention or course completion, and social benefits. As online education continues to take on an increasingly larger role in the delivery of higher education, it is important to understand what practices of online academic student support are effective in each context, as well as how online academic student support is offered and its take-up amongst students. Even though conclusions cannot be drawn, the findings suggest that online academic student support has the potential to successfully overcome high attrition rates (Ali & Smith, 2015; Wang et al., 2019) and low satisfaction rates of online programs (Fish & Snodgrass, 2015; Gray & DiLoreto, 2016) that can negatively impact student satisfaction and a higher education provider's revenue generation.

Future Research Recommendations

This review provides a stimulus for exploring new ways to incorporate online academic student support into the provision of higher education. Conversely, this review has revealed there is more to learn about how providing online academic student support can potentially improve or reverse students' feelings about lack of belonging or connection (Canty et al., 2020; Jackson et al., 2010), social isolation (George et al., 2021; Joyner et al., 2020; Kaufmann & Vallade, 2020) and disconnectedness from other students, staff and the institution (Canty et al., 2020; Kember et al., 2021). Future exploration of online academic student support is critical in enhancing the successful provision of higher education in a post-COVID-19 landscape. This systematic review is beneficial for supporting education providers in a rapidly changing educational landscape where more students, from even more diverse backgrounds, will enroll in online degrees. Many of these students will not experience higher education and vocational education on campus, and to ameliorate high attrition rates and low satisfaction, research into online academic student support is warranted.

The exploration of online academic student support that leads to positive student outcomes is ripe for future consideration. This systematic review of the literature has focused on the practices of online academic student support outcomes, however, with the rapid growth of online learning, exploration of the transferability of online academic student support could be examined for its suitability and engagement with high school students who are increasingly able to attend higher education. The lack of studies that focus exclusively on vocational education to establish what the sector is doing in terms of providing online academic student support is concerning, as providers are not equipped to understand and enact practices that have the potential to increase student satisfaction and turn around high attrition rates.

Declarations

Availability of data and material

The datasets generated and/or analysed during the current study are available in the SysRev https://sysrev.com/

Funding

This work was supported by The Victorian State Government (Australia) – Victorian Higher Education State Investment Fund (Victoria University Education Innovation Hub, 2021).

References

Albert, S., Fulton, D., Ramanau, R., & Janes, A. (2021). Exploring cross-disciplinary differences in course mode, instructional tools and teaching methods in online courses in business & management. *The International Journal of Management Education, 19*(3). https://doi.org/10.1016/j.ijme.2021.100532

Ali, A., & Smith, D. (2015). Comparing social isolation effects on students attrition in online versus face-to-face courses in computer literacy. *Issues in Informing Science and Information Technology, 12*(1), 11-20. https://iisit.org/Vol12/IISITv12p011-020Ali1784.pdf

Aparicio, M., Bacao, F., & Oliveira, T. (2016). An e-learning theoretical framework. *Journal of Educational Technology & Society, 19*(1), 292-307.

Ardekani, A., Hosseini, S. A., Tabari, P., Rahimian, Z., Feili, A., Amini, M., & Mani, A. (2021). Student support systems for undergraduate medical students during the COVID-19 pandemic: A systematic narrative review of the literature. *BMC Medical Education, 21*(1), 1-11. https://doi.org/10.1186/s12909-021-02791-9

Bernard, R. M., Abrami, P. C., Borokhovski, E., Wade, C. A., Tamim, R. M., Surkes, M. A., & Bethel, E. C. (2009). A meta-analysis of three types of interaction treatments in distance education. *Review of Educational Research, 79*(3), 1243-1289. https://doi.org/10.3102/0034654309333844

Billett, S., Choy, S., & Hodge, S. (2020). Enhancing the standing of vocational education and the occupations it serves: Australia. *Journal of Vocational Education & Training, 72*(2), 270-296. https://doi.org/10.1080/13636820.2020.1751247

Bognár, L., Fauszt, T., & Váraljai, M. (2021). The impact of online quizzes on student success. *International Journal of Emerging Technologies in Learning (iJET), 16*(11), 225-244. https://doi.org/10.3991/ijet.v16i11.21679

