Introduction to *Online Learning* Volume 24, Issue 1

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Our first issue of 2020 contains 13 articles in three sections. These papers are included in sections on student and faculty issues and concerns, as well as a collection of other empirical studies investigating online learning environments from a variety of theoretical and methodological approaches.

The first section includes four papers on faculty, professional development, and online teaching. This section begins with "Examining How Online Professional Development Impacts Teachers' Beliefs about Teaching Statistics" by Hollylynne Lee and Gemma Mojica of North Carolina State University and Jennifer Lovett of Middle Tennessee State University. In this study the authors are concerned with improving the teaching of statistics through online professional development provided through a Massive Open Online Course (MOOC). The data is drawn from 412 participants in the MOOC who identified themselves as classroom teachers. The central questions of the study center on identifying elements of the MOOC that trigger critical reflection and evidence that engaging in the MOOC influenced teachers' beliefs, perspectives, and practices in teaching statistics. The paper identifies aspects of the MOOC that hold promise in promoting positive change in teacher beliefs and practices.

The second paper in this section is "Facilitation Matters: Instructor Perception of Helpfulness of Facilitation Strategies in Online Courses" by Florence Martin, Chuang Wang, and Ayesha Sadaf of the University of North Carolina, Charlotte. In an earlier study some of these authors found online instructors' roles can be categorized as facilitator, course designer, course manager, subject matter expert, and mentor. This paper seeks to flesh out the role of facilitator by first reviewing the literature on facilitation and then presenting a result of a faculty survey. The results, from 100 online instructors, identify what they deem the most and least helpful facilitation strategies that were identified in the literature.

The next paper is "Social Media Learning Activities (SMLA): Implications for Design" by Ghania Zgheib of the University of Balamand, Lebanon, and Nada Dabbagh of George Mason University. There can be little doubt that our students are very engaged in social media use and that many instructors are exploring its educational applications. The author of this paper review promising research in this area and conclude that there is consensus on the benefits of social media use for learning. However, we need to better understand principles that can effectively guide SMLA design going forward. The paper investigates the types of learning activities designed through social media, the knowledge and cognitive processes they promote, and strategies experienced faculty use to design SMLAs.

The fourth paper in this issue is "Shifting Teaching and Learning in Online Learning Spaces: An Investigation of a Faculty Online Teaching and Learning Initiative" by Jayson Richardson and John Eric Lingat of the University of Kentucky, Ericka Hollis of Regis College,

and Mikah Pritchard of Eastern Kentucky University. This study utilizes the Diffusion of Innovation (DOI) theory to interpret pedagogical changes that occurred as a result of professional development activities and a subsequent year-long faculty learning community and how perceptions of the diffusion of innovations characteristics influence the level of adoption of online/blended teaching. Results of the study indicate that participants most frequently mentioned experiences that refer to DOI components reflecting relative advantage, compatibility, and trialability.

The next section of this issue contains five papers broadly related to students, community, and online learning. This first of these is "From Discussion Forums to eMeetings: Integrating High Touch Strategies to Increase Student Engagement, Academic Performance, and Retention in Large Online Courses" by Glenda Gay of The University of the West Indies at Cave Hill and Kristen Betts of Drexel University. This paper utilizes an action research approach to examine strategies to address issues that can arise in larger format online courses: student disengagement, poor performance, and subsequent dropout. Based on data collected from more than 3,300 students over a six-year period, results indicate the use of the new eMeeting format integrating online high touch strategies, are correlated with significant increases in student engagement and academic performance. Additionally a comparison between the pre- and postintegration data revealed decreases in attrition, and higher scores on the standardized final exam. Course evaluations after the introduction of these strategies also reflect increased student satisfaction with the course. These approaches appear very promising and deserver further study.

The second paper in this section is "Postgraduate Online Teaching in Healthcare: An Analysis of Student Perspectives" by Cuisle Forde and Silvia Gallagher of Trinity College, Dublin. The goal of this study was to understand student perspectives in online health science courses. The main research questions explored in this study related to expectation and concerns healthcare students have before they start a postgraduate online course and their perceptions and experiences during and after the course. The authors to develop a set of recommendations for online educators that can serve as a guide for online course development and facilitation for students in the healthcare field.

The next paper is "Student Preferences for Learning Resources in a Land-based Postgraduate Online Degree Program" by Duncan Royd Slater of Myerscough College, Lancashire and Richard Davies of the University of Central Lancashire. This paper focuses on a newly emerging area of online study: specialized graduate education. Options for providing learning resources for such programs are myriad and understanding which resources and modes of delivery (e.g., text, audio, and video) are deemed useful is an important component of ensuring effectiveness. The study identified three resources currently used in the program that were significantly more favored than the others: online lectures, academic papers, and tutor's viewpoints. Other resources were rated lower. A number of responses showed there was a clear focus on relevant content over medium of delivery. This study demonstrates the importance of context in making decisions regarding the selection of resources for online learning.

The fourth paper in this section is "Factors Influencing Programming Expertise in a Web-based E-learning Paradigm" by Wajid Rafique, Wanchun Dou, and Khurshid Ahmed of Nanjing University and Khalid Hussain of East China University of Science and Technology. This study investigates the challenges of teaching computer programming in an online environment through the lens of the Technology Acceptance Model (TAM). Using data from 460 seniors in an undergraduate computer science program the authors validate and extend the TAM for students

enrolled in computer programming. They conclude that teaching practices, intrinsic factors, perceived usefulness, efficacy problems, and learning intentions are key factors contributing toward programming expertise development in online learning environments. Much more detail is included in the full paper.

The final paper in this section is "Purposeful Interpersonal Interaction: What is it and How is it Measured?" by Scott Mehall of Carlow University. While we can all agree that interaction is an important contributor to learning in online settings, we can also acknowledge that not all interaction promotes learning or processes that contribute to learning. This paper provides an in-depth investigation of the nature of productive interpersonal interaction to promote online learning. The author outlines a framework for purposeful interpersonal interaction characterized by three components: instructional, social, and support. These forms of interaction have been associated with either processes that support learning (a sense of community) or learning itself. The study details the conditions for creating these forms of productive interaction.

The final section of this issue contains four additional empirical studies on a variety of topics. The first paper is "The Role of an Interactive Visual Learning Tool and its Personalizability in Online Learning: Flow Experience" by Young Ha of California State University, Long Beach and Hyunjoo Im of the University of Minnesota, Twin Cities. Flow theory suggests that interactive visual learning tools have a high potential to engage students in learning processes and the effect is greater when the students' ability is close to the task difficulty level. This study tests these hypotheses with two experiments. The first experiment examines the effect of online interactivity on student learning process that manifest as flow experiences. The second experiment investigates whether students' learning experience is enhanced when students are able to match their skill level with the task difficulty through personalization options. Among other findings, the results demonstrate the important role of dynamic, real-time interactivity in improving students' learning by reducing awareness of physical surroundings and increasing flow states.

The next article in this section is "Using Structured Pair Activities in a Distributed Online Breakout Room" by Jeffrey Saltz and Robert Heckman of Syracuse University. Benefits of classroom-based collaborative learning when using breakout rooms include deeper learning, better grades, longer retention of information, greater communication and teamwork skills, and a better understanding of the professional environment in which students will work. How to structure breakout sessions in synchronous online environments is less well documented, especially for coursework in data science. This exploratory study seeks to close that gap by investigating a promising approach: structured pair activities, specifically using a strategy called "paired programming." In pair programming one member of the pair types at the keyboard while the other reviews each line as it is typed, checking for errors and thinking about the overall design. The paper provides observations of structured and unstructured student behaviors in online synchronous breakout rooms to highlight how the approach improves collaborative learning processes and outcomes.

The third paper in this section is "The Validity and Instructional Value of a Rubric for Evaluating Online Course Quality: An Empirical Study" by Ji Eun Lee and Mimi Recker of Utah State University, and Min Yuan of the University of Utah. Rubrics designed to assess the quality of online course design are commonly used in higher education institutions, but few have been empirically tested for reliability or validity. Even fewer have been assessed for their influence on promoting productive online interactions or actual student outcomes (e.g., grades). This paper seeks to address that issue by providing validity and reliability measures for an online course

quality rubric and tying those metrics to learner outcomes (course passing rates). Using data from 121 online courses enrolling 5,240 students, an analysis demonstrates that only rubric items related to learner engagement and interaction have positive effects on online interactions, while only student-content interaction positively influence course passing rates. This paper will be on interest to faculty and instructional designers seeking to improve the quality of online coursework.

The next paper is "A Dramaturgical Examination of Online University Student Practices in a Second Year Psychology Class" by Dawn Marie Gilmore of the Royal Melbourne Institute of Technology, Australia. This study adopts a framework based on Erving Goffman's classic sociological theory which posits metaphors for the presentation of self as being either on the front stage or the backstage. If the Learning Management System (LMS) is conceived as the front stage, then other environments that students use to prepare for their performance in the LMS combine to form the students' backstage learning environment. This study analyzes what students do beyond the LMS and how social media spaces (especially Facebook) preferred by students support social learning and enhance the student experience. In part the paper concludes that some students avoid the front stage discussion board because the audience is too slow, too harsh, and too formal. The backstage online audience in social media solved these drawbacks of the front stage, which made it a more attractive option for learning.

We invite you to read and share this issue with colleagues and to consider submitting your own original work to *Online Learning*.

Examining How Online Professional Development Impacts Teachers' Beliefs About Teaching Statistics

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Abstract
With online learning becoming a more viable option for teachers to develop their expertise, our report shares one such effort focused on improving the teaching of statistics. We share design principles and learning opportunities in an online course developed specifically to serve as a wide-scale online professional development opportunity for educators, thus deemed as a massive open online course for educators (MOOC-Ed). In this report we focus on a subset of 412 participants who identified themselves as classroom teachers. We use multiple data sources, quantitative and qualitative, to characterize changes in teachers' beliefs and perspectives about statistics and identify triggers in the course that appear to influence teachers' sense making about issues related to teaching statistics. Implications about specific course experiences that served as triggers for critical reflection and change are discussed.

Keywords: MOOC teacher training, online professional development, statistics education, beliefs

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Examining How Online Professional Development Impacts Teachers' Beliefs About Teaching Statistics

Innovations in online learning environments and changes in K-12 mathematics curricula have created new opportunities to think creatively for how technological solutions could be used for providing professional development for teachers. Indeed, in 2013 Marrongelle, Sztajn, and Smith proclaimed it was "incumbent on the field to capitalize on emerging technologies in the design and delivery of effective professional development" and emphasized the need for "research that focused on teacher learning in these environments" (p. 208). The past several decades have included an increased emphasis on student-centered, investigative approaches to learning and teaching content within science, technology, engineering, and mathematics (STEM) classrooms (Granger, Bevis, Saka, Southerland, Sampson, & Tate, 2012; National Research Council, 2000). Changes in mathematics standards over the past twenty years have given the topic of *statistics* a prominent place in secondary curricula in the U.S. and many other countries.

Across the globe, platforms, tools, and internet access paved the way for many Massive Open Online Courses (MOOCs) and other distance course offerings related to STEM content, especially statistics. For *learning statistics*, options abound for courses in which a learner can develop knowledge in statistics. Two examples include the Data to Insight course at University of Auckland in New Zealand (www.futurelearn.com/courses/ data-to-insight), and a five course sequence developed at Duke University in the U.S. (www.coursera.org/specializations/statistics). However, online courses designed for *learning to teach STEM content, particularly teaching statistics*, are relatively rare.

Franklin et al. (2015) call for greater attention to the statistical education of teachers, including practicing teachers. Professional development (PD) for secondary mathematics teachers to develop their statistical content and pedagogy are being offered across the world, typically in local small settings in schools or districts. While such efforts may effectively impact the practices of teachers in these small settings, the need for preparing teachers to teach statistics is much bigger than what can be addressed only by local programs. For example, in Germany, Biehler (2016) led development and implementation of PD for secondary teachers that started on a smaller scale and expanded to reach many more math teachers in Germany. Two efforts to offer MOOCs on learning to teach statistics, with very different approaches, have been developed in the U.S. The design of these courses and lessons learned have been shared by Lee and Stangl (2015; 2017). One of these courses, *Teaching Statistics with Data Investigations* (TSDI), is the focus of this paper.

With an online solution at a much larger scale, methods for examining impacts must also evolve. While research on face-to-face PD can examine teachers' development in-situ and their local classroom practices, PD done at a distance online adds challenges for examining such development. We offer a glimpse at one effort to use participants' online activity, forum discussions, and self-reported changes on surveys to measure impact.

Specifically, our focused questions are:

1. Which resources and experiences in the course seem to trigger critical reflection?
2. What evidence is there that engaging in the MOOC-Ed impacted teachers' beliefs and perspectives about teaching statistics, that could in turn impact teaching practices?

Review of Related Literature

The intent of this section is to provide background information critical in the domain of STEM teacher education, especially statistics teacher education. However, we then quickly focus the literature on broader issues of designing online professional learning experiences and how to frame our study to examine impacts of an online PD course for teaching statistics.

Teaching Beliefs, Perspectives, and Practices

The success of reform movements in STEM education are contingent on changes in teachers' classroom practice (Milner, Sondergeld, Demir, Johnson, & Czerniak, 2012). Many researchers in STEM education agree that understanding teachers' beliefs is critical to integrating reforms in classrooms (e.g., Yasar, Baker, Robinson-Kurpius, Krause, & Roberts, 2006) as teachers' beliefs are an important factor in influencing their practice (Grossman, 1990). According to Stipek, Givvin, Salmon, and MacGyvers (2001), most teachers believe mathematics is a static body of knowledge that involves rules and procedures that lead to one right answer, whereas inquiry-

oriented mathematics teachers view mathematics as dynamic and as a tool for problem solving. They found that teachers' beliefs were associated with their classroom practices in predicted directions (i.e., more traditional beliefs were associated with more traditional practices). Caps and Crawford (2012) found that even well-qualified, highly motivated teachers had difficulty enacting reform-based teaching in science; particularly, teachers held limited views of inquiry-based instruction and the nature of science where these perspectives were reflected in their practice. However, there is evidence to suggest that teachers are able to shift from a perspective that learning is about rules and procedures to one of inquiry, investigation, and critical thinking about key STEM concepts (e.g., Seung, Park, & Narayan, 2011). De Vries, Jansen, and Van De Grift (2013) found that the more teachers engaged in continuing PD, the more student-centered they became, shifting from more traditional orientations.

Beliefs and perspectives that teachers may hold specifically related to statistics include ideas about the nature of statistics, about themselves as learners of statistics, and about what they perceive as important goals for students' learning of statistics (e.g., Eichler, 2011; Pierce & Chick, 2011). Statistics beliefs and perspectives include how teachers view themselves as learners of statistics, which often include memories of lessons focused on graphing or using formulas to generate statistical measures, often without the aid of technology (Lovett & Lee, 2017). Such experiences may lead teachers to believe statistics is about performing a set of procedures. However, teachers may also feel that reasoning with context-rich data and uncertainty in statistical claims can make statistics difficult to learn and teach (e.g., Lovett & Lee, 2017; Leavy, Hannigan, & Fitzmaurice, 2013). One's confidence to teach statistics is then influenced by beliefs and perspectives about statistics, prior experiences in learning and teaching statistics, and understanding of statistical content (Lovett & Lee, 2017; Harrell-Williams, Sorto, Pierce, Lesser, & Murphy, 2015).

Teachers' beliefs and confidence levels would likely lead to different teaching practices. For example, if a teacher believes that statistics is a way of quantifying data and that procedures for computing statistical measures lead to such quantification, they may be quite confident in teaching statistics and their teaching practices may favor a focus on statistical procedures. Such teaching would likely have *less* emphasis on the rich contexts of data, the process of ensuring good data is collected and available, and making claims about data that are uncertain in nature (Pierce & Chick, 2011). Eichler (2011) posited that the focus of teachers' intended curriculum in statistics can be considered on a continuum from traditionalists (focused on procedures absent of context), to those wanting students to be prepared to use statistics in everyday life (focused on engaging in an investigative process that is tightly connected to contexts of real data). A goal in statistics teacher PD is to move teachers along this continuum towards a focus on investigative processes, which requires impacting teachers' beliefs about the nature of statistics and learning goals for students related to statistics.

Designing Online Professional Development

Seaton and colleagues (2015) found that teachers (university and K-12) were enrolling in content-focused MOOCs on the edX platform and that they were highly engaged as participants in discussion forums. The teachers, representing only 4% of MOOC participants, contributed 22% of posts in forums. This suggests that an online community in a MOOC may attract and support teachers as they learn new content and pedagogy. Designing PD in a MOOC context, though, should be based on effective practices for teachers' learning, on and offline.

The Conference Board of Mathematical Sciences (2012) recommends that PD engages teachers in solving problems and deeply exploring content in a professional learning community, analyzing authentic student work, and participating in collaborative task design. PD that includes accessible, personalized, and self-directed elements can provide increased opportunities for sustained, collaborative, and meaningful work among teachers that can affect their knowledge, beliefs, and practice (e.g., Vrasidas & Zembylas, 2004). Online PD that addresses the varied needs and abilities of its participants has been shown to be effective in changing teachers' instructional practice (e.g., Renninger, Cai, Lewis, Adams, & Ernst, 2011). Many designers of online PD emphasize that activities should be meaningful, accessible, and relevant so participants can apply their professional learning to their individual educational context (e.g., Luebeck, Roscoe, Cobbs, Diemert, & Scott, 2017; Vrasidas & Zembylas, 2004). While research on impacts of MOOCs often examine click logs as an indicator of whether or not educators are accessing important learning material, Jacobsen's (2019) work clearly illustrates how busy professional educators that appear to have "dropped out" of a PD MOOC indeed accessed and utilized selected resources they perceived as relevant to their educational context that in turn had an impact on their teaching perspectives and practices.

Active learning experiences and peer interactions are hallmarks of most PD experiences for teachers and can help build a community among participants. Just as communities can form in face-to-face PD, online PD should facilitate an online community. Designers of online courses should build infrastructure to support active learning and peer interaction across geographic and time zone boundaries. Within online PD for educators, asynchronous discussion forums, for example, provide opportunities for participants to reflect on practice, exchange ideas, and discuss ways to improve on their own schedules with colleagues with whom they may not otherwise interact (e.g., Treacy, Kleiman, & Peterson, 2002). Researchers have highlighted benefits of such communities that are not always afforded in traditional face-to-face PD. For example, Mackey and Evans (2011) argued that online communities provide members with "extended access to resources and expertise beyond the immediate school environment" (p. 11), thereby offering ongoing PD and the potential for increased application in classrooms. In order to maximize benefits, designers of online PD programs must be creative in building the infrastructure necessary to support such communities, as participants have the challenge of not being physically in the same place when engaging in online activities.

Online Course Context for the Study

In recognizing the potential for MOOCs to serve as large-scale teacher PD, we are part of teams that have created MOOCs for Educators (MOOC-Eds) to assist teachers in developing new strategies for improving teaching and forming local and global communities of educators. While MOOC-Eds have not had the "massive," large-scale enrollment of other MOOCs, they do reach larger numbers of educators than typical online PD courses. MOOC-Eds are intended to attract professional educators who are specifically looking to engage in a free, open online course that is marketed to educators beyond specific geographical boundaries. Thus, the MOOC-Ed effort at the Friday Institute for Educational Innovation at North Carolina State University includes a collection of courses built using research-based design principles of effective PD and online learning (Garet et al., 200; Darling-Hammond et al., 2009) that emphasize: (a) self-directed learning, (b) peer-supported learning, (c) job-connected learning, and (d) learning from multiple voices (Kleiman, Wolf, & Frye, 2015).

In accordance with suggestions from Sztajn (2011) on aspects of PD that are necessary to understand and interpret research results based on PD, we provide details about the intent, learning goals, and specific designs of the TSDI course. The overarching goal of the course is to engage participants in thinking about statistics teaching and learning in ways that are likely different from their current practices in middle school through college-level introductory statistics (http://go.ncsu.edu/tsdi). The course did not focus on a particular grade level or specific statistical content. A major goal was for teachers to be introduced to and use a framework to consider statistics as a four-phase investigative process (pose, collect, analyze, interpret) that incorporates statistical habits of mind, and views learning statistics from a developmental perspective (Franklin et al., 2007).

The course consisted of an orientation unit and five units, each with seven components. The course was open for about 15 weeks to allow for flexibility for participants to engage while managing their busy professional lives. On September 21, 2015 the Orientation and Unit 1 opened. The Orientation unit included an overview video, survey to self-assess their confidence in teaching confidence (i.e., SETS), and a forum in which they could introduce themselves and learn about other participants. Each unit opened in weekly intervals for 4 weeks thereafter, with earlier units always remaining accessible. This allowed participants to start and engage in course material at their own pace. Once Unit 5 opened, the entire course remained active for seven more weeks. Upon closure, participants could still access material and discussion forums in a read-only format (no new posts allowed), though this activity was not included in our analysis.