Boton, E. C., & Gregory, S. (2015). Minimizing attrition in online degree courses. *Journal of Educators Online, 12*(1), n1. https://files.eric.ed.gov/fulltext/EJ1051044.pdf

Bozada Jr, T., Borden, J., Workman, J., Del Cid, M., Malinowski, J., & Luechtefeld, T. (2021). SysRev: A FAIR platform for data curation and systematic evidence review. *Frontiers in Artificial Intelligence,* 105. https://doi.org/10.3389/frai.2021.685298

Canty, A. J., Chase, J., Hingston, M., Greenwood, M., Mainsbridge, C. P., & Skalicky, J. (2020). Addressing student attrition within higher education online programs through a collaborative community of practice. *Journal of Applied Learning & Teaching, 3*(Sp. Is), 1-12. https://doi.org/10.37074/jalt.2020.3.s1.3

Chen, C., Landa, S., Padilla, A., & Yur-Austin, J. (2021). Learners' experience and needs in online environments: Adopting agility in teaching. *Journal of Research in Innovative Teaching & Learning, 14*(1). https://doi.org/10.1108/JRIT-11-2020-0073

Critical Appraisal Skills Programme. (2018). *CASP Qualitative Research Checklist* https://casp-uk.net/wp-content/uploads/2018/01/CASP-Qualitative-Checklist-2018.pdf

Croucher, G., & Locke, W. (2020). *A post-coronavirus pandemic world: some possible trends and their implications for Australian Higher Education* [Discussion paper]. https://melbourne-cshe.unimelb.edu.au/__data/assets/pdf_file/0010/3371941/a-post-coronavirus-world-for-higher-education_final.pdf

Delnoij, L. E., Dirkx, K. J., Janssen, J. P., & Martens, R. L. (2020). Predicting and resolving non-completion in higher (online) education–A literature review. *Educational Research Review, 29*, 100313. https://doi.org/10.1016/j.edurev.2020.100313

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems, 49*(1), 5-22. https://doi.org/10.1177/0047239520934

Eaton, G., & Cates, S. (2020). Is utilization of university-sponsored social media associated with increased social integration and retention among online students? An examination of social media as a moderator of student retention. *Journal of College Student Retention: Research, Theory & Practice, 0*(0), 1-27. https://doi.org/10.1177/1521025120965231

Effective Public Health Practice Project. (2009). *Quality assessment tool for quantitative studies*. http://www.ephpp.ca/tools.html

Fish, L. A., & Snodgrass, C. R. (2015). Business student perceptions of online versus face-to-face education: Student characteristics. *Business Education Innovation Journal, 7*(2), 83-96. http://www.beijournal.com/images/V7N2_final.pdf#page=83

García-Morales, V. J., Garrido-Moreno, A., & Martín-Rojas, R. (2021). The transformation of higher education after the COVID disruption: emerging challenges in an online learning scenario. *Frontiers in Psychology, 12*, 616059. https://doi.org/10.3389/fpsyg.2021.616059

George, A.-J., McEwan, A., & Tarr, J.-A. (2021). Accountability in educational dialogue on attrition rates: Understanding external attrition factors and isolation in online law school. *Australasian Journal of Educational Technology, 37*(1), 111-132. https://doi.org/10.14742/ajet.6175

Grau-Valldosera, J., Minguillón, J., & Blasco-Moreno, A. (2018). Returning after taking a break in online distance higher education: From intention to effective re-enrollment. *Interactive Learning Environments, 27*(3), 307-323. https://doi.org/10.1080/10494820.2018.1470986

Gray, J. A., & DiLoreto, M. (2016). The effects of student engagement, student satisfaction, and perceived learning in online learning environments. *International Journal of Educational Leadership Preparation, 11*(1), n1. https://eric.ed.gov/?id=EJ1103654

Gray, M. A., & Crosta, L. (2019). New perspectives in online doctoral supervision: A systematic literature review. *Studies in Continuing Education, 41*(2), 173-190. https://doi.org/10.1080/0158037X.2018.1532405

Greenland, S. J., & Moore, C. (2014). Patterns of student enrolment and attrition in Australian open access online education: A preliminary case study. *Open Praxis, 6*(1), 45-54. https://doi.org/10.5944/openpraxis.6.1.95