Each unit began with an *Introduction* video of the instructor highlighting critical aspects of teaching and learning statistics that participants can learn about in the unit. The *Essentials* included materials to read or watch that were created by the course development team or compiled from open online resources (open journal articles, lesson plans, data, videos). Each unit included video of students and teachers engaged in statistics lessons. Teacher educators have shown how impactful video cases depicting learning and teaching in classrooms can be in focusing teachers' learning about pedagogical issues (e.g., Wilson, Lee, & Hollebrands, 2011; Sherin & Van Es, 2005). However, when rich examples were available in statistics education literature, animated illustrations of real students' work were created (using tools like Go Animate or Powtoon) that represented students' statistical reasoning and use of technology tools. Such animations have been shown to be an effective way to include artifacts of practice in teacher education materials (e.g., Herbst, Chazan, Chen, Chieu, & Weiss, 2011; Chazan, 2018). The teachers and students in videos also brought in multiple voices that are closest to the practice of teaching.

Self-directed and job-connected learning opportunities often included a selection of statistics tasks for different grade levels (to provide choice) to engage teachers in doing statistics in ways likely different than what they have experienced before (Franklin, et al., 2015; Stein & Smith, 1998). These tasks included *Dive into Data* experiences for participants to use free technology tools (e.g., Gapminder, Tuva, CODAP, GeoGebra simulations) or import data into their favorite data analysis tools. These active learning experiences allowed teachers to experience investigative statistics tasks using tools accessible in their schools and connected them to relevant and free sources of data. For example, in Unit 4, Dive into Data uses the Census at School website and asked teachers to download data and engage in a cycle of statistical investigation. *Extensions* include extra material (e.g., datasets, lesson plans, brief articles, applets, videos) to explore content and resources of interest that may be useful in their own teaching context. Again, these extension materials provide opportunities for self-directed learning.

The design principle of learning from multiple voices also guided the decision for each unit to include a video of an Expert Panel discussion with the instructor and 3 experts in statistics education. The conversations in these videos brought forth practical experiences and research-based suggestions in a conversational tone where listeners could feel they were part of the conversation. Peer-supported learning is a cornerstone of the MOOC-Ed experience to provide focused and ample opportunities for participants to connect with and support one another (e.g., Borko, 2004). Each unit contains two discussion forums: (a) a forum focused on discussing a specific *Pedagogical Investigation* about aspects of teaching statistics (e.g., analyzing statistics tasks, considering students' approaches to statistics tasks through video clips), and (b) a forum where participants *Discuss with Colleagues* about unit materials or other ideas related to teaching statistics.

Because of its importance in the course, we provide details about a critical framework integrated across the course. Frameworks can assist teachers in applying content and strategies learned in PD to their own instructional practices (Franke, Carpenter, Levi, Fennema, 2001; Boston & Smith, 2011). Building upon an existing framework (Franklin et al., 2007), the development team incorporated recent research on students' statistical thinking and productive statistical habits of mind (e.g., Burrill & Biehler, 2011; Wild & Pfannkuch, 1999). A habit of mind is developed when a person approaches situations in similar ways so they develop a more general heuristic over time (Cuoco, Goldenberg, & Mark, 1996). The new framework, Students' Approaches to Statistical Investigations (SASI), needed a variety of learning materials and opportunities for participants to develop an understanding of its importance and potential ways it can influence their classroom practices. Both a static and interactive version of a diagram was created to communicate the investigative cycle, reasoning in each phase at three levels of sophistication, and an indication of productive habits of mind (Figure 1). Two brief documents described the framework and how to apply it to task design. In a video, the instructor illustrated the framework using example student work, and other videos featured expert discussions and interviews, including one expert statistics educator illustrating the development of the concept of mean across levels of sophistication. Participants could also engage in a simulation task and watch two animated video illustrations of students' work that highlighted how students approach an investigation using different levels of sophistication. See Appendix for a list of URLs to these openly accessible resources.

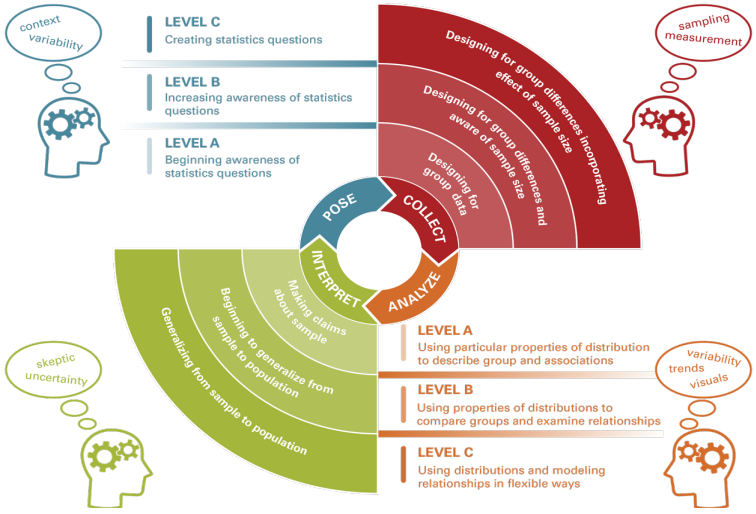

Figure 1. Framework for supporting students' approaches to statistical investigations.

Theoretical Framing of the Study

While making changes in teachers' statistics teaching practices is a major goal, our research is framed by an integrated model for teacher learning in PD proposed by Clarke and Hollingsworth (2002). Their model represents a change process for teachers as including reflection and enactment among an external domain of PD experiences and a teacher's professional world that includes domains of personal, practice, and consequence. The external domain includes information and resources often experienced through a PD, including interactions with others. In our study, the external domain includes learning opportunities (through a variety of resources) within the course and the discussion forums within in each unit. The personal domain includes one's knowledge, beliefs and attitudes. The practice domain includes any professional experimentation a teacher may do in their classroom, with content or instructional strategies, and the domain of consequence is concerned with salient outcomes that result in sustained practice and impacts in a teacher's classroom.

Because of the massive size of our online PD about teaching statistics, we are most concerned with the reflections and enactments between the external domain (experiences and resources in the course) and the reflections and enactments we can discern concerning their beliefs and perspectives about statistics and teaching statistics in the personal domain. To aid us in considering how the MOOC-Ed experiences may impact teachers' beliefs, perspectives, and practices related to statistics, we draw upon Mezirow's (2009) theory of transformational learning in adult education, consistent with constructivist assumptions about learning. Mezirow (2009) describes how meaning schemes—comprised of knowledge, expectations, beliefs and perspectives, and feelings—are used by an individual to interpret their experiences, and through reflection on these experiences, one may transform their understandings. Peters (2014) illustrated how this theory could be used to understand statistics teachers' development of an understanding of variation. In the context of our study, our intent is that a teacher might transform their meaning schemes for teaching statistics by rejecting prior conception of what it means to teach statistics. Transforming meaning schemes often begins with a stimulus, a disorienting dilemma, which requires one to question their current understandings and beliefs that have been formed from previous experiences (Mezirow, 2009). Specifically, we are interested in what stimuli and experiences within the TSDI course may act as triggers to evoke disorienting dilemmas (or cognitive dissonance) for teachers where they engage in critical reflection and question their current understandings or perspectives.

Methods

Participant Demographics

Though the course has been offered multiple times, this paper focuses on the Fall 2015 section. To attract a broad audience, the free course was advertised through websites and listservs of many different educational organizations (NCTM, ASA, CAUSEweb, IASE), social media posts, emails to past participants in any MOOC-Ed, state-level leaders in mathematics education in the U.S., and personal contacts. For the purpose of the research reported in this paper, we are only interested in the potential ways the course experiences could be impacting the beliefs and perspectives of K-12 classroom teachers. Of the course's total enrollees (n = 829), over half self-classified as classroom teachers (n = 489). In this study, we focus on these 489 teachers. The enrolled classroom teachers resided in 46 different states and 29 different countries, with most teachers in the U.S. (n = 380) and New Zealand (n = 48). The majority of the 489 classroom teachers were female (67.5%)

and 72.8% had a master's degree or above. Their years of experience in education, however, was fairly evenly distributed, creating a diverse pool of participants with varied teaching experiences that impact their starting perspectives and growth opportunities during the course. Of those 489 self-identified classroom teachers, we were able to use additional registration data (e.g., organization type and name) to infer that 412 enrollees *seemed to be* actively working in K-12 contexts. For example, some enrollees identifying as a classroom teacher also identified their organization type as a college/university and provided a community college as their organization.

Data Sources and Analysis Methods

In our research, we needed data from a variety of sources to help us measure impact of the online learning opportunities for a broad range of active and passive teacher participants. Aside from registration data, five other data sources were used: (a) click logs; (b) discussion forum posts; (c) end-of-unit surveys; (d) an end-of-course survey, and; (e) a follow-up survey six months after course to participants who engaged in any aspect of the course. The purpose of the follow-up survey was to inquire about how they may have applied their learning and what they considered the most impactful ideas from the course.

Course activity was tracked through click logs that allowed us to examine trends in participants' engagement. We limited data to those click logs made by classroom teachers that occurred between September 21, 2015 (opening of Orientation Unit) and December 31, 2015 when the course closed. All registration and click log data were merged and displayed in a dashboard that allowed investigators to visualize participants' engagement over time and with certain types of resources. Descriptive statistics and graphical displays were used to examine overall engagement patterns.

Our qualitative analysis initially focused on teachers' discussions in forums. Because the needs of a community college classroom teacher may differ than that of a K-12 teacher, we focused our qualitative analysis of discussion forum data on posts made by those we had inferred were K-12 teachers. There were 2,097 total posts made by all participants in the course (after removing instructional team), across 12 forums. We eliminated the introduction forum in the Orientation unit and the project discussion forum, leaving 10 forums across the five units. Of the remaining posts, 977 were made by 206 participants classified as classroom teachers. For this study, since we were only interested in beliefs and perspectives of K-12 classroom teachers, only these 977 posts were analyzed, with each post considered a unit of analysis. The posts by teachers were first analyzed using open coding (Strauss, & Corbin, 1998) guided by our focus on cognitive dissonance and critical reflection that may lead to change in beliefs, perspectives and practices related to teaching statistics. Posts were tagged for evidence of what course elements seemed to be triggering critical reflection and any evidence that a teacher may put forth in their written post that may indicate a reflection on, or shift in, their perspectives or beliefs related to teaching statistics. We documented which triggers were the most prevalent and only kept triggers that were associated with many instances of critical reflection. The occurrences of triggers were quite skewed, with many occurring an abundance of times, and a few occurring once or twice. Thus, it was a clear distinction to identify major triggers for impacting changes. Codes for describing perspectives and beliefs about teaching statistics were sorted and collapsed into broader themes.

In accordance with Loizzo, Ertmer, Watson and Watson (2017), to more deeply understand aspects of the external domain that triggered critical reflection and impacts on the personal and practice domains, we examined open-ended responses to end-of-unit and end-of-course surveys,

as well as the follow-up survey. The themes generated from the analysis of the discussion forum data—related to changes in beliefs and perspectives, and triggers that seemed to impact such critical reflection—were used as initial codes to examine K-12 classroom teachers' open-ended responses on the end-of-units, end-of-course, and follow-up surveys to questions related to what they appreciated most in a unit and what they considered to be the most impactful learning experiences. While we were looking for confirming *and* disconfirming evidence of themes and triggers, disconfirming evidence was not evident, and no new themes or triggers were documented.

Results

We first briefly describe teachers' participation in the MOOC-Ed (external domain) to help situate our findings. We then present our results related to the four elements of the course that teachers identified that triggered critical reflection. We discuss each element and provide evidence to illustrate the critical reflection the element triggered. Then, we discuss ways that engagement with, and triggers from, elements of the external domain seemed to impact teachers' perspectives and beliefs about teaching statistics in the personal domain.

Teachers' Participation

The purpose of this section is to briefly describe how classroom teachers chose to participate in the course and engage with resources (external domain). The click log data used in this analysis included all 489 enrollees who self-classified as classroom teachers at any level at registration.

Overall, a majority of enrolled classroom teachers (n = 370, 75.6%) engaged in various aspects of the course (e.g., accessing a page, viewing a video, downloading a document, posting in a forum). While some started in Orientation, others started in Unit 1. There were 293 classroom teachers who engaged in Unit 1, with an assumed intent to engage in PD through accessing learning material. Participants did not have to view Orientation or earlier units to access later ones, though almost all traversed the course linearly once they engaged in Unit 1. Figure 2 shows the sharp drop in teachers' participation between Units 1 and 2. By Unit 5, 31.4% (n = 92) of classroom teachers that began Unit 1 were still engaging in the course.

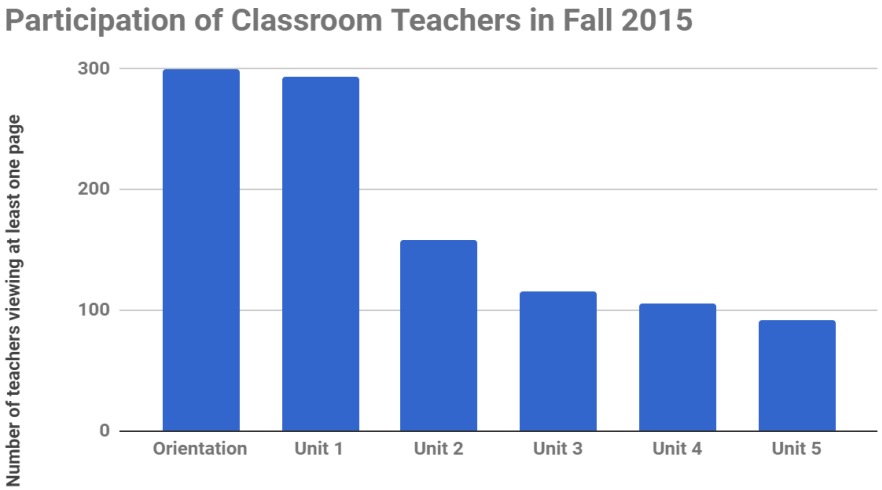

Figure 2. Number of teachers accessing each unit in course.

Over half of classroom teachers who began the course posted to a discussion forum (n = 206, 57.5%). The frequency of posts per teacher was a skewed distribution, with 57% of teachers posting 1–3 times (typically in Orientation and Units 1–2), 38% of teachers posting 4–14 times across several units, and 11 very active teachers posting 15–45 times. The levels of engagement in discussion forums by classroom teachers was highest in Units 1–3.

The examination of the click log data provides a strong indication of how classroom teachers took advantage of learning opportunities in the course through accessing resources and participating in discussion forums, with about a third of them finishing the course. A deeper dive into the qualitative data highlights *which* of the learning experiences in the course (external domain) seemed to trigger pedagogical dilemmas for them.

Course Features Triggering Critical Reflection

Four elements from the external domain emerged as often cited for triggering critical reflection. We briefly discuss each trigger and use examples from classroom teachers to illustrate the types of dilemmas or critical reflection they engaged in.

SASI framework. By far, the SASI framework (and all documents and multimedia associated with it, see Appendix) was the most dominant trigger for change. For example, in Unit 5, upon reflecting on why their confidence to teach statistics had increased, some teachers noted how the framework triggered changes. Triggers are bolded. A teacher posted,

> The most important point that I got from this course is being able to **develop habits of mind** that will help students to **build conceptual frameworks** for statistics. … We should be interested in the students' reasonings (as opposed to the result).

In the same discussion thread, a teacher responded, "I have found the **frameworks for statistical thinking** presented in the **videos** and materials to be very helpful in articulating the essence of statistics to my students." These teachers view statistics as more than a set of procedures and describe how the SASI framework impacted their perception of teaching statistics. Also in Unit 5, another teacher reflected on how the framework will help to improve her lessons.

> I feel more confident as well. It is my first time teaching stats and I was overwhelmed with ideas of how to approach it. This MOOC has supplied us with a **framework** to base our classwork on. I am developing a set of tasks for my class using the A-B-C levels as a way for me to differentiate instruction because I have a wide variety of ability. I knew I wanted to go in this direction but … the framework gave me the perfect guidelines to do this.

More specifically, this participant indicated that this framework guided her in developing several tasks to differentiate instruction and support students at different levels of statistical sophistication. Another participant indicated, "The **SASI framework** instilled in me a new mind-set. It showed me the study Statistics under a different light. It allowed me to view it from a different angle and really excited me to start applying and implementing it." Engaging with the SASI framework in the course not only led to teachers expressing a different perception of statistics, it supported them in imagining ways to change their practice.

Expert panel videos. The discussions among experts within the expert panel videos were another main trigger to assist teachers in reconsidering prior experiences in learning and teaching

statistics. In Unit 2, a teacher began a discussion thread detailing a dilemma about prior teaching practices because of points made in a video by the expert panel. The extensive post began as:

> I had a "lightbulb moment." Although I have been teaching HS math for 24 years, I have never actually taught "statistics" as defined by the members of the expert panel. I have taught units that I THOUGHT were statistics, but I was merely providing students with a few mathematical tools that statisiticians [sic] can use (e.g. finding a mean, making a histogram, calculating a standard deviation, etc.) ...

Twelve participants joined that discussion, 10 of which were teachers. They echoed that they were "guilty" of teaching statistics this way and that their own prior experiences in learning statistics treated the subject in a procedural manner for computing measures and creating graphs. Similar discussions and replies about this issue were also started by several others. To complete the first shift in perspective, teachers also recognized that attending and engaging in all parts of an investigation would give students opportunities to make sense of how statistics is used to answer questions and how important data collection (or experimental design) is to the process. Many admitted they spent little time on this with students and aimed to improve.

In their reflections in discussions and on surveys, several teachers referred to a Unit 3 video where one expert illustrates developing the concept of mean through tasks at different levels of sophistication.

> Wow—that whole idea around how to introduce the idea of variability as seen in the **'Number in your family activity'** at level A through to C is fantastic. Loved the video of **[Expert Name]**. I can see what an advantage it is when they get to high school level to have been introduced to the concept [of mean] in this way.

The expert panel videos evoked critical reflection and many opportunities for teachers to consider different perspectives and learn how statistics learning and teaching could be conceived of as something different from their own experiences as teachers and learners.

Classroom-based videos. The videos of students and teachers engaged in statistics tasks, both those of real classrooms, and the animated videos depicting real students' work, also triggered critical reflection about how students and teachers engage in statistics, helping them envision a different outcome for their students if they change their practices. In Unit 4, several teachers discussed the use of hands-on projects and experiments.

> I loved the **Gummy Bears In Space Video**. It was short, and to the point but I loved the activity … The students in this video were able to conduct their own experiment, collect data, and really analyze what was going on... A common theme I am seeing with statistics is that it is very project based friendly and can be an extremely engaging classroom!

Another teacher in Unit 4 shared their reflection after watching two animated videos of representations of students' work with a sample of messy Census at Schools data with technology and how they envisioned using such an approach with their students.

> I had several "aha" moments throughout these two **videos**. It occurred to me that cleaning up data is a valuable lesson that students must know in order to correctly interpret their findings and draw conclusions to answer their questions. If my students were to work with **Census at School data** to investigate a question of interest to them, I think they would struggle with cleaning up their data to interpret

> their results... I would think my students would accept the data as is, and begin to draw conclusions using the raw messy data. I think this tool would be a great resource for teaching this type of lesson, and showing students how to make sure their data is meaningful in accordance to the context.

These quotes represent typical posts where teachers reflected on and discussed videos of students and teachers engaging in statistics and made connections to their own classroom practices.

Dive into Data activities. The use of technology in the Dive into Data activities for investigating real data that were multivariable and sometimes "messy" served as an additional trigger that seemed to impact teachers' perspectives. Technology experiences directly influenced their ideas that engaging in statistics is enhanced by using dynamic technology tools and real-world messy data. As illustrated in quotes from teachers in the above section on the impact of viewing videos of students' work with data, experiences that triggered reflection on the usefulness of technology came from learning opportunities that included videos of students using technology, discussions in expert panel videos, and opportunities to Dive into Data themselves.

Two prominent triggers were using the Gapminder tool in Unit 1 and engaging with Census at School for gathering and sampling data from students in Unit 4. In a Unit 5 discussion, teachers were prompted to discuss course impacts and share ideas for their classrooms. One teacher posted, "*I loved the **Gapminder site**! I spent three very engaging days doing activities with the site and my students were simply shocked at some of the numbers. What an eye-opener!*" Another indicative post mentions Census at School,

> The **School Census** [sic] data is very interesting and serves as a great resource for teaching. This type of data is applicable to our students and **since it is real data**, not simply some fabricated textbook example, it has more power to influence learning and thinking.