Greenland, S. J., & Moore, C. (2022). Large qualitative sample and thematic analysis to redefine student dropout and retention strategy in open online education. *British Journal of Educational Technology, 53*(3), 647-667. https://doi.org/10.1111/bjet.13173

Gregori, E. B., Zhang, J., Galván-Fernández, C., & de Asís Fernández-Navarro, F. (2018). Learner support in MOOCs: Identifying variables linked to completion. *Computers & Education, 122*, 153-168. https://doi.org/10.1016/j.compedu.2018.03.014

Gregory, M. S.-J., & Lodge, J. M. (2015). Academic workload: The silent barrier to the implementation of technology-enhanced learning strategies in higher education. *Distance Education, 36*(2), 210-230. https://doi.org/10.1080/01587919.2015.1055056

Hall, M., & Harvey, B. (2021). *Methodological approaches for projecting completion rates for apprentices and trainees*. National Centre for Vocational Education Research. https://www.ncver.edu.au/__data/assets/pdf_file/0034/9668401/Methodological_approaches_for_projecting_completion_rates_for_apprentices_and_trainees.pdf

Haydarov, R., Moxley, V., & Anderson, D. (2013). Counting chickens before they are hatched: An examination of student retention, graduation, attrition, and dropout measurement validity in an online master's environment. *Journal of College Student Retention: Research, Theory & Practice*, *14*(4), 429-449. https://doi.org/10.2190/CS.14.4.a

He, H., Zheng, Q., Di, D., & Dong, B. (2019). How learner support services affect student engagement in online learning environments. *IEEE Access*, *7*, 49961-49973. https://doi.org/10.1109/ACCESS.2019.2910589

Higgins, J. P., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (2022). *Cochrane handbook for systematic reviews of interventions* version 6.3 (updated February 2022*)*. Cochrane. https://training.cochrane.org/handbook/current

Hume, S., & Griffin, T. (2021). *The online delivery of VET during COVID-19: part 1*. National Centre for Vocational Education Research (NCVER). https://files.eric.ed.gov/fulltext/ED615346.pdf

Hume, S., & Griffin, T. (2022). *The online delivery of VET during the COVID-19 pandemic: part 2*. National Centre for Vocational Education Research (NCVER). https://www.ncver.edu.au/__data/assets/pdf_file/0031/9671053/The_online_delivery_of_VET_during_the_COVID-19_pandemic__part_2.pdf

Jackson, L. C., Jones, S. J., & Rodriguez, R. C. (2010). Faculty actions that result in student satisfaction in online courses. *Journal of Asynchronous Learning Networks, 14*(4), 78-96. https://files.eric.ed.gov/fulltext/EJ909918.pdf

Jaggars, S. S., & Xu, D. (2016). How do online course design features influence student performance? *Computers & Education, 95*, 270-284. https://doi.org/10.1016/j.compedu.2016.01.014

Joyner, D. A., Wang, Q., Thakare, S., Jing, S., Goel, A., & MacIntyre, B. (2020, August 12-14). *The synchronicity paradox in online education* [Conference paper]. The 7th ACM Conference on Learning@ Scale, Virtual Event, United States. https://dl.acm.org/doi/pdf/10.1145/3386527.3405922

Kaufmann, R., & Vallade, J. I. (2020). Exploring connections in the online learning environment: student perceptions of rapport, climate, and loneliness. *Interactive Learning Environments*, 1-15. https://doi.org/10.1080/10494820.2020.1749670

Kember, D., Leung, D., & Prosser, M. (2021). Has the open door become a revolving door? The impact on attrition of moving from elite to mass higher education. *Studies in Higher Education, 46*(2), 258-269. https://doi.org/10.1080/03075079.2019.1629411

Kember, D., Trimble, A., & Fan, S. (2023). An investigation of the forms of support needed to promote the retention and success of online students. *American Journal of Distance Education*, 37(3), 169-184.