The teacher discussing Gapminder used this new resource and implemented it in his classroom; whereas we cannot tell from the teacher discussing Census at School if he intends to use it with students, but it seemed to trigger the notion of using real data as an important aspect of statistics.

On a follow-up survey that asked participants the most valuable thing they learned, teachers often identified one or some of the four previous triggers. The following is an example of a teacher reflecting on the MOOC-Ed holistically and identifying several triggers.

> The most valuable aspect of the MOOC was obtaining **resources for the improved use of technology** to make instruction come to life and be more meaningful to students. I was able to **see the statistical process in action** and now have an idea of **what it should look like in the classroom**."

For this teacher, a combination of learning about new technologies to use in statistics (Dive into Data) and engaging with videos that showed students and teachers using technology in statistical investigations seemed to make a lasting impact.

Impact on Perspectives and Beliefs

In accordance with our guiding framework, we are interested in ways that engagement with, and triggers from, elements of the external domain impact teachers' perspectives and beliefs in the personal domain. Here we describe evidence of impact on teachers' perspectives and beliefs related to teaching statistics. Because we saw comments related to these themes in discussion

forums in Units 1–2, on unit and end-of-course surveys, and on the follow-up survey from participants who had only engaged in early units, the impacts on perspectives and beliefs seemed to occur with both classroom teachers who completed the course as well as those who only engaged in early units. It is beyond the scope of this paper to include a deeper analysis about differences between these groups of participants.

We found four major ideas related to how teachers' beliefs and perspectives about teaching statistics may have changed:

- viewing statistics as more than computations and procedures,
- engaging in statistics is enhanced with technology,
- engaging in statistics requires real data, and
- statistical thinking develops across a continuum.

Each perspective is described below highlighting teachers' beliefs and implied changes they would need to make in their teaching practices.

We noticed a shift in thinking about *statistics as more than computations and procedures* that began in discussion forums in Unit 1 and expanded in later units. This was also evident in responses to surveys. There were two aspects to this shift in perspective. The first can be characterized as a realization that the statistics they experienced and tended to teach was too focused on procedures. This was illustrated above as a teacher who had a "lightbulb moment" when listening to an expert panel video. Further, teachers recognized that a procedural approach to statistics was not aligned with their experiences in the TSDI course. For example, one teacher posted that she

> used to teach statistics like a pure mathematics course with a focus more on the process rather than the investigative side. This course has opened my eyes to the variety of statistical methods you can demonstrate using data investigations.

This shift in beliefs about statistics appeared in teachers' responses to the follow-up survey, where one teacher suggested that, "The MOOC prompted me to rethink what sorts of questions I ask students, shifting more to statistical reasoning questions and away from statistical processes." One teacher summarized what she learned in the course.

> The statistics that I got in high school and higher education was only based on direct teaching of formulas and drill learning. After going through all the simulations, videos, and technological tools that are provided here I came to realize what statistics really is. It is much more than just the ability to read graphs or compute numerical results, but it is more about quantitative reasoning, figuring/analyzing the messy data, and building critical arguments.

The second theme that emerged is that teachers recognized that *engaging in statistics is enhanced with technology*. For some teachers, using statistical software was also intertwined with using real data. An example of this perception is expressed by a teacher who stated on a follow-up survey "I use more technology throughout my semester to help intergrate [sic] my lessons that help intertwine real world applications." Another teacher joined in a discussion in Unit 4 started by another participant to express gratitude (subject: "a Big thank you") for the course focused on how a particular Dive into Data experience in Unit 2 had made an impact for her.

> I have really enjoyed getting to know the Tuva labs website [an online graphing tool] and exploring some of the activity worksheets. I created box plots from the Pixar and Dreamworks data and got the students to try and discuss the different comparisons using the SASI levels of sophistication with median, range, IQR and LQ and UQ.

For this teacher, a combination of learning about new technologies to use in statistics and applying her understandings of the SASI framework was assisting her in creating new experiences for her students. There were certainly several posts where teachers explicitly described how they were using technology to assist themselves in learning new approaches and how they hoped to use these in their classroom. For example, a teacher in Unit 4 described:

> Last year, I created an account with tuvalabs, but never looked into it. So I took the data from census at schools and was able to upload into tuva labs. There, I was able to create dot plots, bar graphs, histograms, and more. The stats section is coming up here at the end of November, and I'm excited to have my students be able to use this free resource.

While she had previously accessed Tuva it was her experience using Tuva in the TSDI course with Census at School data that gave her the needed knowledge to make plans to implement this with students in her practice.

A third theme that emerged was that *engaging in statistics requires the use of real (and messy) data*, and in many cases datasets that included bigger data (more attributes and cases). One participant shared in a follow-up survey,

> the data emphasis was what I really took away from the course. There were little tidbits here and there I have "borrowed" to polish what I do—but by far I am most proud of creating more concrete data sets for my students to actually experience (say, the left/negative skew effect) rather than just showing a picture.

Teachers recognized the need to use data that included a large number of cases and multiple attributes (numerical and categorical) and that may require some cleaning (e.g., "getting real/messy data that needs to be cleaned is an important exercise in itself"). Using real data was one idea that experienced teachers contributed a lot in the community discussions. These teachers were reaffirming their pedagogies and sharing what they do for others to learn from. Consider how this classroom teacher gave glimpses into her practice, which was part of one of the longest discussion threads, in Unit 2, with 48 different posts, about the subject "Classroom experiments."

> I think that by having these meaningful discussions about the real world implications of statistics is what makes it real for them. Using real data sets and showing them how it relates to the world around them is not only meaningful, but is what statistics truly is. Use contexts that are real for your students. I had a class last year that was made up mostly of students who played sport. I used lots of sports datasets which are easily accessible and full of stats. This year I had a lot of students passionate about government and politics so I used a lot of governmental datasets

This extended discussion is a strong example of how the online community allowed the teachers to learn from one another by discussing issues that emerged when they did classroom experiments, some sharing types of experiments they have tried, and others reflecting on their newfound bravery to try these types of experiments in their classroom.

The final theme is that teachers began to realize that *statistical thinking and understanding develops across a continuum* and that they could use this thinking to inform instructional decisions, use of tasks, and assessment of students. For example, one teacher indicated that, "The idea of the 4-process cycle and the different levels for different ages of each process, has helped me a lot. I understand more and feel I am a better teacher to my students." Considering statistics as developing across levels was a cornerstone aspect of the SASI framework and seemed to take hold for many teachers. After commenting on students' work in a video in Unit 3 and describing what levels she thought students may be working at on a task, another teacher noted,

> … with the SASI framework, I like how it never mentions age or grade level. I feel it's a continuum that students, depending on the context, can move back and forth between. If they get to a harder problem, they may not know how to exactly collect the data without bias and ensuring randomness. But with an easier experiment, that may be more obvious to them.

Some teachers indicated they would use specific tasks from the courses with their own students, suggesting they would implement tasks that included more student engagement with the four phases of a statistical investigation. For example, one teacher said, "I have done a lot of labs with my students but I really loved this one [coke vs. pepsi] to try. I can't wait to see how they react with this one." Other teachers showed evidence of applying more general pedagogical knowledge about implementing tasks that involve the investigation cycle and can develop statistical habits of mind. Some indicated they would utilize the task design resource in selecting and/or adapting and implementing tasks in their classrooms that could support students at different levels.

Discussion and Conclusion

Researchers have yet to agree on the most appropriate ways to measure participants' progress and outcomes as they engage in MOOCs (Perna et al., 2014). Despite these inconsistencies, a common way to evaluate the impact of MOOCs has been to report completion rates or retention rates. Koller, Ng, and Chen (2013) define retention rate, or completion rate, as the fraction of participants who enroll who successfully complete the course using criteria established by the instructor. Perna et al. (2014) define retention rate as the number of people who accessed the last module of the MOOC, divided by the number of participants who accessed the first module. While definitions of both vary throughout the literature, completion rates typically range between 5% and 19% of registrants (Ho et al., 2014; Koller, et al., 2013; Perna et al., 2014). Recall that Jacobsen (2019) found that educators who had only accessed a few resources in the first two modules of an online PD, reported having meaningful interactions with those resources, and how their engagement impacted their practices. Loizzo et al. (2017) found that one measurement of success of a MOOC was that participants gained new resources. The major findings from our study are discussed below to provide broader implications for research and design in online PD.

In just this one course offered over a 15-week period, almost 300 classroom teachers engaged in at least the first unit, with 31% of those teachers completing the course through Unit 5. Thus, the MOOC-Ed succeeded in reaching and engaging K-12 teachers, with evidence of high engagement by many with different resources and active participation in discussion forums. This completion rate is higher than reported with most other MOOCs (e.g., Perna et al. 2014). We know that not everyone intended to complete the course, but some teachers who only participated in Unit

1 engaged in discussions, responded to follow-up surveys, and showed evidence of reflections based on triggers such as expert video discussions about how statistics is different than mathematics and seeing students in a video using the Gapminder tool (all introduced in Unit 1). By using data from discussion forums, end-of-unit surveys and follow-up surveys that included anyone who enrolled in the course, we were able to include perspectives of teachers who may have only engaged with a few resources. Thus, our approach to data sources expands how Jacobsen (2019) examined ways online PD can impact educators' beliefs, perspectives, and practices.

One challenge in designing online PD for teachers is identifying how to leverage stimuli that has the potential to act as triggers to impact teachers' beliefs about teaching. For those who are at a crossroads facing this challenge, our identification of triggers can provide guidance as they embark on designing and implementing online PD efforts for teachers. While we have no evidence (yet) that teachers' experiences in a brief online PD in teaching statistics has impacted actual teaching practices and students' learning, our research indicates that the purposeful design elements of the course were successful in causing critical reflection through certain triggers. Having a framework that can guide teachers' ability to plan tasks and assess students can provide a way for teachers to understand a bigger picture of teaching the content beyond what is in their particular grade-level curriculum. Active learning opportunities to experience new technology tools and engaging tasks was a critical trigger. PD for teachers should include opportunities to engage more deeply, and perhaps in a different way, with content teachers are expected to teach. Designers of online PD need to continue to find ways to engage teachers in such active learning opportunities.

The use of two types of videos that appeared as triggers is important to consider in future designs. For those that work in teacher education, it is not surprising to hear that teachers can learn much from watching and reflecting on videos depicting students' thinking on tasks and teachers' pedagogical moves (e.g., Chazan, 2018). It may be surprising though, that teachers learn a lot from videos that are conversational in nature between expert educators in a domain. In a typical face-to-face PD, there is generally 1–2 leaders who engage teachers in activities and present material. Current practices in online PD may tend to feature a single instructor presenting critical information in lecture-style videos. Rarely do teachers get an opportunity to hear a *discussion* about critical issues related to teaching and learning. While each unit in the TSDI course had a brief video of the instructor introducing key ideas in the unit, these were *rarely* brought up in discussions. The exception was a video in Unit 3 where the instructor illustrated the SASI framework with examples from students' work. Quite simply, hearing from the instructor alone in videos did not seem impactful; but, hearing from the instructor engaged in discussions with experts in the field (see sample expert video linked in Appendix) served as triggers for educators to experience cognitive dissonance about their own ideas that they in turn seemed to willingly discuss in forums.

The classroom teachers not only learned from expert opinions, but also from the voices and experiences of other teachers and participants with whom they interacted with in the course. This is similar to findings from Loizzo et al. (2017) where some MOOC participants expanded their world views by engaging in forums where they shared their personal experiences. In other research on the posting behaviors of participants in this course, Bonafini (2018) found that there was one classroom teacher and three other non-classroom teachers who served as super-posters and contributed greatly to conversations through starting threads and replying to many posts by others. Peer voices along with the voices of the instructional staff in the forums acted as additional

resources to support collegiality and practical exchange of ideas outside of teachers' physical school environment (Borko, 2004; Mackey & Evans, 2011). Well-designed discussion prompts focused on pedagogical issues and an open forum for sharing indeed provided opportunities for teachers to express their critical reflections and share in development of new classroom practices.

Many teachers reported increasing their confidence to teach statistics and appeared to move towards beliefs that we should engage students through investigations, not merely teach them mathematical tools to apply to numbers devoid of context. Thus, our results in this online context align with others who have done PD about teaching STEM content in face-to-face contexts (De Vries et al., 2013; Eichler, 2011; Seung et al., 2011). Like MOOC participants' in Loizzo et al.'s (2017) study, who measured one aspect of success in that teachers were able to apply things they had learned, our teachers were attracted to and made sense of how to apply a framework to their practice. Teachers learned a lot about what it means to engage in statistics, by doing it themselves, as well as from examining students' thinking in videos. Is any of this a big surprise? Perhaps not to experienced teacher educators. However, the key is to include these types of learning opportunities in online PD, whether it is to a local group or massive and open to teachers around the world. To help answer the call from Marrongelle et al. (2013), our research also supports the idea that online courses that emphasize: (a) self-directed learning, (b) peer-supported learning, (c) job-connected learning, and (d) learning from multiple voices *can be effective* for designing online PD in teaching STEM content (e.g., teaching statistics) that need wide-scale efforts to impact the perspectives and practices of classroom teachers.

Of course, our research is limited by the fact that we did not include interviews, collection of artifacts of practice (e.g., lesson plans or tasks), or conduct classroom observations of a subset of teachers. Such methods should be included in future studies and would provide more nuanced and direct evidence of whether teachers' espoused changes in perspectives and beliefs, and intentions for changes in their practices, were actually realized in classrooms.

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Appendix A

Multimedia resources for participants to learn elements of SASI framework in Units 2 and 3.

Title	Multimedia elements	Link to Resource
Resources accessed through the course library resource database		
Statistical habits of mind	text with color-coded diagrams	https://fi-courses.s3.amazonaws.com/tsdi/unit_2/Essentials/Habitsofmind.pdf
Describing the SASI framework	text with diagrams and color coordinated tables	https://s3.amazonaws.com/fi-courses/tsdi/unit_3/SASI%20Framework.pdf
Illustrating the SASI framework	"talking head" video with diagrams, animated titles, interspersed with slides with voice overlay (12:32 min)	https://youtu.be/XTobbqSpUZc
Interactive Diagram of SASI framework	webpage with framework diagram and pop-up descriptions of different aspects of the framework	https://s3.amazonaws.com/fi-courses/tsdi/sasi_framework/index.html
Considerations for design and implementation of statistical tasks	text with tables that applies SASI framework to task design	http://fi-courses.s3.amazonaws.com/tsdi/unit_3/CDIST.pdf
Resources accessed through video embedded on a course page		
Expert Panel discussion on investigation cycle, differences between mathematics and statistics, and statistical habits of mind.	video with instructor and 3 experts having discussion. (16:39 min)	https://youtu.be/Te5EyDD-QE8
Expert Panel discussion on task design	video with instructor and 3 experts having discussion. (18:32 min)	https://youtu.be/xG-5ockl7Tg
Expert interview on	video interview between	https://youtu.be/QSEPd7afQRo

development of 2007 GAISE K-12 framework	instructor and expert (7:06 min)	
Expert Interview on developing the concept of mean across levels	video instructor interviewing expert with interspersed slides (22:07 min)	https://youtu.be/h5t0V9qe82k
Working with a dynamic simulation tool (to explore Schoolopoly task)	video with animated depiction of students working on task with human reading task and real student voices and images of computer work and video of computer work (4:24 min)	https://youtu.be/VuFjTaGgsCw
Multiple levels of sophistication (with Schoolopoly task)	video with animated depiction of teacher introducing task and three student pairs working on task with computer images or written work (voices automated) (5:09 min)	https://youtu.be/tdLx7eMecB4
Sample Dive into Data experiences		
Dive into Data About Vehicles Using CODAP	A random sample of 300 vehicles manufactured in 2015 is provided to explore questions about relationships between fuel economy in the city and highway, types of transmission, hybrid vehicles, annual fuel cost, and number of cylinders.	https://codap.concord.org/releases/latest/static/dg/en/cert/index.html#shared=16202
Dive into Data about Fairness of Dice for Schoolopoly game with GeoGebra simulation	Given a simulation of dice produced by six companies. Investigate whether or not the die made by each company is fair. Collect data through a simulation and support a decision as to whether to recommend that dice be purchased from each company.	Die Roll Simulation https://www.geogebra.org/m/KBAEuEJh PDF of activity https://s3.amazonaws.com/fi-courses/tsdi/unit_3/Schoolopoly%20Task.pdf

Facilitation Matters: Instructor Perception of Helpfulness of Facilitation Strategies in Online Courses

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Abstract
Online course facilitation is critical to the success of online courses. Instructors use various facilitation strategies in online courses to engage students. One hundred instructors were surveyed on their perception of helpfulness of twelve different facilitation strategies used in online courses to enhance instructor presence, instructor connection, engagement, and learning. Instructors' timely response to questions and instructors' timely feedback on assignments/projects were rated the highest in three of four constructs (instructor presence, engagement, and learning). For instructor connection, ability to contact the instructor in multiple ways was rated the highest. Interactive visual syllabi of the course were rated the lowest in all four constructs. In the open-ended comments, group projects and synchronous sessions were rated helpful. Descriptive statistics for each of the construct by gender, delivery method, and course level taught are presented. Significant differences were found between gender but analysis of variance failed to detect differences between primary delivery method or course level taught.

Keywords: facilitation strategies, instructor presence, online learning, instructor perception, instructor connection

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Facilitation Matters: Instructor Perception of Helpfulness of Facilitation Strategies in Online Courses

According to National Center for Educational Statistics (2017), almost twenty million students are enrolled in online courses, and enrollment is likely to grow. By interviewing award-winning online instructors, (Martin, Budhrani, Kumar & Ritzhaupt, 2019) found online instructors' roles to be categorized as facilitator, course designer, course manager, subject matter expert, and mentor. In this study, the online instructor role of being a facilitator is examined (Berge, 1995; Pappas, 2014). Online facilitation is described as to be present, available, to share expertise online and model for the students what it means to participate in an online course (Martin, Budhrani, Kumar & Ritzhaupt, 2019). Gustafson and Gibbs (2000) state that successful online facilitators need to learn strategies to humanize the online course and identify new ways to engage the learners to construct meaning. Online instructors use multiple strategies to facilitate student learning and critical thinking skills (Richardson et al., 2015; Schindler & Burkholder, 2014), to

improve students' sense of community (Rovai, 2007), and to promote students' connectedness and learning (Shea, Li, & Pickett, 2006). Berge's (1995) study on Instructor Roles Model focused on the functions of instructors, which shifted from a subject expert to a course facilitator, and categorized facilitation into four categories: pedagogical, social, managerial, and technical.

Previous literature discussed various types of facilitation strategies in an online setting, such as instructor's feedback to students' assignments (Badiee & Kaufman, 2014; Thiele, 2003), responses to students' questions (Sheridan & Kelly, 2010), announcements (Ko & Rossen, 2010), questionings (Wang, 2014), and video-based course introduction (Jones, Naugle & Kolloff, 2008). Few studies have looked at students' perception of facilitation strategies in online environments and outcomes (Martin, Wang & Sadaf, 2018; Shea, Li, & Pickett, 2006; Hew, 2015). Martin, Wang and Sadaf (2018) reported that instructor's timely response and feedback were highly valued by students on establishing instructor presence, instructor connectedness, engagement and learning. Hosler and Arend (2012) found that course organization and timely specific feedback improved students' participation. Shea, Li, and Pickett (2006) added that instructors' questioning and feedback have positive impact on students' perception of learning and connectedness.

However, few studies have examined instructor perceptions regarding facilitation strategies in online classes and their impact on students' learning achievements. Cavanaugh and Song (2014) compared instructor and students' perspectives regarding audio feedback and written feedback and found that instructors had mixed feelings about giving feedback using audio, whereas students welcome audio feedback. Borup, West, and Thomas (2015) surveyed both students and instructors on their perceptions of text and video feedback in blended courses and discovered that both students and instructors believed that feedback in a written form is more efficient and organized whereas video feedback facilitated supportive communication. Santilli and Beck (2005) examined graduate faculty perceptions of online learning and found that about half of the instructors considered peer interaction as the most significant feature of online discussion and instructor feedback as the second most important feature. Hsiao (2012) discovered that online teachers use several strategies to facilitate online communication, including providing clear guidelines, rubrics and examples for online discussions; showing instructor presence by monitoring students' discussion; and absorbing other strategies that facilitate online discussion. Although these studies identified faculty perceptions regarding a few facilitation strategies, online faculty need to be knowledgeable in the use of facilitation strategies in order to maintain high academic standards in online courses (Bigatel & Williams, 2015; Al-Salman, 2011).