Kim, Y., & Thayne, J. (2015). Effects of learner–instructor relationship-building strategies in online video instruction. *Distance Education, 36*(1), 100-114. https://doi.org/10.1080/01587919.2015.1019965

Knobbout, J., & Van Der Stappen, E. (2020). Where is the learning in learning analytics? A systematic literature review on the operationalization of learning-related constructs in the evaluation of learning analytics interventions. *IEEE Transactions on Learning Technologies, 13*(3), 631-645. https://doi.org/10.1109/TLT.2020.2999970

Lee, K., Fanguy, M., Bligh, B., & Lu, X. S. (2022). Adoption of online teaching during the COVID-19 pandemic: A systematic analysis of changes in university teaching activity. *Educational Review*, 1-24. https://doi.org/10.1080/00131911.2021.1978401

Li, K. C., & Wong, B. T.-M. (2019). Factors related to student persistence in open universities: Changes over the years. *International Review of Research in Open and Distributed Learning, 20*(4), 132-151. https://doi.org/10.19173/irrodl.v20i4.4103

Lockee, B. B. (2021). Online education in the post-COVID era. *Nature Electronics, 4*(1), 5-6. https://doi.org/10.1038/s41928-020-00534-0

Luo, T., Shah, S. J., & Cromptom, H. (2019). Using Twitter to support reflective learning in an asynchronous online course. *Australasian Journal of Educational Technology, 35*(3). https://doi.org/10.14742/ajet.4124

Martin, L. (2020). *Foundations for good practice: the student experience of online learning in Australian higher education during the COVID-19 pandemic*. https://files.eric.ed.gov/fulltext/ED610395.pdf

McLaughlin, C. J., & Sillence, E. (2023). Buffering against academic loneliness: The benefits of social media-based peer support during postgraduate study. *Active Learning in Higher Education*, 24(1), 63-76. https://doi.org/10.1177/1469787418799185

Methley, A. M., Campbell, S., Chew-Graham, C., McNally, R., & Cheraghi-Sohi, S. (2014). PICO, PICOS and SPIDER: A comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. *BMC health services research, 14*(1), 1-10. https://doi.org/10.1186/s12913-014-0579-0

Morris, N. P., Ivancheva, M., Coop, T., Mogliacci, R., & Swinnerton, B. (2020). Negotiating growth of online education in higher education. *International Journal of Educational Technology in Higher Educatio*n, *17*(48), 1–16. https://doi.org/10.1186/s41239-020-00227-w

Moore, C., & Greenland, S. (2017). Employment-driven online student attrition and the assessment policy divide: An Australian open-access higher education perspective. *Journal of Open, Flexible and Distance Learning, 21*(1), 52-62. https://files.eric.ed.gov/fulltext/EJ1148193.pdf

Morris, T. H., & König, P. D. (2020). Self-directed experiential learning to meet ever-changing entrepreneurship demands. *Education + Training, 63*(1), 23-49. https://doi.org/10.1108/ET-09-2019-0209

Muljana, P. S., & Luo, T. (2019). Factors contributing to student retention in online learning and recommended strategies for improvement: A systematic literature review. *Journal of Information Technology Education: Research*, *18*, 19-57. https://doi.org/10.28945/4182

Mulyono, H., Suryoputro, G., & Jamil, S. R. (2021). The application of WhatsApp to support online learning during the COVID-19 pandemic in Indonesia. *Heliyon*, *7*(8), e07853. https://doi.org/10.1016/j.heliyon.2021.e07853

Nieuwoudt, J. E. (2020). Investigating synchronous and asynchronous class attendance as predictors of academic success in online education. *Australasian Journal of Educational Technology, 36*(3), 15-25. https://doi.org/10.14742/ajet.5137

Oluwafolakemi, G. A., Hongtao, Y., & Ayodeji, A. A. (2021). Leveraging integrated peer-assisted learning clusters as a support for online learning. *Interactive Learning Environments*, 1-13. https://doi.org/10.1080/10494820.2021.1943454

Oregon, E., McCoy, L., & Carmon-Johnson, L. (2018). Case analysis: Exploring the application of using rich media technologies and social presence to decrease attrition in an online graduate program. *Journal of Educators Online*, *15*(2), n2. https://files.eric.ed.gov/fulltext/EJ1186019.pdf