While specific online facilitation strategies have been examined by other researchers, faculty perception on the helpfulness on a variety of these facilitation strategies and the factors associated with them have not been studied in online settings. In order to address this limitation, Berge (1995) Instructor Roles Model was used as a comprehensive validated model in online instruction to identify a variety of facilitation strategies based on the most important roles of online instructors as learning facilitators. In this study, we examine (a) which facilitation strategies do instructors perceive to be most and least helpful in establishing instructor presence, instructor connection, engagement, and learning in online courses, and; (b) which factors (gender, delivery method, level taught, discipline) are associated with instructor perception of facilitation strategies in online teaching.

Theoretical framework for online course facilitation

Berge (1995) categorizes instructor facilitation strategies into four functions: Managerial, Social, Pedagogical and Technical (Figure 1). These instructor facilitation roles were initially described within the online discussion context, but later Berge (2008) changed the roles to focus on broader online learning environments that are "informal, collaborative, reflective learning, with user-generated content" (p. 412). Berge (2008) suggested that some functions of instructors and facilitation strategies may overlap or can be categorized in more than one group.

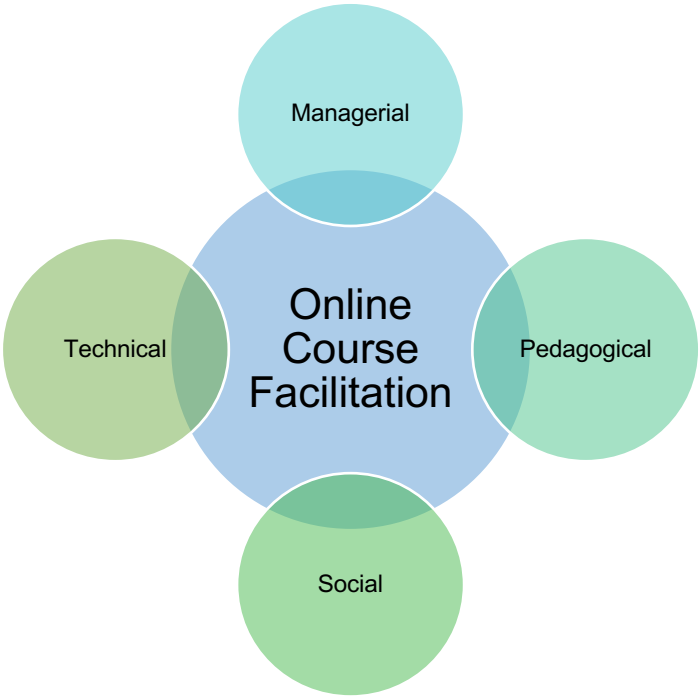

Figure 1. Online Facilitation framework (Berge, 1995).

Pedagogical

In the pedagogical role, instructors facilitate students' learning and sustain their participation and motivation in an online course (Bawane & Spector, 2009). Pedagogical facilitation strategies include having clear objectives, encouraging participation, promoting conversations, making the course material relevant, and encouraging contributions (Berge, 1995). Instructors also model effective learning and keep discussions on track, provide special knowledge and perceptions, combine course content, and maintain group harmony (Rohfeld & Hiemstra, 1995). To facilitate and focus effective discussions, instructors use questions and probes (Berge, 2008). Eskey and Schulte (2010) found that instructors' prompt responses to questions in the discussion and via email are two important facilitation strategies for students to be successful in online courses. Swan (2001) found that student to instructor interaction and active discussions significantly impact student's satisfaction and their perceived learning of the course material in asynchronous online environments.

Managerial

In the managerial role, instructors design the logistics of the course. Some of the managerial strategies include providing administrative responsibilities, procedural leadership, planning and developing course materials, organizing the course, deciding the dues dates, and

pacing the online discussions (Anderson, Rourke, Garrison, & Archer, 2001; Berge, 1995). Wei and Chen (2012) suggested that online instructional design should include a roadmap to effectively guide the learner through the course to foster a positive learning environment. In addition to facilitation and scaffolding, instructors should focus on organizational structure, such as learning objectives, due dates, and expectations to facilitate effective online learning (González-Sanmamed, Muñoz-Carril, & Sangrà, 2014; Richardson et al., 2015). Research indicates that instructors facilitation in terms of prompt response to questions and timely feedback on assignments are important in creating instructor presence, student engagement in their courses, and facilitating higher levels of learning (Hodges & Cowan, 2012; Martin, Wang & Sadaf, 2018; Sheridan, & Kelly, 2010). Ko and Rossen (2010) suggested that regular announcements in an online course can be used to get students attention and remind them about the course activities during the semester. In online courses, instructors sending weekly reminders activities and assignments that are due is helpful for students to manage their time effectively (Kelly, 2014).

Social

In the social role, instructors encourage and promote meaningful human relationships for working together in a mutual cause. Some of the social facilitation strategies include using introductions to help build the sense of community, facilitating interactivity, modeling the discussions behaviors, and reinforcing online etiquettes (Berge, 1995). In online learning, promoting student-student or student-instructor relationships, developing cohesive groups, and helping students work together for their shared benefit are helpful to the success of online learning activities (Berge, 2008). Ko and Rossen (2010) suggested strategies for instructors to design and facilitate the discussions that include narrowing down topics, starting topic threads, responding to discussion posts, and mentioning student names.

Jones et al. (2008) found that video-based instructor introduction assisted in connecting with the students from the start of the course which contributed to students' growth in the course. Researchers suggest that students demonstrate high levels of cognitive presence in discussions facilitated by well-structured discussions and discussion questions (Oh & Kim, 2016;Richardson, Sadaf & Ertmer, 2012; Sadaf & Olesova, 2017). Lowenthal (2010) recommend instructors to create a space to interact socially with the students, engage them, and provide feedback on time.

Technical

In the technical role, instructors facilitate a transparent technology environment so that the learners can focus on the academic tasks and learning activities (Berge, 1995). Technical facilitation strategies include providing resources, materials, and other tools to facilitate learning within the online course. Berge (2008) suggested that it is important for the facilitator to help learners become comfortable with the information and communication technologies being used within the online course. Research suggests that using multimedia tools in online courses increase student learning and engagement. Using synchronous tools provide opportunities for instructors and students to interact with each other using various features within the synchronous tools including audio, video, text chat, interactive whiteboard, and applications (Martin & Parker, 2014). Draus, Curran, & Trempus (2014) found positive relationships between content created by instructors in the form of videos and student engagement, satisfaction, and retention. Instructor-created videos assists students grasp the instructional content better and connect with their instructors (Borup et al., 2012; Rose, 2009). Table 1 lists the 12 facilitation strategies proposed by Martin, Wang and Sadaf (2018) categorized by Berge's framework.

Table 1

Facilitations Strategies in Online Courses (Martin, Wang & Sadaf, 2018)

	Facilitation Strategies
Social	Video-based instructor introduction
	Instructor being present in the discussion forums
	Able to contact the instructor in multiple ways
Managerial	Video-based course orientation
	Instructors timely response to questions
	Instructors weekly announcements to the class
Pedagogical	Instructors timely feedback on assignments/projects
	Instructor's feedback using various modalities
	Instructors personal response to student reflections
Technical	Instructors use of various features in synchronous sessions to interact with students
	Interactive visual syllabi of the course
	Instructor created content in the form of short videos/multimedia

Helpfulness of online facilitation in this manuscript is examined through four variables, instructor presence, instructor connection, engagement, and learning. The following sections discuss the literature on how facilitation strategy helped the instructor be present in the classroom (instructor presence), how the facilitation strategy helped the instructor get to know the students (instructor connection), how the facilitation strategy helped the instructor engage the students in the online course (engagement), and how the facilitation strategy helped the instructor facilitate learning of the content (learning).

Instructor Presence

According to Richardson et al. (2015), instructor presence is defined as the "specific actions and behaviors taken by the instructor that project him/herself as a real person" (p. 259). Within the context of online instruction, instructor's role can be seen as more of a facilitator instead of a teacher or lecturer (Richardson & Swan, 2003). With a focus on the role of facilitator, instructor presence is described as the instructor validating their personal identity by acknowledging and performing their role through various strategies (Martin, Wang & Sadaf, 2018). Research has demonstrated that instructor' presence influences their students in their affective learning, cognition, and motivation (Baker, 2010), students' satisfaction (Brinkerhoff & Koroghlanian, 2007), and students' sense of community (Sheridan & Kelly 2010). Vesely, Bloom, and Sherlock (2007) stated that receiving frequent, timely, and constructive feedback from instructor are important elements of instructor presence for the online students. Richardson, Besser, Koehler, Lim, and Strait (2016) found that instructors perceived their presence as an important factor in online courses. Mandernach, Gonzales, and Garrett (2006) studied instructor interactivity and establishing standards to enhance instructor presence in online discussions.

Results showed that the majority of instructors believed online instructors' participation in online discussions is important.

Instructor Connectedness

According to Gallien and Oomen-Early (2008), "Connectedness refers to a person's sense of belonging or presence, feelings of support, and level of communication/interaction with the instructor. Students who perceive a sense of connectedness with their instructor are likely to feel satisfied and perform well in their online courses" (p. 468). Similarly, D'Alba (2014) believes connectedness is the "perceived closeness between the student and instructor as well as the instructor and student" (p. 8). Regarding connectedness and its psychological effects, students with close connection with instructors are likely to build more confidence (Ryan, Gheen & Midgley, 1998), feel less isolated (Cates & Slagter van Tryon, 2002), and reduce anxiety (Creasey, Jarvis & Knapcik, 2009). Creasey et al. (2009) conducted a survey with 94 students to validate the scale of student and instructor relationship and found students were less anxious as they felt more connected with their instructors. Creasey, Jarvis, and Gadke (2009) found that instructor immediacy impacts student achievement orientations which was partially mediated by student-instructor relationship. Micari and Pazos (2016) reported that instructor connectedness together with self-efficacy and peer alignment are predictors of student satisfaction. LaBarbera (2013) examined how email correspondence between student and instructor influences students' perceived connectedness with instructors. Results showed that students' sense of connectedness were associated with instructor feedback, instructor interaction and support, email correspondence, and their satisfaction with the online course.

Engagement

Newman, Wehlage and Lamborn (1992) defined student engagement as "the students' psychological investment in and effort directed toward learning, understanding, or mastering the knowledge, skills, or crafts that academic work is intended to promote" (p. 12). Student engagement denotes student commitment and effort to learning (Krause & Coates, 2008). Compared to traditional classes, engagement is more important to online courses due to its lack of face-to-face interactions between instructor and students. Engagement has a positive impact on students' satisfaction (Swan 2001), sense of community (Robinson, 2011), and persistence (Kuh et al., 2008). An interactive online course that connects instructors and students can help to eliminate students' feelings of isolation and reduce dropout rates and online attrition (Banna, Lin, Steward, & Fialkowski, 2015; Boton & Gregory, 2015). Dixson (2010) studied 186 students enrolled in six universities and found that instructor presence had a positive influence on student engagement. Bolliger and Martin (2018) compared student and instructor perceptions of online student engagement strategies and found that instructors and students showed consensus on the significance of multiple engagement strategies. However, instructors tend to rate most of the strategies higher than students, including "the use of virtual lounges, icebreaker discussion, reflections, peer review, interaction with peers, student moderation of discussions, collaborative activities and projects, and the use of learner's names in discussion forums by instructors" (p. 13).

Learning

Learning is defined as the attainment of knowledge or skills through experience or education (Martin, Wang & Sadaf, 2018). In terms of online learning, Ally (2004) defined learning as "the use of the internet to access learning materials, to interact with the content, instructor, and other learners, and to obtain support during the learning process, in order to acquire knowledge, to

construct personal meaning, and to grow from the learning experience" (p. 7). Online learning benefit learners and instructors in which they can update or access learning materials anytime at any locations. However, there are differences between learner and instructor perceptions of online learning. Tanner, Noser, and Totaro (2009) found that faculty showed less preference to online learning than students when they compared business faculty and undergraduate students' perceptions. Delaney-Klinger, Vanevenhoven, Wagner, and Chenoweth (2014) found that faculty members who lack online teaching experience and the knowledge of using effective tools in online environment are at a disadvantage that may have negative impact on their students' learning.

Role of Instructor Demographics in Online Courses

Because of the impact online instructors have on students' learning achievements, researchers have explored and found differences in demographics factors that may influence faculty facilitation in online teaching and learning environments (Chang, Lin, & Song, 2011; Shea, 2007). For example, Chang, et al., (2011) investigated faculty perceptions of teaching efficacy and their relation to their demographic backgrounds and found that education faculty have higher perception of efficacy than faculty in other disciplines, female faculty score higher in class management and learning assessments than male faculty, and faculty with less teaching experience indicate low perception of their teaching efficacy. In another study, Shea (2007) explored instructors' motivations to teach online and found that female faculty were more attracted to online teaching than male faculty, older faculty (those 45 or over) were more motivated to experiment with new pedagogy then were younger faculty, and faculty at four-year institutions were more motivated to teach online than community college faculty. Similarly, Seaman (2009) examined online teaching and course development by gender found that females more confident in instructional skills and are more involved in course development than males. The results of these studies show that since the demographics of online faculty can play an important role in their online teaching, having a clear picture of whether or how demographics affects instructors' perceptions of facilitation strategies is essential to enhance student learning.

Purpose of the Study

There is limited research focusing on online course facilitation and the studies on facilitation focus on individual facilitation strategies. Since the choices faculty make to facilitate online learning in their courses can have important effects on desired student learning outcomes, identifying their perceptions of facilitation strategies can help enhance student learning in online courses. Therefore, the main purpose of this study is to bring together several strategies and faculty perception of these strategies on how it helps their online teaching. The second purpose is to identify factors associated with faculty perceptions of facilitation strategies. The following questions guided the study:

1. What facilitation strategies do instructors perceive to be most and least helpful in establishing instructor presence, instructor connection, engagement, and learning in online courses?
2. What factors (gender, delivery method, level taught, discipline) are associated with instructor perception of facilitation strategies in online teaching?

Method

Data Collection Procedure

Once the institutional review board approval was received, data was collected using an online survey tool (SurveyShare) that was used at the university where the researchers were affiliated. Email invitations were sent to Association of Educational Communications and Technology (1,900 members) and to the distance education instructors at a southeastern university through the director of distance education (411 instructors). The response rate was at 4.8%. This survey had instructions stating that only faculty who teach hybrid or online courses to complete the survey. The AECT email list has practitioners, students, and faculty. Hence the low response rate was expected. One reminder was sent about two weeks after the initial email. Three $25 gift cards were given as incentives for their participation in this study through a random drawing.

Participants

A total of 115 instructors responded to the survey. Out of these 115 respondents, 11 missed at least 10% of the questions and were therefore dropped from the study. Three respondents reported teaching face-to-face and one person did not report this information, so these four respondents were removed from the analyses. The final sample consisted of 100 instructors who responded to at least 90% of the questions in the survey. The sample was mostly female instructors (n = 65, 65%) with 34 (34%) male instructors. One person reported "other" as his/her gender identity. Their age ranged from 25 to 68 years with a mean of 49.25 years and a standard deviation of 10.71 years. Half of the participants (n = 48, 48%) taught undergraduate students and the other participants (n = 51, 51%) taught graduate level courses. One participant did not report this information. Most of the participants (n = 83, 83%) reported the delivery method, 72 asynchronous online and 11 synchronous online, and the rest of them reported teaching hybrid courses (n = 17, 17%). Faculty were from various disciplines such as arts (n = 20, 20%), business (n = 7, 7%), engineering (n = 6, 6%), health (n = 9, 9%), and education (n = 53, 53%). Five participants (n = 5, 5%) did not report this information.

Instrument

The instrument developed in a previous study on facilitation strategies by Martin, Wang and Sadaf (2018) and administered to students was used in this study. The Cronbach's alpha for students' responses to all items was .98, and that for students' responses to items used to measure instructor presence, instructor connection, and engagement was .91, .94, and .95, respectively (Martin, Wang & Sadaf, 2018). The evidence of structural validity was measured by confirmatory factor analysis and the results were satisfactory with all comparative fit index values greater than .93, normed fit index values greater than .90, and standardized root mean residual values less than .09 (Martin, Wang & Sadaf, 2018). The online facilitation strategies survey was developed after conducting an extensive literature review on facilitation strategies in online courses and based on the practical experience of expert online instructors. Participants were asked to rate each of the 12 facilitation strategies on a five-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree) for the four aspects of facilitation strategies: instructor presence, instructor connection, engagement, and learning. The questions that the online instructors were asked include:

(1) The following facilitation strategy helped me be present in my classroom (instructor presence);

(2) The following facilitation strategy helped me get to know my students (instructor connection);

(3) The following facilitation strategy helped me to engage my students in the online course, and;

(4) The following facilitation strategy helped me facilitate learning of the content.

The international consistency, measured by Cronbach's alpha, for instructors' responses to all items was very satisfactory (.96). The Cronbach's alpha for the subscales were .85 for instructor presence, .88 for instructor connection, .87 for engagement, and .81 for learning. In addition to these 12 items, two open-ended questions were used to solicit instructor use of facilitation strategies in addition to those listed in the 12 items: (a) What are some facilitation strategies that you use but not listed here and you have found it helpful? (b) What are some facilitation strategies that you use but not listed here and you have found it least helpful?

Data Analytical Procedure

Participants' perception of the facilitation strategies were reported with descriptive statistics. Analysis of variance (ANOVA) was used to see if instructor perceptions of facilitation strategies vary across gender, delivery method (hybrid versus online), level taught (undergraduate versus graduate level courses), and discipline (education versus non-education majors). Pearson correlation coefficients were used to represent relations between the perceptions of facilitation strategies and age and the number of online courses taught. Thematic analyses were used to code the instructor responses to open-ended questions.

Results

Facilitation Strategies

Instructors rated the helpfulness of facilitation strategies listed on the 12 items with a mean of 3.80 and a standard deviation of 0.63. Descriptive statistics at the item level and subscale level (instructor presence, instructor connection, engagement, learning) are presented in Table 2.

Table 2

Instructor Perception of the Helpfulness of Facilitation Strategies

	Facilitation Strategies	Instructor Presence M (SD)	Instructor Connection M (SD)	Engagement M (SD)	Learning M (SD)
1	Video-based instructor introduction (e.g., Voicethread, animoto, Camtasia)	3.83 (1.21)	3.40 (1.35)	3.55 (1.25)	3.39 (1.24)
2	Video-based course orientation (e.g., recording using Camtasia, screencast-o-matic)	3.87 (1.14)	3.05 (1.22)	3.61 (1.12)	3.69 (1.13)
3	Able to contact the instructor in multiple ways (Contact the Instructor Forum, Email, Phone, Virtual Office hours)	4.47 (0.78)	4.31 (0.88)	4.29 (0.85)	3.91 (1.01)

4	Instructors timely response to questions (e.g.,within 24 to 48 hours) via forums, email	4.74 (0.59)	4.18 (1.08)	4.50 (0.74)	4.45 (0.75)
5	Instructors weekly announcements to the class (e.g. Every Monday via announcement forum, email)	4.17 (1.02)	3.25 (1.35)	3.92 (1.12)	3.78 (1.09)
6	Instructor created content in the form of short videos/multimedia (e.g., Camtasia, articulate modules)	3.94 (1.09)	3.02 (1.29)	3.91 (1.04)	4.05 (1.06)
7	Instructor being present in the discussion forums (e.g., refers to students by name, responds to students' posts)	3.93 (1.16)	3.92 (1.14)	3.97 (1.13)	3.85 (1.12)
8	Instructors timely feedback on assignments/projects (e.g., within 7 days).	4.62 (0.69)	4.09 (1.15)	4.43 (0.78)	4.43 (0.75)
9	Instructor's feedback using various modalities (e.g., text, audio, video, and visuals) on assignments/projects.	3.58 (1.26)	3.31 (1.31)	3.61 (1.22)	3.70 (1.15)
10	Instructors personal response to student reflections (e.g., via journals to questions on benefits/challenges)	4.04 (1.10)	3.86 (1.18)	4.06 (0.95)	4.03 (1.05)
11	Instructors use of various features in synchronous sessions to interact with students (e.g., polls, emoticons, whiteboard, text, or audio and video chat).	3.43 (1.23)	3.45 (1.30)	3.55 (1.28)	3.49 (1.23)
12	Interactive visual syllabi of the course (e.g., includes visual of the instructor and other interactive components)	2.98 (1.18)	2.82 (1.27)	2.89 (1.23)	2.94 (1.20)
Subscale Total		**3.97 (0.65)**	**3.55 (0.82)**	**3.86 (0.68)**	**3.81 (0.64)**

Participants rated item 4 (Instructor's timely response to questions) most helpful for instructor presence, engagement, and learning. Although the most helpful facilitation strategy for instructor connection was item 3 (Able to contact the instructor in multiple ways), item 4 was rated second to Item 3 only. Item 8 (Instructors timely feedback on assignments/projects) was rated second highest as helpful for instructor presence, engagement and learning. Item 12 (Interactive visual syllabi of the course) was rated least helpful for all four subscales: instructor presence, instructor connection, engagement, and learning.

Most-Helpful Instructor Facilitation Strategies

Responses to open-ended questions demonstrate most helpful facilitation strategies (Table 3). Using group projects to support peer learning was rated as helpful by 13% of the respondents. Another facilitation strategy rated helpful by 11% of the respondents was using synchronous sessions to explain the content. An exemplary quote is "I have found an always open synchronous chat to be helpful, especially with graduate students. Tools like this could include Skype chat, Slack chat, and the like."

Table 3

Most Helpful Facilitation Strategies

Codes	Frequency	Percentage
Group projects to support peer learning	15	13
Synchronous sessions to present content or answer questions	13	11
Feedback to enhance communication between students and instructor.	9	8
Students to take active role in leading discussions or presenting projects etc.	8	7
Consistent course structure in terms of deadline and content	8	7
Having personal interaction with students for clarifying the concepts	7	6

Least-Helpful Instructor Facilitation Strategies

The least helpful facilitation strategies are presented in Table 4. Some participants (4%) did not find synchronous sessions helpful as one of them said that "Synchronous sessions tend to not be well attended and does not really encourage active learning due to limitations in how you can present information." Similarly, discussion boards are not effective for some instructors (4%): for example, "Required replies to student discussion posts without a specific requirement or prompt. Discussions too hard to read via threads and don't have sufficient new info to make the effort valuable."

Table 4

Least Helpful Facilitation Strategies

Codes	Frequency	Percentage
Synchronous sessions	4	4
Discussion boards	4	4
Group projects	3	3
Personal interactions	3	3
Announcements	2	2
Exams and quizzes	2	2

Demographics and Facilitation Strategies

Since the relationships between the subscales of facilitation strategies and the total score (ranged from .87 to .95) were very high (Table 5), the total score of instructor facilitation strategy instrument was used for the following analyses.

Table 5

Relationships between Subscales of the Facilitation Instrument

	Connection	Engagement	Learning	Total
Presence	.73***	.89***	.81***	.93***
Connection		.74***	.64***	.87***
Engagement			.84***	.95***
Learning				.89***
Total				--

Note. *** $p < .001$.

Statistically significant differences were noted between male and female instructors who teach online with respect to their perception of the helpfulness of facilitation strategies. Specifically, female instructors endorsed the strategies more than male instructors: t (97) = 2.63, p = .01, Cohen's d = 0.54 (medium effect size). Results from four-way ANOVA suggested no statistically significant differences in either delivery method, level taught or discipline after controlling for gender. No statistically significant interaction effects were found either ($p > .05$). Specifically, no statistically significant differences in instructor perception of facilitation strategies were found between education and non-education faculty: F (1, 90) = 0.34, p = .56, partial η^2 = .004 (small effect size). No statistically significant differences in instructor perception of facilitation strategies were found between faculty who teach online courses and faculty who teach hybrid courses: F (1, 90) = 0.96, p = .33, partial η^2 = .011 (small effect size). Moreover, no statistically significant differences in instructor perception of facilitation strategies were found

between faculty who teach undergraduate courses and faculty who teach graduate courses: F (1, 90) = 0.96, p = .33, partial η^2 = .011 (small effect size). Means and standard deviations of instructor perception of facilitation strategies by gender, delivery method, and course level taught are reported in Table 6.

Table 6

Means and Standard Deviations of Instructor Perception of Facilitation Strategies

Gender	Delivery Method	Level Taught	Discipline	*M*	*SD*	*n*
Female	Hybrid	Under	Non-Education	4.38	--	1
			Education	3.86	0.38	5
		Graduate	Non-Education	4.29	--	1
			Education	3.64	0.63	7
	Online	Under	Non-Education	3.83	0.69	15
			Education	3.81	0.33	10
		Graduate	Non-Education	3.77	0.62	7
			Education	4.13	0.44	19
Male	Hybrid	Under	Non-Education	--	--	0
			Education	3.92	--	1
		Graduate	Non-Education	--	--	0
			Education	4.11	0.58	2
	Online	Under	Non-Education	3.36	0.63	13
			Education	2.41	2.00	2
		Graduate	Non-Education	3.68	0.50	8
			Education	3.88	0.63	7

Discussion

In the following section, we discuss the most helpful and least helpful instructor facilitation strategies based on instructors' perception.

Timely response to questions/feedback is very helpful

Instructors rated timely response to questions and timely feedback on assignments/projects as the two most helpful facilitation strategies in three out of the four constructs (instructor presence, engagement, and learning). This is consistent with findings from research studies that indicate that instructors' facilitation in terms of timely response to questions and timely feedback on assignments are important in establishing instructor presence, student engagement in their courses, and facilitating higher levels of learning (Hodges & Cowan, 2012; Sheridan & Kelly, 2010).

Martin, Wang and Sadaf (2018) noted that instructor's timely response and feedback were highly valued by students. There is consistency in both students and instructors valuing the importance of timeliness in online course facilitation. When instructors respond promptly it establishes immediacy and reduces isolation for the online students. Instructors can use a variety of strategies to provide timely responses, including a group forum where all students can see the questions posted, periodic virtual office hours, and providing collective feedback.

Group Work is helpful

In the open-ended comments, instructors rated group projects as a helpful facilitation strategy. Research has shown the benefits of group work. Koh, Barbour, and Hill (2010) identified strategies for instructors to improve online group work that include assist group formation, build a sense of connection, be involved in group processes and evaluate group processes. Chang and Kang (2016) recommend instructors to split group work into individual portions, use peer evaluation, create guidelines for communication, and oversee group work processes. Instructors in the open-ended comments listed that group work supports peer learning and these studies confirm the findings.

Synchronous Session helpful or not

In the quantitative data, the synchronous session was rated as average helpful by the instructors, and the open-ended comments showed 11% of the instructors consider it as helpful. Synchronous session was considered least helpful by 4% of the instructors. There has been mixed perception by instructors on the benefits of synchronous session. In online programs that are entirely asynchronous instructors may not see the benefit of facilitation strategies since their students are not mandated to participate in synchronous sessions. Moreover, in this study 72% of the instructors primarily taught in an asynchronous format. According to Lowenthal, Dunlap, and Snelson (2017), faculty avoid using synchronous communication for various reasons including not having to be in class at specific time, scheduling, and technological challenges. Instructors who see the benefit of synchronous sessions use it to assist student's isolation and provide immediacy in online environment (Martin & Parker, 2014).

Visual Syllabi is the least helpful

Using Visual Syllabi was rated the least helpful by the instructors for all four constructs. Although there is reference in the literature about the importance of using a visual syllabi, it is not widely researched (Grigorovici, Nam, & Russill, 2003; Richards, 2003). Like the instructors, students rated the visual syllabi the least helpful (Martin, Wang & Sadaf, 2018). They recommended that for visual syllabi to be beneficial, online instructors should create syllabi with hyperlinks and visuals where students can easily find information they need and answers to all their questions.

Demographics

Female instructors rated the facilitation strategies higher than male instructors. Female faculty were more interested in online teaching compared to male faculty (Shea, 2007) and to be more confident in instructional skills and involved in course development than male faculty (Chang, Lin, & Song, 2011; Seaman, 2009). The sample in this study included 65% of female instructors and majority of them teaching online (83%). The findings on high ratings of the female instructors is consistent with the previous studies.

Implications and Recommendations

This study has implications for online instructors, instructional designers and administrators. The results of this study recommend helpful facilitation strategies for instructors who teach online. It is not only important for the instructors to design an effective online course, but also be an effective facilitator.

Instructors

Use a variety of facilitation strategies: All the facilitation strategies except the one to use visual syllabi were rated strongly high. This shows that instructors who teach online could use all the 11 strategies in their online teaching and benefit from it. Most important, it is essential for the instructors to provide timely responses to questions and provide timely feedback along with providing multiple ways for the students to contact them.

Set aside time for facilitation: It is important to reserve time for facilitation of the online course. This will assist in responding to questions and in grading work and providing timely feedback to students. Some of the creative strategies to provide timely responses include using a common forum for questions that saves them time from responding to questions individually, using a frequently asked questions that students can read and benefit from, and hosting synchronous office hours to answer student questions. Re-using feedback comments, providing collective feedback to the class, using various modalities to provide feedback (audio, video) in situations where it saves time will assist in providing timely feedback.

Include policies for facilitation in syllabus: Regarding providing timely feedback to students, it is essential to have a policy in the syllabus on the timeframe when students can expect to receive feedback.

Instructional Designers

This study also has recommendations for instructional designers who support instructors in the design of the online course. Facilitation Strategies are important in addition to design. In many cases, the emphasis is placed on design when instructional designers work with instructors. The findings from this study recommends that instructional designers also recommend faculty to build in various facilitation practices in their online courses. All the recommendations listed above for the online instructors also apply for the instructional designers.

Administrators

This study has recommendations for administrators who provide support for instructional designers and faculty who teach online.

Teaching evaluation: When peer observation or teaching evaluation forms and processes are created, it is important to include items on facilitation along with design. More and more campuses are adopting processes such as Quality Matters that focus on design only. The findings from this study emphasizes that in addition to design, facilitation is also important. A well-designed course if not implemented well will not be effective.

Policies on online teaching: Creating policies on presence of online instructors in the online courses will enable instructors to be present in the online course.

Limitations and Future Research

This study is limited due to small sample size and low response rate. We received only 100 complete responses, with a response rate of 4.8%, from the instructors surveyed because the AECT email list includes faculty, practitioners, and students. We did not have access to the email list of only faculty. Only faculty who teach online or hybrid were requested to complete the survey. In addition, the data were self-reported so there might be a response bias. For example, instructors who chose to respond to the survey might be different from those who chose not to. In this case, the data would not be representative of the population and conclusions reached in this study would be limited in external validity. Moreover, only the 12 facilitation strategies identified in a previous study (Martin, Wang & Sadaf, 2018) were used in the survey. They might not be an extensive list of strategies. Future research studies could examine other facilitation strategies and use qualitative methods to interview expert instructors to identity more facilitation strategies in online teaching.

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Social Media Learning Activities (SMLA): Implications for Design

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Abstract
This study explored how experienced faculty are using social media to support student learning. It analyzed the types of social media learning activities (SMLAs), their design, the cognitive processes that they support, and the types of knowledge that students engage in when completing SMLAs. Data gathered from five different cases of six faculty using social media in their courses revealed that social media has the potential to support student learning and promote different levels of cognitive processes and types of knowledge. Results also revealed that experienced faculty select social media tools based on their technology features or their popularity in the field of study, and they recommend integrating several media sources in the design of a single SMLA. Furthermore, this study suggested that experienced faculty who use social media, specifically wikis and blogs, use them as Learning Management Systems (LMS). Finally, the social factor of social media was not evident in the design of the learning activities, and faculty reported promoting more dialogue in their revised SMLA. The findings of this study yielded significant considerations for faculty when designing SMLA.

Keywords: social media, social media learning activities, social media design, instructional design, online learning, LMS

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Social Media Learning Activities (SMLA): Implications for Design

In the last two decades, the world has experienced a degree of networked digital connectedness that exceeds the limits of traditional communication tools such as phone or email. The rise of social media over the last ten years has led to a wired universe impacting the way people interact with each other and the way they process the wealth of information surrounding them. Social media technologies have become integral in today's learning environments, especially for college students, leading to a paradigm shift in the education system calling for learner collaboration, personalization, and user-generated content.

Social media, also referred to as Web 2.0 applications or technologies (Ravenscroft, Warburton, Hatzipanago & Conole, 2012; Valjataga, Pata, Tammets, 2011), are defined as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content" (Kaplan & Heinlein, 2010, p.61). There are hundreds of social media technologies at the user's disposal and many of them share similar affordances like networking, communicating, and sharing while other tools have additional distinguishing features. Kitsantas and Dabbagh (2010) and Dabbagh and Reo (2011b) classified social media technologies as follows:

- *Experience- and resource-sharing tools* that enable online/social bookmarking, blogging, wiki-ing, and microblogging such as Delicious, WordPress, PbWorks, and Twitter;
- *Media sharing tools* that enable social tagging such as Flickr and YouTube;
- *Social networking tools* that enable *socio-semantic* networking such as Facebook and LinkedIn;
- *Communication tools* such as email and web-conferencing tools like Skype.

In a recent EDUCAUSE Center for Applied Research (ECAR) study, Brooks and Pomerantz (2017) reported that 97% of undergraduate students own a smartphone and 78% of these students consider these devices as moderately important for their academic achievement. The use of mobile devices and mobile apps are driving forces in the increase of adopting social media (Bannon, 2012). Perrin (2015) reported that 90% of young adults (18–29 year-olds) use social media. Likewise, in a 2015 ECAR study, students requested the use of social media as a learning tool (Dahlstrom, et al., 2015). Research shows that students are mainly using social media technologies for collaboration through online file sharing tools, online sharing of information through websites, tracking and managing their academic schedule, and communicating with peers (Smith, 2017).

On the other hand, faculty adoption of social media to support student engagement and learning has been on the rise. Seaman and Tinti-Kane (2013) reported that 41% of faculty in higher education use social media in their teaching with a higher percentage in the Humanities and Arts disciplines. They also reported that faculty mostly use wikis and blogs for instructional purposes and prefer using online videos through YouTube and similar platforms as course resources. Similarly, del Valle, Gruzd, Haythornthwaite, Paulin and Gilbert (2017) reported that multimedia repositories, social networking sites, and document sharing tools where the most commonly used tools for teaching. Del Valle et al. (2017) also reported a correlation between faculty personal use of social media and academic use; the more faculty use social media for personal benefit, the more likely they are to integrate these tools in their teaching.

While social media use for teaching and learning is on the rise at the tertiary level, few studies have examined how faculty are designing learning activities using social media and whether faculty are leveraging the intrinsic or integral affordances of social media for teaching. Understanding how experienced faculty are using social media in higher education is essential to developing best practices for implementing social media in teaching and learning contexts.

Social Media as Learning Resources

A review of existing research suggests a positive impact of social media on student learning, specifically on students' engagement with peers and with the content, and as tools to supplement classroom teaching (Yang & Chang, 2012; Churchill, 2009; Rambe, 2012; Hung & Yuen, 2010; Domizi, 2013; Fox & Varadarajan, 2011; Menkhoff & Bengtsson, 2012; Lichter, 2012). These studies revealed that faculty from different disciplines including education, pharmacy, language learning, public administration, information technology, science, business, music, and visual arts are using social media to support their face-to-face or online courses.

Studies revealed that social media learning activities mainly engaged the students in connecting with peers and with learning outside the classroom, commenting on each other's work, collaborating, and creating projects through microblogging platforms, social networking sites, media sharing tools, and experience and resource sharing tools. A review of the literature conducted by Zachos, Paraskevopoulou-Kollia and Anagnostopoulos (2018) synthesized the benefits of using online social networks (OSNs) like Facebook and Twitter in education. Their findings suggested that OSNs support student formal and informal learning, provide opportunities for students to be exposed to new perspectives for learning through virtual communities, enhance student communication, collaboration, and motivation.

Furthermore, blogs have been used for writing essays, giving students opportunities to comment on each other's blogs, access course material, post course artefacts, form online groups and as a reflection journal (Chawinga, 2017; Churchill, 2009; Farwell & Kruger-Ross, 2013; Gedera, 2011; Yang & Chang, 2012). Wikis have been used as collaboration tools to complete group projects and Capstone projects, for peer reviewing and editing, for sharing resources, asking questions, and reflecting on readings (Abdekhodaee, Chase & Ross, 2017; Berthude & Gliddon, 2018; Bonne & Lin, 2013; Franklin & Thankachan, 2013; Hu & Johnston, 2012; Oskoz & Elola, 2011; Park et al., 2010). Social networking tools are used for asking and answering questions and participation in discussion forums, sharing resources, inviting guest speakers, and posting notifications and reminders (Cain & Policastri, 2011; Hung &Yuen, 2010; Irwin, Ball, Desbrow & Leveritt, 2012; Junco, 2012; Omar, Embi, &Yunus, 2012; Rambe, 2012). Microblogging tools such as Twitter are being used to post tweets about a course topic, tweet class announcements and reminders, discuss a topics in class and outside class, ask and answer questions, and vote on answers (Andrade, Castro & Ferreira, 2012; Chawinga, 2017; Domizi, 2013; Fox & Varadarajan, 2011; Gao, Luo, & Zhang, 2012; Junco, Heibergert & Loken, 2011; Lin, Hoffman, & Borengasser, 2013). Media sharing tools such as YouTube and Flickr are being used to create a video and share it, upload and tag photos, comment on photos and videos, summarize important lecture notes and record demonstrations (Bussert, Brown, & Armstrong, 2008; Lehmen, Dufren & Lehman, 2010; Lichter, 2012; Orùs, 2016; Price, Tsui, Hart & Saucedo, 2011). While the research is clear regarding the benefits of social media use for learning, it is lacking in the area of designing social media learning activities (SMLA). In other words, how are faculty integrating SMLA in their teaching? Is there a well-defined process that guides the design of SMLA?

Social Media Learning Design Frameworks

Existing Web 2.0/social media learning design frameworks have taken into consideration the interaction between technology and pedagogy. Bower, Hedberg, and Kuswara (2010) proposed a Web 2.0 learning design process through the following steps: (a) identifying learning goals; (b) identifying the type of knowledge that students should gain from the activity; (c) identifying the

cognitive processes that the students should engage in; (d) selecting the type of pedagogy, and finally; (e) selecting the "preferred modalities of representation" such as audio, video, and text. Two main components of Bower et al.'s (2010) Web 2.0 learning design process are *cognitive processes* established by *Bloom's Taxonomy of Cognitive Domains* and *knowledge dimensions* or types of knowledge, factual, conceptual, procedural, and metacognitive, proposed by Anderson and Krathwohl (2001). Bower et al. presented a conceptual framework that cross-tabulated Bloom's revised cognitive processes with the types of knowledge and another component, types of online pedagogies.

Similarly, Karvounidis, Chimos, Bersimis, and Douligeris (2015) presented i-SERF as a guiding framework for the integration of social media in higher education. I-SERF is a two-layered framework in which the first layer is educational and draws on the interaction between three forms of knowledge: content, technology, and pedagogy while the second layer proposes an evaluation methodology to the first layer. This framework adds the elements of the learner's self-regulation and self-evaluation that were missing in previous frameworks (Karvounidis, Chimos, Bersimis, and Douligeris (2018).

Since Bloom's taxonomy plays a key role in the design of learning activities, Bosman and Zagenzysk (2011) and Lightle (2011) interpreted social media learning using Bloom's Taxonomy. For instance, they reported that social bookmarking promotes remembering, social blogging promotes understanding, social file sharing supports applying, social collaboration supports analyzing, social decision-making tools stimulate evaluating, and social creativity sharing tools promote creating. However, Bosman and Zagenzysk's (2011) and Lightle's (2011) analysis of social media in the light of Bloom's taxonomy is only perceptual. Hence, there is a need to formalize our understanding of social media use for learning and the levels of cognitive skills and types of knowledge though evidence-based research.

Current Study and Research Questions

This study aimed to explore how experienced faculty are using social media to support learning activities in their courses. More specifically, it aimed to analyze social media learning activities (SMLA) in light of cognitive processes and types of knowledge that students engage in when completing these activities. Research questions addressed in this study were:

a. What types of learning activities are designed through social media?
b. What cognitive processes do SMLA promote?
c. What types of knowledge do SMLA promote?
d. What strategies do experienced faculty use to design SMLA?

Method

This study was conducted in a public higher education institution in the mid-Atlantic region of the U.S. A qualitative approach was used with quantification of some results. A multiple case-study design was implemented and data was gathered from five cases of six faculty (n = 6) who were using social media in their courses for at least two years. Students enrolled in the six courses taught by the faculty participants were considered secondary participants, and consented to observation of their course-related posts in the examined SMLA. Out of 279 students who were

enrolled in the six courses, 115 (n = 115) students gave consent to the researcher to observe their course-related social media posts.