Organisation for Economic Co-operation and Development. (2020). *The potential of online learning for adults: Early lessons from the COVID-19 crisis*. OECD Publishing. https://www.voced.edu.au/content/ngv:87762

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., & Brennan, S. E. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *International Journal of Surgery,* 88, 105906. https://doi.org/10.1016/j.jclinepi.2021.03.001

Park, S., & Robinson, P. A. (2021). The effect of online academic coaches on supporting graduate students' performance in intensive online learning environments: A three-course comparison. *European Journal of Training and Development*. https://doi.org/10.1108/EJTD-10-2020-0144

Patterson, B., & McFadden, C. (2009). Attrition in online and campus degree programs. *Online Journal of Distance Learning Administration, 12*(2), 1-8. https://ojdla.com/archive/summer122/patterson112.pdf

Pélissier, C. (2019). *Learner support in online learning environments*. John Wiley & Sons.

Richardson, J. T. E. (2016). Face-to-face versus online tutorial support in distance education: Preference, performance, and pass rates in students with disabilities. *Journal of Postsecondary Education and Disability, 29*(1), 83-90. https://files.eric.ed.gov/fulltext/EJ1107475.pdf

Roddy, C., Amiet, D. L., Chung, J., Holt, C., Shaw, L., McKenzie, S., Garivaldis, F., Lodge, J. M., & Mundy, M. E. (2017). Applying best practice online learning, teaching, and support to intensive online environments: An integrative review. *Frontiers in Education, 2:59*. https://doi.org/10.3389/feduc.2017.00059

Rotar, O. (2022). Online student support: A framework for embedding support interventions into the online learning cycle. *Research and Practice in Technology Enhanced Learning, 17*(1), 1-23. https://doi.org/10.1186/s41039-021-00178-4

Simpson, O. (2012). *Supporting students for success in online and distance education* (3 ed.). Taylor & Francis Group.

Sønderlund, A. L., Hughes, E., & Smith, J. (2019). The efficacy of learning analytics interventions in higher education: A systematic review. *British Journal of Educational Technology, 50*(5), 2594-2618. https://doi.org/10.1111/bjet.12720

Tan, K. H., Chan, P. P., & Mohd Said, N. (2021). Higher education students' online instruction perceptions: A quality virtual learning environment. *Sustainability, 13*(19), 10840, 1-24. https://doi.org/10.3390/su131910840

Thistoll, T., & Yates, A. (2016). Improving course completions in distance education: An institutional case study. *Distance Education, 37*(2), 180-195. https://doi.org/10.1080/01587919.2016.1184398

Trespalacios, J., Uribe-Flórez, L., Lowenthal, P. R., Lowe, S., & Jensen, S. (2021). Students' perceptions of institutional services and online learning self-efficacy. *American Journal of Distance Education*, 1-15. https://doi.org/10.1080/08923647.2021.1956836

Ulla, M. B., & Perales, W. F. (2021). Facebook as an integrated online learning support application during the COVID19 pandemic: Thai university students' experiences and perspectives. *Heliyon, 7*(11), e08317. https://doi.org/10.1016/j.heliyon.2021.e08317

Van Wyk, M. M. (2020). Academic support under COVID-19 lockdown: What students think of online support e-tools in an ODeL course. *Interactive Technology and Smart Education*. https://doi.org/10.1108/ITSE-08-2020-0121

Walsh, C., Mital, A., Ratcliff, M., Yap, A., & Jamaleddine, Z. (2020). A public-private partnership to transform online education through high levels of academic student support. *Australasian Journal of Educational Technology, 36*(5), 30-45.

Walters-Archie, A. (2017). Academic support for online students in the English-speaking Caribbean at the University of the West Indies Open Campus. *Journal of Further and Higher Education, 42*(6), 868-878. https://doi.org/10.1080/0309877X.2017.1332353

Wang, W., Guo, L., He, L., & Wu, Y. J. (2019). Effects of social-interactive engagement on the dropout ratio in online learning: Insights from MOOC. *Behaviour & Information Technology, 38*(6), 621-636. https://doi.org/10.1080/0144929X.2018.1549595

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education: Where are the educators? *International Journal of Educational Technology in Higher Education, 16*(1), 1-27. https://doi.org/10.1186/s41239-019-0171-\