Table 1

Description of Participants

Faculty Participants	Course Title in Which SM is Used	Number of Semesters Teaching this Course	Course Delivery Format	Years in Higher Ed	Year Started Using SM	Number of Students per Course	Number of Student Consent
Faculty A	Digital Future: Digital Activism (DFDA)	2	Hybrid 6 credits	17	1997	18	N/A
Faculty B1	Food, Culture, and Technology (FTC)	3	Face-to-Face Non-credit	15	2007	6	5
Faculty B2		3		18	2010		
Faculty C	Leading Change (LC)	3	Face-to-Face 4 credits	19	2009	25	22
	Leadership Theory and Practice (LTP)	3	Face-to-Face 3 credits			20	16
Faculty D	Introduction to Digital Studies (IDS)	1	Face-to-Face 3 credits	9	2005	25	22
Faculty E	Introduction to Business Information Systems (IBIS)	5	Face-to-Face 3 credits	3	2011	185	50

Data Sources

Data sources included syllabi and course documents describing the social media learning activities (SMLAs), students' posts in SMLAs, and faculty initial and follow-up interviews. The syllabi and the descriptions of the SMLA provided baseline data about the requirements and deadlines that guided the analyzes of the SMLAs. Faculty participants were interviewed at the beginning and end of the semester in initial and follow-up interviews giving participants the freedom to express their range of perceptions about the use of social media in their courses (Maxwell, 2013). Both interviews were semi-structured and included open-ended questions. In the initial interview, faculty were asked to analyze their SMLAs in light of Bloom's taxonomy, and they were asked about their perceptions regarding social media to support student learning, the criteria they use to choose their social media, and strategies they used to develop the learning activities involving social media. In the follow-up interview, faculty were asked to describe their experiences with the outcomes of the social media activity, whether it has achieved what it was intended to achieve, the types of knowledge that students gained, and revisions they would make to their SMLAs. Social media platforms used by the faculty and the students were also observed online and then students' posts and interactions in the SMLA were analyzed. The focus of the

observations was to identify cognitive processes and knowledge domains observed in students' SMLA posts.

Data Analysis

Influenced by Bower et al.'s conceptual framework for Web 2.0 learning design, two taxonomies guided the analysis of the SMLAs in this study: original and digital versions of Bloom's *Taxonomy of Cognitive Domain* (Churches, 2009) (see Figure 1), and *Knowledge Dimensions or Types of Knowledge* (Anderson & Krathwohl, 2001).

Krathwohl (2002) provided a detailed explanation of the different types of knowledge:

- *Factual Knowledge*—The basic elements that students must know to be acquainted with a discipline or solve problems in it.
- *Conceptual Knowledge*—The interrelationships among the basic elements within a larger structure that enable them to function together.
- *Procedural Knowledge*—How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.
- *Metacognitive Knowledge*—Knowledge of cognition in general as well as awareness and knowledge of one's own cognition (p. 215).

As presented in Tables 3 and 4, both the researcher "R" and the faculty participants "F" analyzed the social media activities as described in the syllabi. Content analysis of SMLAs was conducted using preestablished categories pulled from Bloom's Taxonomy of Cognitive Domains and Krathwohl's (2000) Knowledge Dimensions. The students' posts in social media were also analyzed by the researcher using the preestablished categories. Percentages in Tables 3 and 4 suggest the extent to which cognitive processes and knowledge dimensions where evident in the students' posts. The boxes that include "F" indicate that Faculty identified the presence of the corresponding cognitive process or knowledge domain in the SMLA and the "R" shows the researcher's analysis of the SMLAs. Patterns relevant to the absence of cognitive processes and knowledge domains were identified based on triangulated data from faculty analysis, researcher's analysis, and students' posts. In some boxes, the researcher's analysis and the analysis of students' posts highly converged as indicated by a percentage greater than 50.

In order to achieve fairness in the analysis of students' posts in SMLAs, 30% of the posts in each SMLA were selected, resulting in a total of 343 student posts analyzed. The 30% of posts were sampled from students' beginning, middle, and end of activity, in order to analyze the students' work across the whole activity. The researchers conducted the same analysis to achieve inter-rater reliability.

Initial and follow-up interviews were analyzed using deductive coding (Miles & Huberman, 1994). Deductively, categories from the initial and follow-up interview questions were first established based on the research questions that were addressed in the interviews. Further, open coding was conducted to analyze data that does not align with the preestablished categories. Credibility was established by obtaining member checks, triangulation of data, and long-term involvement in data collection. Since this multiple-case study is holistic in nature, a meta-matrix was created in order to focus on the findings across cases rather than on every individual case (Miles & Huberman, 1994).

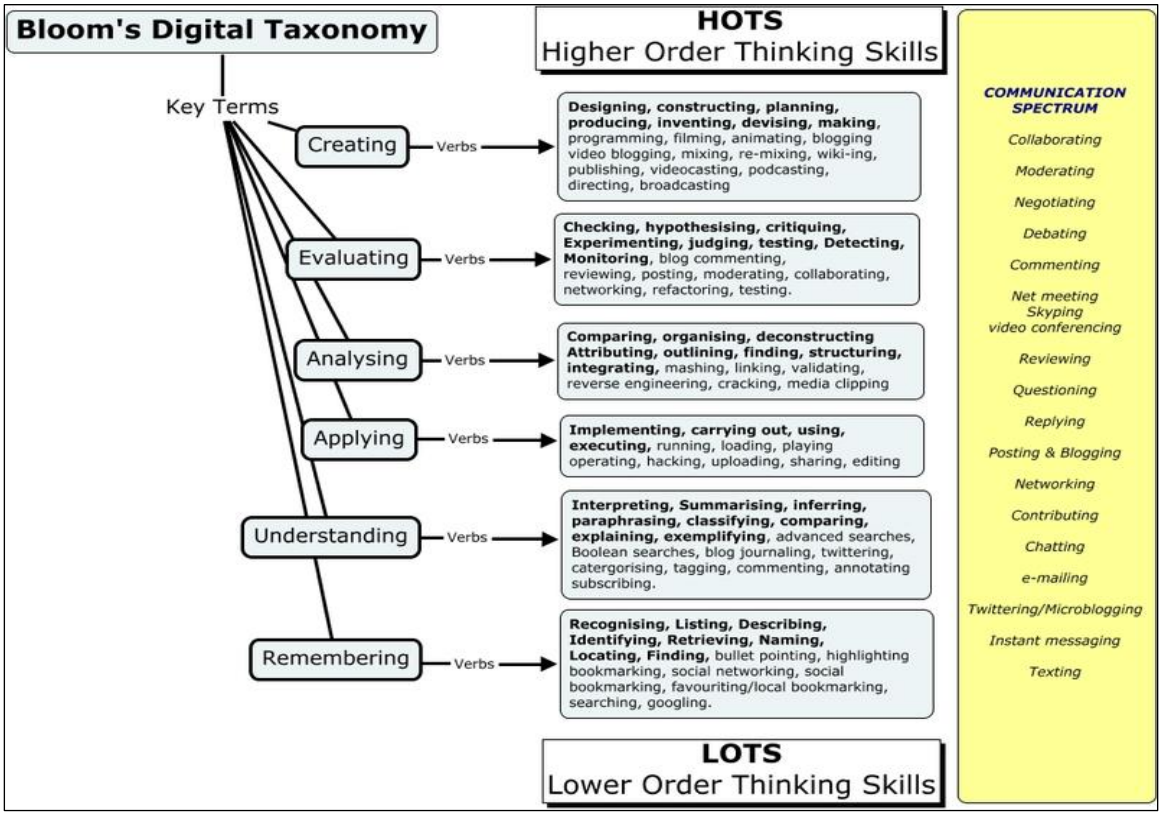

Figure 1. Bloom's digital taxonomy (adapted from Churches [2009]).

Research Findings

The analysis revealed that overall, social media has the potential to support student learning and promote different levels of cognitive processes and types of knowledge. The findings are reported by research questions below.

Research Question 1: ***What types of learning activities are designed through social media?***

A total of 12 SMLA across the five courses were identified in this study. Out of these activities, there were four microblogging activities, two blogging activities, three wiki activities, one podcasting activity, one infographic activity integrated into a blog, and one YouTube activity (see Table 2). Out of the 12 SMLA, 2 were unstructured used for informal class reminders, announcements and discussions while 10 were structured, graded, and described in the syllabi. The latter represented 5% to 100% of the total course grade. Seven out of the structured 10 activities were mandatory and the remaining three were optional. In the optional activities, students had the alternative to select SMLA or traditional non-social media activities identified in the course syllabus that would count toward the course grade.

Table 2

Social Media Learning Activities (SMLAs) Included in the Study

Social Media and Course Title	Social Media Learning Activities (SMLAs)	Private vs. Public	Structured vs. Unstructured	Mandatory vs. Optional	Course Grade Percentage
Microblogs Leading Change (LC)	Personal Transformation Experiment using Twitter.	Public	Structured	Mandatory	15%
Introduction to Business Information Systems (IBIS)	Online Class Participation at Twitter	Public	Structured	Optional	5%
Digital Futures: Digital Activism (DFDA)	Digital Activism Twitter Projects	Public	Structured	Mandatory	15%
DFDA	Twitter in-class and small group participation	Public	Unstructured	Optional	Unspecified
Blogs Food, Culture and Technology (FCT)	Language Blog	Public	Structured	Mandatory	100%
Introduction to Digital Studies (IDS)	Digital Studies Course Blog	Public	Structured	Mandatory	20%
Wiki Leadership Theory and Practice (LTP)	Collaborative Note-Taking	Private	Structured	Mandatory	25%
	Wiki as LMS	Private	Unstructur-ed	Optional	Unspecified
Podcasts FCT	Podcasting	Public	Structured	Mandatory	Unspecified
Infographic FCT	Creating Infographics	Public	Structured	Mandatory	Unspecified
YouTube DFDA	Participatory Action Video using YouTube	Private	Structured	Mandatory	50%
Wikipedia DFDA	Wikipedia	Public	Structured	Optional	25%

The use of the social media technologies to support the SMLAs was either private or open to the public, allowing any person to observe the students' work or interact with them. Nine out of 12 SMLAs were public and three were private. Microblogging or Twitter activities were all public because the tool does not have private features. Two blogging activities were public. Both were also searchable online, although only specified users could contribute to them. Wiki activities were private and access to them requires an invitation from the wiki administrator. However, Wikipedia activity was public because students had to edit an existing Wikipedia entry and could get feedback on their edits from the public. Podcasts and infographics activities were public since they were posted on a public blog while the YouTube activity was also private, since students posted their videos privately to YouTube and only students and faculty had access to them.

Research Question 2: ***What cognitive processes do SMLAs promote?***

As explained in the data analysis, the SMLAs were analyzed using Bloom's original and digital taxonomy of cognitive processes to identify the level of cognitive processes that students are expected to achieve while completing the learning activities, as well as evidence of students' cognitive processes in their SMLA posts. The analysis of the data across courses and social media technologies revealed two overarching themes. First, both higher and lower levels of cognitive processes were evidenced through SMLAs. Second, alignment was perceived between particular social media affordances and cognitive processes.

These overarching themes were based on common patterns observed in the analysis. Based on Bloom's Digital Taxonomy, "Remembering" and "Understanding" were perceived as basic cognitive processes promoted in all the examined SMLAs (see Table 3). The analysis of blogging and wiki activities revealed that blogs and wiki SMLAs may promote several cognitive processes ranging from "Remembering" to "Creating." Furthermore, the analysis suggested that higher levels of cognitive processes may be promoted mainly by blogs, wikis, and media sharing tools such as the Collaborative Note Taking activity, the Language Blog, and the Digital Studies Course Blog. Finally, the results suggested that SMLAs may promote "Analyzing" through hyperlinking and may promote "Evaluating" through judging and critiquing peer work.

Table 3

Sample Analysis of SMLAs Based on Bloom's Taxonomy

	Cognitive Processes					
Social Media Activities	Remember	Understand	Apply	Analyze	Evaluate	Create
Twitter: Personal Transformation Experiment (PTE)	F 37.2%	 R 95%	 8.13%	F R 12.8%	 33.7%	
Twitter: Online Course Participation (and sharing resources)	 R 50%	 F R 22%	 F R 	 R 12.9%	 1.2%	

Note. Letter "F" indicates the faculty member's content analysis of the SMLA as presented in the syllabus. Letter "R" shows the researcher's content analysis of the SMLA as described in the syllabus. The % shows the researcher's analysis of the presence of cognitive processes in the students' posts on social media.

Research Question 3: ***What types of knowledge do SMLAs promote?***

Both faculty and the researcher analyzed the knowledge domains perceived in SMLAs as listed in the course syllabi and documents. The students' posts in SMLAs were also analyzed in terms of types of knowledge using pre-established categories (see Table 4). The convergence in the data analysis revealed two overarching themes: all types of knowledge were evidenced through SMLA and there is a perceived alignment between particular social media affordances and types of knowledge.

The overarching themes were based on common patterns observed in the data analysis. The analysis of students' posts in seven SMLAs revealed that students achieved factual knowledge about the course content in five out of the seven observed SMLAs, which suggests that factual knowledge is a common outcome in SMLAs. Results also suggested that linking and tagging in SMLAs promoted conceptual knowledge especially in activities that required them to use #hashtags or include links to external resources. Procedural knowledge was mainly evident in activities that required students to create a product such as a Personal Language Blog, podcasts, or infographics. In both activities, students engaged in a procedure to create the final product and to learned how to use it. Finally, metacognitive knowledge was identified in three out of seven activities that were examined. Students were expected to think about their learning or how they might use the subject matter to reflect on their own cognition. The design of the SMLAs in these courses suggested that students had several chances to reflect on their learning and revise their posts before sharing them.

Table 4

Sample Analysis of the SMLAs Based on Krathwohl's (2002) Knowledge Dimensions

	Knowledge Domain			
Social Media Activities	Factual	Conceptual	Procedural	Metacognitive
Twitter: Personal Transformation Experiment (PTE)	R 44%	R 65%	1%	F R 60%
Twitter: Online course participation	F R 68%	F 54%		

Note. Letter "F" indicates the faculty member's content analysis of the SMLA as presented in the syllabus and shows that the knowledge domain was present in this SMLA. Letter "R" shows the researcher's content analysis of the SMLA as described in the syllabus. The % shows the researcher's analysis of the presence of knowledge domains in the students' posts on social media.

Research Question 4: ***What strategies do experienced faculty use to design SMLA?***

Experienced faculty with social media were selected for this study in order to capture best practices in designing SMLAs. In the initial interview, faculty were asked about the criteria they used to select social media technologies, and how they paired it with the learning activity. The follow-up interview captured faculty's reflection on the SMLA and suggestions for future

revisions. The two overarching themes that emerged in data collected for this research question were *Faculty Reliance on Social Media Affordances and Fit With their Course Content* and *Integrating Additional Media Sources to Enhance SMLAs*. These themes were the result of six common patterns observed across findings related to strategies that faculty use when designing SMLAs:

a. Matching the discipline with the social media;
b. Selecting social media based on affordances;
c. Taking advantage of the affordances of social media;
d. Including media sharing (website, video, audio) in the SMLA;
e. Integrating tools or social media affordances that support dialogue, and;
f. Making the SMLA mandatory and not optional.

Discussion

Evidence of Several Cognitive Processes and Types of Knowledge in SMLAs

The analyzed SMLA in this study suggested that all social media tools could promote more than one type of knowledge or level of cognitive processes depending on the design of the SMLA and how students use the social media technology, a finding that is in line with Bower et al. (2010), Bosman and Zagenczyk (2011), Lightle (2011), and Gülbahar, Rapp, Killis and Sitnikova (2017). Findings suggested that wiki SMLAs can promote all levels of cognitive processes, and can support Factual, Conceptual, and Metacognitive knowledge. Blog SMLA can also foster all levels of cognitive processes and can support all types of knowledge, a finding that resonates with Gülbahar et al. (2017). Microblog SMLA can promote Remembering, Understanding, and Analyzing, and foster Factual, Conceptual, and Metacognitive Knowledge. Podcast SMLA can support Creating, Applying, and Remembering, and promote all types of knowledge. Finally, media editing and sharing SMLA can support Creating, Understanding, and Remembering, and promote Factual, Conceptual, and Metacognitive Knowledge.

The Absence of Dialogue

One of social media's roles is to promote social presence through social networking in addition to shareable user-generated content (Anderson, 2017). As social media is grounded in social learning theory of Bandura, it is supposed to enhance students' self-efficacy beliefs through social interaction in a low-risk environment (Deaton, 2015). The examined SMLAs in this study did not require conversational or interaction tasks among students. This was evidenced in the description of the SMLAs and in the deactivation of the comment feature in the blogging activities, the lack of comments in wikis, and sparse commenting or retweeting between students on Twitter. As a result, the communication took place mainly between faculty-students and not between students-students or students-others. This suggested that the design of the SMLAs were mainly used at the level of "private information management," and "basic interaction or sharing," without taking advantage of the social networking affordance of social media (Dabbagh & Reo, 2011a).

Social Media as Learning Management Systems

Analysis and observations of SMLAs revealed that four out of the five cases in this study used mostly wikis and blogs as social media technologies in their courses, a finding that concurs with Moran, Seaman, and Tinti-Kane (2012), who suggested that wikis and blogs are faculty's most adopted social media tools for teaching. Furthermore, the findings revealed that social media is used to replace Learning Management Systems (LMS) and share course content or communicate with students. More specifically, in courses where blogs and wikis were used, the faculty did not use the institution's LMS to share content and communicate with students. Rather, wikis and blogs were used as an integrative platform to share content with students, post assignment descriptions, and allow students to share their work. In other studies, Meishar-Tal, Kurtz, and Pieterse (2013), Zachos et al. (2018), and Salavuo (2008) reported the advantages of using social media as LMS in promoting collaboration and active learning over traditional institutional LMSs.

This study went a step further and suggested that the public nature of blogs gives them an advantage over LMSs, which are limited to the course participants. For instance, public blogging activities made students' work visible beyond their peers and teacher reaching out to a public audience which made their posts of higher quality and activated their metacognitive knowledge. In line with this finding, Chawinga (2017) reported the benefits of blogs as tools that allow students to write longer posts and comments as there is no word limit which results in self-expression and self-reflection (Deng & Yueng, 2011). Previous studies revealed blogs' usage as LMSs in some cases, and a platform for students to access course materials and to comment on each other's blogs, and in other cases, they are used as reflective journals or personal writing sites (Churchill, 2009; Farwell & Kruger-Ross, 2013; Gedera, 2011; Yang & Chang, 2012).

Wikis are primarily used as collaboration tools and support peer reviewing and editing (Abdekhodaee, Chase & Ross, 2017; Bonne & Lin, 2013; Franklin & Thankachan, 2011; Menkhoff & Bengtsson, 2012; Ozkoz & Elola, 2011; Park et al., 2010). The wikis examined in this study resembled LMS in their private access, but little evidence of student social interaction was perceived. Hence, this study revealed that blogs and wikis were used for sharing course content and assignments rather than promoting social interaction and collaboration among students.

Strategies for Designing SMLAs

This study did not reveal a formal approach or strategy for designing SMLAs. Rather, experienced faculty approached this task differently based on their familiarity with social media technology, the popularity of the tool in their discipline, and affordances of the technology. However, in the follow-up interviews, faculty suggested that SMLAs should be mandatory because students should learn to experiment with technology. This finding resonated with Lin, Hoffman and Borengasse (2013), who explained that Twitter activities should be structured and mandatory so that students participate in them.

Bower et al. (2010) explained that the design of the learning activity and the selection of social media are interdependent. When the faculty in this study designed the SMLAs, some were more intuitive in how they selected the social media technology because they had been using it for a while, while others designed the activity and selected the social media whose technology affordances supported the learning goals of the learning activity. On the other hand, others selected the social media technologies because they were popular and they could experiment with them and add an innovative layer to their course delivery. Therefore, experienced faculty strategies for

designing SMLAs concurs with Bower et al. (2010), who emphasized the interdependence between social media tool and the design of learning activities. Integrating different media sources within a SMLA was also another design feature that faculty recommended to help students gather information from different sources, a finding confirmed by Soares (2008).

The findings also revealed that while faculty were not aware of Bloom's Taxonomy or did not design SMLA with cognitive processes and types of knowledge in mind, the researcher's analysis showed that SMLAs promoted different cognitive processes and different types of knowledge. This finding suggests that faculty have little pedagogical training. In a previous study, Keengwe, Kidd, and Kyei-Blankson (2009) and Hughes and Zulkifli (2012) explained that faculty need organizational support and technology training in order to use technology in their teaching.

Twitter as a Popular Course Tool

Although Moran et al. (2012) revealed that faculty use Twitter the least in their courses, Twitter was used by three faculty participants in three out of five cases in this study. Twitter assignments in this study were mainly a micro-reflection activity and course participation tweets about course topics. A more informal activity was in-class participation using Twitter. The findings in this study concurred with previous studies that revealed Twitter as a reflection tool and a platform to post tweets about course related topics (Domizi, 2013; Fox & Varadarajan, 2011; Junco, Heibergert & Lokert, 2011; Lin, Hoffman, & Borengasser, 2013). However, there was little evidence of communication using Twitter in the observed SMLAs, a finding that contradicted previous research that claimed Twitter is a tool that supports communication with the professor and classmates (Fox & Varadarajan, 2011; Junco, et al., 2011).

Conclusion

This study and previous studies implied that social media technologies may engage students with the subject matter when integrated in course learning activities. Hence, designing SMLAs that take into account the technology affordances of social media can engage students' higher levels of cognitive processes and knowledge.

Findings from this study inferred that faculty use of social media in their courses is varied. SMLAs can promote learning as perceived by faculty participants in this study. The study also suggested that wikis and blogs may replace and be used as LMS as perceived by faculty in this study. Furthermore, well-structured SMLA activities should take into consideration the social affordances of the tools to optimize the use of these activities and designing SMLAs is a process of reciprocity between the selection of social media affordances and the fit of the tools. Mandatory use of SMLAs in courses may ensure student engagement. The study also suggested that there is a perceived disconnect between faculty intended and observed cognitive processes and types of knowledge of SMLAs. As a result, faculty should receive pedagogical training and support to design more effective SMLAs.

Although the study examined the use of social media in higher education within cases and across cases, because of the nonexperimental design of the study, the impact of social media activities on students' learning was not measured. Furthermore, the study was limited to faculty perceptions and students' posts in social media. Hence, students' perceptions about these SMLA were not explored. Due to the complexity of cognitive processes, identification of students' processes was limited in cases where students had short posts on social media. Furthermore, this study included faculty from a single institution, which might have limited the external validity and the generalizability of the study. Further research could involve the students in the evaluation of these SMLA and their impact on their learning.

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Shifting Teaching and Learning in Online Learning Spaces: An Investigation of a Faculty Online Teaching and Learning Initiative

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Abstract
This article presents results from a study of a year-long, teaching and learning center-directed, professional development initiative that focused on both the technology and the pedagogical supports for online and blended course delivery at a research university. The purpose of this mixed methods study was two-fold. The first purpose was to investigate pedagogical changes that occurred as a result of the professional development that included a year-long faculty learning community by exploring influences on pedagogical changes. The second purpose was to understand the perceptions of the diffusion of innovations (DOI) characteristics that influenced the level of adoption of online/blended teaching by faculty participants. A survey was used to measure the perceived characters of innovation as defined in the theoretical framework. Following the survey, one-on-one interviews that were linked to the DOI theoretical framework were conducted to better understand those characteristics. The results presented herein focus on barriers, challenges, and successes of adopting e-learning pedagogy in these online and blended learning environments.

*Keywords***:** online learning, higher education, professional development, diffusion of innovations theory, faculty development, instructor development

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Review of Related Literature

Recent trends in higher education indicate that distance learning courses are in high demand with over 31.6% of enrolled undergraduate, graduate, and noncredit students in the United States taking at least one course in a fully online format (Allen & Seaman, 2018). Given the popularity of online and blended courses and programs, 63.3% of chief academic officers in institutions of higher education in the United States have integrated online or blended learning into their long-term strategic planning (Allen & Seaman, 2018; Chen, Lambert, & Guidry, 2010). With more than 6.3 million university students enrolled in online courses (Allen & Seaman, 2018), it has become accepted that "institutions must ensure that online students receive high-quality instruction, support services, and other fringe benefits enjoyed by traditional face-to-face students" (Chen et al., 2010, p. 1229). Universities are attempting to meet this need through an array of professional development opportunities for their instructors that focus on various aspects of teaching and learning in a distance learning environment. While universities address the growing complexities of distance education, studies regarding these efforts by institutions remain limited.

The existing literature often provides numerical figures that depict how many faculty members adopted a given online teaching practice as a result of professional development. Alternatively, researchers tend to list barriers or lessons learned that are disconnected from existing innovation adoption or implementation theories. In contast, some existing research focuses on the design and implementation of a given professional development program without considering how these design decisions influenced adoption decisions by faculty members. Seldom does the existing research use theory to support the investigation of these practices. Hence, there is a dearth of literature at the nexus of theory, experiences of the instructors, and professional development for online teaching and learning in higher education.

The existing literature base contains several studies of adopting online teaching among higher education instructors in specific fields where the focus is expanding upon the nuances of that field such as with agriculture (e.g., Drape, 2013) or with nursing (e.g., Cash & Tate, 2012). The literature, however, rarely focuses on researching the adoption of distance education through a theoretical framework. Additionally, the details of how professional development influenced faculty members' teaching approaches are seldom told. When this story of adoption is told, it is usually captured in a single survey as in the work conducted by Shea (2007) where the researcher used a survey to capture motivating and demotivating factors to teaching online.

Of the studies reviewed that focused specifically on course instructors' professional development in higher education around online learning, only four studies were located that explicitly noted a theoretical framework that grounded the study. For example, Barker (2003) researched faculty development that used change theory to leverage faculty buy-in. Additionally, Shipman (2017) used the Substitution, Augmentation, Modification, and Redefinition (SAMR) model, which focuses on technology's impact on teaching and learning, to identify challenges and barriers to technology use in university classrooms. Shea, Pickett, and Li (2005) used the DOI theory as a lens to analyze satisfaction with online learning of faculty members with online learning of 913 faculty members in the State University of New York (SUNY) Learning Network. A study by Wingo, Ivankova, and Moss (2017) took a different approach and used the Technology Adoption Model (TAM) to organize a review of the research to discuss what is known about faculty perceptions about teaching online. These theory-driven research approaches to understanding the experiences of instructors at higher education institutions with professional development for online and blended learning, though useful, remain limited in the current literature body.

Nevertheless, there remains a paucity of, and yet increasing interest in, research focused on how universities support e-learning efforts to improve online and blended teaching and learning. As evidence, Mohr and Shelton (2017) conducted a four-survey-round Delphi study of higher education leaders of online learning initiatives to determine best practices for online faculty professional development. Mohr and Shelton found that professional development topics should include training in faculty roles, classroom design, learning processes, and legal issues. This research is compelling but does not bring to light the lived experiences of the stakeholders.

A limited number of existing studies of online professional development focus on training faculty for blended course delivery (Childre & Van Rie, 2015; Linder, 2017; Littlefield, 2012; Varkonyi, 2012), training faculty for online course delivery (Barker, 2003; Gunay, 2013; Keengwe & Georgina, 2011), understanding factors that influence faculty satisfaction with asynchronous teaching and learning (Fredericksen, Pickettt, Shea, Pelz, & Swan, 2000), and student engagement in online learning (Chen et al., 2010). Few studies addressed both online and blended course deliveries (Powell, 2010). Some studies take an anecdotal approach and explain how a given training was conducted and what worked or did not work in that training (Linder, 2017; Terantino & Agbehonou, 2012). Nevertheless, these studies lack a theory to drive the investigation.

Alas, the ever-changing nature of online and blended learning, coupled with a broad conception of professional development, makes comparing studies difficult. For example, studies of professional development around distance education in higher education institutions include on-demand training (Sullivan, Burns, Gradel, Shi, Tysick, & van Putten, 2013), traditional seated courses (Linder, 2017; Littlefield, 2012; Powell, 2010), workshops (Keengwe & Georgina, 2011), and faculty mentorship programs (Barker, 2003; Childre & Van Rie, 2015). Despite these efforts, there is a lack of empirical research that connects faculty experiences and perceptions of their professional development with e-learning and the resultant shifts in their attitudes and teaching approaches with regards to online and blended learning.

Given the lack of empirical research published in peer-reviewed journals on this topic, it is possible that this knowledge remains contained within universities as internal evaluations. Thus, it is likely that most e-learning program evaluations are reported internally within a given university and not shared with the outside world. Another complication is that professional development opportunities might be constrained to the implementation in a specific college or department, rather than a university-wide implementation. The few published works that exist typically take the approach of anecdotally explaining how a given training was conducted and what worked or did not work (e.g., Linder, 2017; Terantino & Agbehonou, 2012) or understanding motivators and demotivators to teaching online (Shea, 2007). Success is typically based on an internally developed self-reported survey instrument that has not been analyzed for validity or reliability. Concomitantly, these studies are often devoid of a theoretical approach. Thus, there is a need to disseminate research on e-learning professional development that is theoretically driven, situated in institutions of higher education, and captures the lived experiences of the stakeholders. In this study, this multilayered approach is taken.

Theoretical Framework

The diffusion of innovations (DOI) theory was used to guide the current research. The primary focus of diffusion research is to understand the adoption of a given innovation (Rogers, 1962). This theory was chosen as it is prominent in research studies situated in instructional technology as well as general postsecondary faculty development (Drape, Westfall-Rudd, Doak,

Guthrie, & Mykerezi, 2013; Grosz, 2012; Huun & Hughes, 2014; Jordan et al., 2012; Lewis & Slapak-Barski, 2014; Martin, Parker, & Allred, 2013; Molina, 2013; Soffer, Nachmias, & Ram, 2010). This theory has also been used to understand technology initiatives such as massively open online courses (MOOCs) (Claffey, 2015), technology policy diffusion (DeRousie, 2014), team-based learning (Freeman, 2012), mobile campuses (Han & Han, 2014), personalized learning (Karmeshu & Nedungadi, 2012), adoption of online education by traditional liberal arts colleges (Hollis, 2016), and technology in the education systems of developing countries (Richardson, 2009, 2011). The theory has also been used to understand changes in organizational culture (Shiflett, 2013). Additionally, the DOI theory has been applied to determining barriers to the continued growth of online teaching based on faculty satisfaction in the entire SUNY Learning Network (Shea, Pickett, & Li, 2005). According to Meyer (2004), Rogers' theoretical model has been used in thousands of studies across many fields including education and technology (e.g., sociology, marketing, public health, economics).

Rogers (2003) defined an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (p. 12) and noted how "diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system" (p. 5) through four fundamental elements: innovation, communication channels, time, and social system. This definition indicates a critical point—the newness of the "idea, practice, or object"—is not objectively measured but rather based on the perception of the adopter. DOI seeks to explain the processes through which ideas, practices, or objects are communicated and thereby adopted by members of a particular social system.

There are five characteristics of innovation that explain differences in adoption rates: relative advantage, compatibility, complexity, trialability, and observability. These five attributes account for most of the variance (between 49–87%) in the rate of adoption of an innovation (Rogers, 1962). Subsequently, research regarding these attributes has been further conducted, modified, operationalized, and expanded by Moore and Benbasat (1991), who generated three additional adoption constructs (see Table 1). The authors included: image (the degree to which the use of a system is perceived to enhance one's image or status in one's social system); voluntariness (the degree to which use of the innovation is perceived as being of free will); and result demonstrability (the ability to show results of using an innovation).

While Rogers (1962) provided a general approach to the theory, Moore and Benbasat (1991) focused specifically on the adoption of information technology innovations. As such, Moore and Benbasat created an instrument to measure the eight characteristics. Given the increasing demand for online and blended courses, the limited body of literature on e-learning professional development in higher education, and the need to use theory to understand this innovation in higher education, this study is both timely and needed.

Table 1

Description of the Perceived Characteristics of Innovation

PCI	Description
Relative Advantage	Degree to which an innovation is perceived as a better idea measured by economics, social factors, convenience, and satisfaction
Image	Degree the innovation enhances one's reputations with peers
Compatibility	Degree of perceived consistency with one's values, experiences, and needs
Ease of Use	Perceived degree of difficulty with using the innovation
Visibility	Degree the innovation is visible
Results Demonstrability	Degree one can see results using the innovation
Trialability	Degree the innovation can be experimented or practiced
Voluntariness	Degree using the innovation is viewed to be voluntary

Source. Rogers, E. M. (1962). *Diffusion of innovations.* Free Press and Moore, G. C.; Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information System Research, 23,* 192–220.

Method

A mixed method sequential explanatory design (Creswell & Plano-Clark, 2018) was used in this study so that quantitative results could be further explored through the collection and analysis of qualitative interview data. An initial survey was used to measure the perceived characters of innovation as defined in the theoretical framework. Following the survey, one-on-one interviews that were linked to the DOI theoretical framework were conducted to better understand those characteristics. The research questions guiding this study were:

1. What pedagogical changes occurred as a result of the professional development and subsequent year-long faculty learning community?
2. How did the perceptions of the diffusion of innovations characteristics influence the level of adoption of online/blended teaching by participants?

Project Background

The University of Kentucky launched the eLearning Innovation Initiative (eLII) in 2014. The eLII provided funding for the creation of new online or blended degree programs and the innovative redesign of large-lecture courses. Recruitment for participation in this training initiative occurred via email. The Center for the Enhancement of Learning and Teaching (CELT) emailed all faculty and instructors at the university through an open call for applications. Participation was open to anyone who wanted to participate. Thirty-six faculty members received eLII professional development funding and agreed to participate in two training initiatives.

Phase 1 of the initiative was a week-long, face-to-face professional development workshop that occurred in the summer. Phase 2 required faculty members to participate in monthly, face-to-face faculty learning communities (FLCs) for one year. These FLCs consisted of eight to ten faculty members and were led by an instructional coach from CELT. The year-long FLCs were designed as opportunities for small groups of faculty members to come together monthly to share their experiences with their own online and blended efforts. Each FLC was tasked with creating a resource that would be of service to the other learning communities. This practice allowed each group to work on a given topic while discussing the challenges and successes experienced by individual faculty members.

Participants

After Institutional Review Board approval, all 36 course instructors who participated in the training were emailed a link to the DOI survey on January 8, 2015. Of the possible participants, 31 out of 36 completed the online survey thus yielding an 86.1% response rate. The last question on the survey linked to a new survey where participants were asked to volunteer to engage in an interview. Thirteen of the 31 survey completers indicated their willingness to be interviewed. The interviews were conducted via Uberconference. The interviews ranged from 30 to 45 minutes long.

Table 2

Survey & Interview Participants by Rank

Instructor Role	**Survey *N* = 31**	**Interview *N* = 13**
Lecturer	*n* = 11	*n* = 5
Assistant	*n* = 5	*n* = 3
Associate	*n* = 7	*n* = 4
Full	*n* = 6	*n* = 1
Other	*n* = 1	*n* = 0
Unknown	*n* = 1	*n* = 0

Measures

Survey instrument. The survey used to measure DOI characteristics was a slightly altered version of the Moore and Benbasat (1991) survey (see Appendix A). The survey used a 4-point Likert-type scale and consisted of eight scales with a total of 25 items. Items were reworded for the eLII professional development program such that "personal work stations" was replaced with "skills gained from the eLII professional development." This initial instrument was developed and tested by Moore and Benbasat in three stages: item creation, scale development, and instrument testing in two pilot rounds and two field test rounds. The parsimonious instrument was developed with "a high degree of confidence in their content and construct validity" (p. 210).

In addition to the survey, three 5-point Likert-type scaled questions were used for participants to self-assess their level of adoption of the training techniques. In this study, this score is referred to as an innovation score. Here, participants rated their level of adoption using digital technology, blended learning, and online learning. The scale ranged from 1 (*last to adopt*) to 5 (*first to adopt*). Each participant received one innovation score that was calculated by averaging answers to the three items.

Semi-structured interviews. Interviews were conducted to explore survey responses further, providing concrete examples about the experience. This additional investigation allowed the exploration of latent themes and underlying trends that may not have been immediately evident. Questions for the semi-structured interview protocol (see Appendix B) were designed to explore the constructs on the Moore and Benbasat (1991) survey. Hence, interview questions were designed to understand better the eight theory-driven constructs detailed in Table 1.

Data Analysis

Analysis of the quantitative data began with running tests for reliability to determine if this population responded to the survey differently than tested in the construction of the original instrument. ANOVAs were conducted to determine if and how characteristics of innovation accounted for innovation uptake. Next, *t*-tests were run to determine if the instructors who completed the survey and then were interviewed differed on the eight perceived characteristics of innovation from those who only completed the survey. This was done to ascertain if selection bias existed for the individuals interviewed.

The quantitative analysis was followed by the analysis of the interviews. Analysis of the qualitative data began with an a priori coding scheme that was restricted to the eight characteristics defined by the DOI framework (see Table 1). As a first step, one coder coded all data within the eight constructs. After coding for these constructs, the codebook was expanded by the team to include codes related to perceptions of professional development as they related to the theoretical framework. As a second step, using inductive coding, one researcher coded all the transcripts. A second and third researcher confirmed all codes. This allowed the team to capture deep rich details about the professional development as it related to the theory-driven characteristics.

Results

Internal consistency of reliability was investigated for the eight individual characteristics using coefficient alpha (see Table 3). Most characteristics had a Cronbach's alpha of greater than 0.80, with only visibility ($\alpha = 0.79$) and trialability ($\alpha = 0.69$) falling below this level. The internal consistency of the trialability characteristics being the lowest of all constructs is similar to what was reported by Moore and Benbasat (1991). The internal consistency of reliability for the entire instrument was considered suitable ($\alpha = 0.92$).

Table 3

Diffusion of Innovations Short Scales Cronbach's Alpha

Characteristic	Number of Items	Cronbach's alpha reported by Moore and Benbasat (1991)	Cronbach's alpha of the current study
Compatibility	3	0.86	0.90
Ease of use	4	0.84	0.94
Image	3	0.79	0.99
Relative advantage	5	0.90	0.90
Results demonstrability	4	0.79	0.92
Trialability	2	0.71	0.69
Visibility	2	0.83	0.79
Voluntariness	2	0.82	0.86

A one-way ANOVA was used to compare the effect of innovation score on the DOI characteristics for the 31 participants who completed the survey to determine if there were group differences. There was not a significant effect of innovation level on any characteristic at the $p < 0.05$ level. These results indicate that the survey did not accurately capture the degree to which the participants adopted this innovation, which could be attributed to the small sample size (see Cohen, 1992). Table 4 provides the innovation score for each of the 13 interview participants.

Table 4

Interview Participants Descriptive Summary

Participant	Faculty Rank	Gender	College	Innovation Score	Adoption Level
Instructor A	Lecturer	Female	Fine Arts	5.00	Early
Instructor B	Associate	Male	Education	4.67	Early
Instructor C	Associate	Female	Business	4.67	Early
Instructor D	Lecturer	Female	Business	4.67	Early
Instructor E	Associate	Male	Law	4.33	Moderate
Instructor F	Lecturer	Female	Engineering	4.33	Moderate
Instructor G	Lecturer	Female	Communication & Information	4.33	Moderate
Instructor H	Lecturer	Female	Communication & Information	4.0	Moderate
Instructor I	Assistant	Male	Arts and Sciences	3.67	Moderate
Instructor J	Assistant	Female	Design	3.33	Late
Instructor K	Assistant	Female	Education	3.33	Late
Instructor L	Full	Male	Arts and Sciences	2.67	Late
Instructor M	Associate	Male	Education	2.67	Late

The results from an independent samples *t*-test were used to determine if interview participants differed from the rest of the population on scales (see Table 5). No statistically significant differences were found between interview participants (n = 13) and participants who only completed the survey but did not interview (n = 18). Thus, it is believed that selection bias was not an issue. The qualitative results reported below are constrained to only those faculty members who completed the survey and participated in the interviews (n = 13).

Table 5

Results of t-Test and Descriptive Statistics for Diffusion of Innovations Survey Short-Scale by Interview Participation

	Participant						95% CI for Mean Difference		
	Did Not Interview			Interviewed					
	M	*SD*	*n*	*M*	*SD*	*n*		*t*	*df*
Compatibility	3.09	0.69	18	2.97	0.67	13	-0.63, 0.39	-0.47	29
Ease of Use	2.75	0.75	17	2.77	0.84	13	-0.58, 0.62	0.07	28
Image	2.31	0.76	18	1.85	0.90	13	-1.08, 0.14	-1.57	29
Relative Advantage	3.03	0.71	18	2.86	0.70	13	-0.70, 0.35	-0.67	29
Results Demonstrability	3.01	0.71	18	3.04	0.83	13	-0.54, 0.59	0.09	29
Trialability	2.67	0.51	18	2.38	0.71	13	-0.73, 0.17	-1.28	29
Visibility	2.47	0.76	18	2.23	0.86	13	-0.84, 0.35	-0.83	29
Voluntariness	2.69	1.11	18	2.54	1.31	13	-1.05, 0.74	-0.36	29

* $p < .05$.

Based on interview results, participants most frequently discussed their experiences related to relative advantage, compatibility, and trialability. Faculty also shared experiences regarding online teaching in general and professional development specifically. Their innovation scores were taken into consideration when interpreting the interview. The three adoption classifications previously used were carried forward into this analysis and were determined based on the rounding of each participant's innovation score. Innovation scores that rounded to 5 were considered early adopters. Moderate adopters were those who had a rounded score of 4. Individuals with a rounded score of 3 were considered late adopters. These classifications were considered acceptable based on the idea of a normal distribution or a bell curve of innovation adoption discussed by Rogers (2003). The following sections outline how the perceived characteristics of innovations were discussed among participants through the interviews.

Relative Advantage

While most participants (10 out of 13) found the professional development and FLC personally advantageous, only two instructors (moderate adopters) stated that the weeklong professional development was not beneficial. Instructors who did benefit noted advantages related to social factors, convenience, and personal satisfaction.

The desire to increase student engagement was brought up by three participants across different adoption levels. One participant noted an effort to increase instructor presence in discussion boards stating, "I respond to them more frequently. I just want to make sure the students realize that I'm responding, and they don't feel like I left them hanging" (Instructor M). Another participant said, "I think that we learned things that will allow my students to be more engaged" (Instructor K). Another social factor that was mentioned was the willingness to utilize web conferencing technologies to hold meetings. Instructor M noted, "I've been more open to it, but I've only had one or two students taking me up on Skype meetings or virtual meetings."

Moderate and late adopters (n = 9) seemed satisfied with the specific pedagogical lessons gleaned from the professional development. One participant was particularly satisfied with the training regarding the alignment between learning outcomes and course activities which included assessments. Instructor G stated "We really talked about ...what those outcomes are and what's going to really work best in an online environment and what's going to work best in a face-to-face environment." A late adopter, Instructor L, shared "the workshop really gave me insight into ways that I can use a lot of different modes of delivery. When I'm delivering a single topic, I'm using video, I'm using some writing, I'm using Prezi presentations, I'm using discussions, I'm using open-ended quizzes…all just to deliver one idea."

Four participants who were across all adoption levels found that learning how to leverage a learning management system (i.e., Canvas) was the most advantageous element of the professional development. "For grading and project submittals, I do a lot more of online submittals and online grading and doing assessments and rubrics through Canvas. But I also use the anonymous survey tool in Canvas to get reflective feedback from the students" (Instructor J). Similarly, Instructor D said that "My face-to-face [courses] continue to improve because I can now put the very important key pieces of material or expectations in a user-friendly manner online so the students have access to it 24/7 regardless of the mode of implementation, faculty members found learning about tools and how to deliver content beneficially."

Compatibility

Participants (n = 13) discussed the level of compatibility of the professional development with their needs, teaching styles, and pedagogical preferences. These participants discussed how networking, with either new or veteran colleagues, proved to be helpful. Instructor C remarked "We get to network together and share practices on how to do things better. I enjoy that part." Similarly, Instructor H noted that "hearing how other people have gone about it and attending some of the meetings that we have had within our faculty learning communities have been pretty good because we were able to talk about what worked and what isn't working in others' courses."

Consistency with teaching approach. More than 61% (8 out of 13) of participants noted that components of the professional development and subsequent FLC were incongruent with their preferred teaching approach. Instructor E remarked that "The pedagogical instruction was completely disconnected from the way I teach. It was all directed at lecture teachers. I'm not a

lecture style teacher." Another participant shared similar feelings in saying that "It's not really helping so much because...the challenge I have is with the large class size. And, my teaching style involves mostly interaction with my students. I don't do lecturing" (Instructor C). According to four of the participants, the focus of the initial professional development was how to convert lecture-based instruction into an asynchronous online learning environment. This approach was incompatible for instructors who were not going to teach in an asynchronous format and created a schism between participant needs and training objectives. Instructor B, an early adopter, highlighted this issue by stating "The professional development was more focused on asynchronous teachings, but all of my courses are synchronous so there's a little bit of disconnect there." Late adopters also noticed this disconnect. As Instructor M noted, "They threw together synchronous and asynchronous. I think those crowds are a bit different."

Various benefits of the training were also recognized. Both early and moderate adopters (n = 8) found the range of topics beneficial, noting that exposure to different technologies allowed them to find the tool that would best address their teaching needs. Instructor C noted how "the workshop actually opened my eyes. I can see it as a good way of helping me to make the online course more interactive. In addition to the content, how I can use it to bring more interaction with the participants was useful" (Instructor C). Another participant pointed out, "They presented all kinds of different options...You can pick what you need and what works for you. That really worked well for me" (Instructor F). One late adopter discussed how her teaching strategies improved as a result of learning new online teaching strategies and techniques. "I think it really helped my teaching style. I try to use technology and social media in the classroom to gain awareness" (Instructor J).

Consistent with expectations. Several participants (n = 7) expected more individualized and tailored instruction to assist with the design of their own courses. Instructor L stated, "It was not really tailored to individual needs." Additionally, Instructor K shared "For me, I'm a very hands-on learner and so not being able to actually implement what we're learning didn't really work for me. But for people who learned by watching someone else do something, this may have been helpful for them...but it wasn't for me." This less hands-on approach led some participants to feel less confident in executing delivery strategies that were discussed. For example, Instructor E shared that "I just don't know how to do it myself. So, I feel like I'm back at square one with just a lot more knowledge about what's out there." Likewise, another participant commented "Some sessions just kind of talk about technology and we didn't actually try it. I prefer trying it" (Instructor F).

In addition to the less hands-on training approach, moderate and late adopters tended to feel that a one-size-fits-all approach was utilized. Instructor H commented "I probably would have benefited from having us grouped by level of experience or level of interest in certain topics...I probably could have utilized my time a little bit better if there had been stronger sessions offered for different things." Two participants perceived that prerequisite knowledge was presumed. "I felt like sometimes the [professional development] instructors almost assumed prior knowledge—at least for me... I think there were too many assumed knowledges about what you knew for teaching online" (Instructor M). Instructor M continued by stating "I think that if the talks or workshops have been individualized to certain interest groups, and more hands-on...that would have been a lot more helpful."

Conversely, four early adopters like Instructor D, articulated that "I think participating in that kind of hands-on, pretty intense professional development helped me find the things that I

could implement and find the things that could apply to me specifically and then go to it." These two opposing viewpoints might point to a disparity between the training needs for early adopters versus moderate and late adopters.

Trialability

Nearly half (46%) of the participants indicated they practiced using some online tools, skills, and strategies presented in the training. Some participants (n = 7) reported that trying to use new tools and techniques was vital. For example, "I think we had class time to practice and ask questions. Some things that interest me, I would practice more than others. I also think I didn't have a clear enough understanding of what I wanted to know and what I needed to practice" (Instructor J).

Additionally, Instructor A stated, "I brought my laptop. I did everything as we were learning. I was able to try out as we were learning it." As an example, Instructor F created a blog during the training. "I put all the proctoring websites that I've used on a blog and shared with the other faculty. So, that was very productive, and I actually got to do it hands-on."

Five participants commented that they ended up practicing on their own. Instructor M commented "I think I actually practiced with students or other faculty. I've done that with a few faculty or a couple of faculty where I'm able to show what I've created or show them how I created it and how to put it online. That's how I'm able to practice it." Along the same line, Instructor H stated that "implementing Adobe Connect and just doing that trial and error, trying to see what works... I didn't do that with the eLII staff. I did that on my own with our information technologist over in my own college. But I definitely practiced." One participant even practiced with family members. "I tested out Adobe Connect with my wife who just acted like a pretend student. That tool is really easy" shared Instructor E.

Practicing on their own after the training was also noted by Instructor F, who commented "I learned to use Adobe Captivate and I practiced that on my own." Likewise, Instructor A remarked "I tried a lot of different things...I have a lot of accounts to try to find out more and see what would really work. It took me getting in there, signing up for it and everything to really start playing around with it to really understand what was going to work best." Independent experimentation and exploration of new tools was more common for early and moderate adapters.

Ease of Use

Most participants (9 out of 13) found the skills gained from the professional development easy to implement. The remaining participants either claimed that implementation would be too difficult or too time-consuming. One instructor noted that they did not gain any skills and did not have an opportunity to use the skills. When participants were asked to comment on the ease of implementation, two participants shared how selectiveness is important when thinking about what to implement in blended and online courses. Instructor D said "I think one thing I did take away from it is that you can't do all of it. You must pick one thing and try to make it work this time. And if it doesn't, then try something different. So, I find that every time I try a new platform or a new app that it seems to work, but I can't do everything." Along the same line, Instructor G commented "I try to be selective in the type of things that I'm going to try to implement in my classes. If I don't think I can do it, or I think that I'm not going to be able to figure it out and do it well with my students, then I don't do it. I think that's probably the better way that I handle it." This approach really speaks to the classification of implementation as either "easy" or "difficult."

Six participants from each adoption level commented that incorporating video and web components into a course would be difficult and time-consuming. Synchronous video components, such as using Adobe Connect, or recording and editing lectures using Echo 360 or Camtasia, were specifically mentioned as challenges. “It’s such a simple thing, but I didn’t learn how to use it during our training. I think that it’s such a basic thing that we should have known. We really should have learned how to use it” remarked Instructor K. Another participant asserted, “Everything is very time-consuming. Even though Captivate is cool, there’s so much to it, and as I try to explore it takes a lot of time” (Instructor C). Similarly, Instructor J shared his experiences with video creation, “Well, I think that it was challenging—creating, adding, and coming up with video stuff. I just didn't understand. Maybe I didn't have a clear idea of what were the best or most effective practices, but I didn't know enough.” Another participant shared how initial difficulty resulted in long-term benefits. “What I've learned about all of this, any time you create something digital, you have to keep at it! So, I don’t mind putting a lot of work into something that I can use every semester over and over,” proclaimed Instructor F.

Voluntariness

Out of the 13 interviewed instructors, only three (23%) of the adopters reported being required to teach online or hybrid. Each of the three was classified as a moderate adopter. The requirement to teach online appeared to be most closely associated with their rank and title. Those participants with full faculty rank did not express administrative pressure, while lower faculty rank individuals felt that demands from their superiors made participation involuntary. One participant discussed how her rank as lecturer contributed to the requirement of teaching online. “The Dean asked me to develop the online class. So now that it's developed, I guess I'm kind of required to teach it. I'm a lecturer, so a lot of this distance learning falls on the lecturers,” commented Instructor F. Likewise another lecturer expressed how her contract called for her to teach online during the summer. “I'm on a twelve-month contract as opposed to a nine-month contract. The first time they [the department] needed somebody to teach online was during a summer when people weren’t around. So, basically, it was given to me” (Instructor G).

The remaining ten participants reported that they teach blended courses on a voluntary basis. Instructor I stated, “I'm a tenured faculty member so there would not be any requirement per se to teach online. There are certainly opportunities provided from my department. I'm interested in experimenting and trying to figure out new and compelling ways to incorporate [technology].” Similarly, Instructor H shared, “There is no requirement to do that [teach online]. It's encouraged, but it's not required. Honestly, it wouldn't work for all of our classes.” Many of the participants commented that they were just interested in learning more about online and hybrid teaching practices.

Image

Like voluntariness, image appeared to be unrelated to adoption level. Participants were neutral (n = 8) on how the implementation of skills was related to image or reputation, or positive (n = 5) that the training improved their reputation and image with peers. For example, Instructor K said “There’s not a perceived difference between people who participated in the training. I don’t think people in my department even know that I participated in it.” Likewise, Instructor H shared “In my division, honestly, it's not really a big deal. I mean I think people are like, ‘Oh, that's cool. Tell me how it goes.’ But it's not this prestige thing.” In contrast, another participant shared “I’m

sure that the faculty who are not part of the eLII process see it as perhaps a good thing and something that we should be doing. We should be training new cohorts of faculty" (Instructor I).

On a similar note, Instructor A commented "I'd say on the university level, it's perceived as what's going to push the university forward and progress the university." Another participant shared how her involvement in this professional development lead to speaking engagements. Instructor G shared "From my perspective people are perceived pretty well. As a result of my involvement with this program, I've been invited to give professional development sessions not only for my own college, but also for other colleges around the university for the eLII program. I reviewed some of the new rounds of eLII grants because of my experience. So, it seems like we're perceived in a positive manner."

Those participants who reported a positive impact on their image (n = 5), tended to note knowledge gained and the status of being an early adopter of online teaching. Instructor D remarked "The perception is that we're the most tech-savvy people. However, it seems that I've always been the person that if anybody has problems with clickers or with Blackboard or with Echo 360 or with any of other technology, they'll come find me." Similarly, Instructor M stated "I think people probably perceive it positively." Instructor F shared a similar experience. "My chair sent another faculty to me who had a question about recording lectures and that kind of thing. So, I guess we are perceived a little bit as the experts in the area."

When asked about their improved image, the same five participants indicated positive perceptions about peers who participated in the professional development. "All of them are pretty motivated regarding wanting to be better teachers online, so I think of them positively in that sense. They are motivated to be good teachers" commented Instructor K. Likewise, Instructor C shared that "It's nice to know others are so excited about teaching because we are research school. And so most of the time we're excited about research, but the teaching part is so fun on each side. So, I'm very happy to see that so many of us also have a heart for how our students learn and how can I do a better job for them and for me."

Visibility

Participants (n = 11) discussed being more aware of instructors teaching online as a result of the training. Instructor B commented, "I hear about what some people do, but I have no idea whether it is connected with eLII or not...Sure we kick around stuff in our departments, and some of those folks were involved in eLII stuff, but they were doing this stuff already anyway." On a more global level, Instructor C asserted "I hear about more people teaching online now I think just because that's where the market is going, and we're going to have to respond to that." Instructor A shared her experience:

> I've seen it [online learning] across our department...I would say a positive outcome is the fact that if other people want to do it. This friend of mine over in [another department], we talk all the time. She tells me about how she is implementing flipped learning. She does more of the traditional flipped classroom where she does the lectures outside of class and then they do the problem working inside of class.

Discussion

Findings from the current study illustrated some of the changes that occurred as a result of the year-long professional development initiative at a single research university. The results suggest that early adopters benefited from a wider exposure to tools and required a much less-formal hands-on approach. In contrast, instructors who were moderate or late adopters of online and blended learning benefited from a step-by-step training approach that walked them through the integration of digital tools based on their specific teaching needs.

The current study is a tale of a single university and provides details on barriers, challenges, and success of a small group of instructors. Nevertheless, this study demonstrated the benefits of combining a qualitative and quantitative approach when the sample size is small. In this case, the quantitative results (i.e., the survey) provided a baseline on a point in time, but the data were inadequate to make comments about group and individual differences. Likely due to this limited sample size, no significant statistical findings were found regarding differences by innovation level. However, the qualitative data illustrated nuanced differences and gave voice to the experiences of the instructors.

As detailed in the literature review, few studies are situated in higher education institutions that focus on online and blended learning and that use a theory to ground the methodology. The current study was grounded in Roger's (1962, 2003) innovation model and Moore and Benbasat's (1991) conceptualization of the perceived characteristics of innovation. Using this theory to guide the current inquiry helped to better understanding how innovation characteristics influenced one another in the context of preparing instructors at a research university to teach in online and blended environments. Results of this study indicate that faculty members most frequently mentioned experiences that fell within the perceived characteristics of innovation of relative advantage, compatibility, and trialability. The characteristics of voluntariness or visibility were interpreted as having little influence on adoption levels. The fact that voluntariness did not influence innovation adoption is likely because instructors at research institutions, on the whole, do not choose which courses they will teach and in which format those courses will be taught. With the caveat that rank (i.e., lecturer, assistant, associate, or full) might provide the individual with leverage in these decisions. The fact that image did not influence adoption rates is likely a result of the siloed nature of research institutions. At these types of institutions, instructors rarely interact across departments and might never interact with others across colleges. Thus, an instructor at a research university might be unaware to what is happening outside of his/her own department.

The current study furthers the research that has been conducted on faculty development for online and blended learning in institutions of higher education. For example, a study conducted by Shea, Pickett, and Li (2005) focused on satisfaction with online teaching of instructors across 33 unique and diverse campuses that include community colleges, technical colleges, four-year colleges, doctoral universities, as well as university centers. Although those findings were also theoretically situated in the DOI, those researchers focused on satisfaction with online learning within a network. In the current study, the findings are focused on the story of one research-intensive university and pedagogical changes that resulted around the eight perceived characteristics. The current study also took a more theoretical approach than previous research by using the perceived characteristics of the DOI theory as the measurable constructs, both qualitatively and quantitatively. Thus, by focusing on accepted theoretical constructs in the

research design, the study was able to go deeper into the theoretical levers that may impact the adoption of online teaching and learning, not just overall satisfaction.

Limitations

Limitations of the current study include a lack of distinction between online and blended delivery. This lack of distinction may have resulted in a feeling of mismatch between the purpose of the training and faculty expectations. There was also no presurvey data from faculty participants. The inclusion of presurvey information would have been helpful in determining if the training assisted in increasing an individual's self-reported innovation level. Changes in faculty perceptions of the innovation characteristics may have differed between the initial week-long training versus the follow-up meetings. Lastly, the relatively small sample size hindered the use of advanced quantitative analysis.

Conclusion

It is important to note that networking through the initial professional development, and later in the faculty learning communities, was an unexpected beneficial aspect of the professional development training. The creation of the learning communities with small groups of participants allowed faculty members with differing expertise to support one another through the learning process over a longer period beyond the initial week-long training. This direct application of skills and networking with peers may result in increases to some innovation characteristics (e.g., results demonstrability, relative advantage) in the context of a specific endeavor.

The research presented in this article details how one research university used professional development training to increase the quality, and quantity, of online and blended courses. As research-intensive universities shift more resources from the brick and mortar classroom into an online or blended learning environment, professional development of the course instructors will be imperative. This research highlighted one approach taken to the professional development as well as the method taken to evaluating the outcomes of that professional development. The lessons learned can be of service to future instructors, learners, and leaders.

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Appendix A

eLII Analysis of Online Learning Professional Development Survey

Q1 Please rate how much you personally agree or disagree with these statements regarding voluntariness.				
My department does not require me to use the skills I gained in the eLearning Innovation Initiative professional development (i.e., I am not required to teach online or blended now or in the foreseeable future).	Strongly Disagree	Disagree	Agree	Strongly Agree
Although it might be helpful, implementing the skills I gained in the eLearning Innovation Initiative professional development is not compulsory in my job.	Strongly Disagree	Disagree	Agree	Strongly Agree

Q2 Please rate how much you personally agree or disagree with these statements regarding implementing the skills you gained in the eLearning Innovation Initiative professional development.				
The skills enable me to accomplish tasks more quickly.	Strongly Disagree	Disagree	Agree	Strongly Agree
The skills improve the quality of work I do.	Strongly Disagree	Disagree	Agree	Strongly Agree
The skills make it easier to do my job.	Strongly Disagree	Disagree	Agree	Strongly Agree
The skills enhance my effectiveness in my job.	Strongly Disagree	Disagree	Agree	Strongly Agree
The skills give me greater control over my work.	Strongly Disagree	Disagree	Agree	Strongly Agree

Q3 Please rate how much you personally agree or disagree with these statements regarding how people in your organization who implement the skills gained in the eLearning Innovation Initiative professional development are perceived.				
They have more prestige.	Strongly Disagree	Disagree	Agree	Strongly Agree

They have a higher profile.	Strongly Disagree	Disagree	Agree	Strongly Agree
They are a status symbol in my organization.	Strongly Disagree	Disagree	Agree	Strongly Agree

Q4 Please rate how much you personally agree or disagree with these statements regarding implementing the skills you gained in the eLearning Innovation Initiative professional development.

The skills are compatible with all aspects of my work.	Strongly Disagree	Disagree	Agree	Strongly Agree
The skills fit well with the way I like to work.	Strongly Disagree	Disagree	Agree	Strongly Agree
The skills fit into my work style.	Strongly Disagree	Disagree	Agree	Strongly Agree

Q5 Please rate how much you personally agree or disagree with these statements regarding implementing the skills you gained in the eLearning Innovation Initiative professional development.

Using the skills is clear and understandable.	Strongly Disagree	Disagree	Agree	Strongly Agree
I believe it is easy for me to do what I want to do with the skills.	Strongly Disagree	Disagree	Agree	Strongly Agree
Overall, I believe it is easy for me to implement the skills.	Strongly Disagree	Disagree	Agree	Strongly Agree
Learning the skills is easy for me.	Strongly Disagree	Disagree	Agree	Strongly Agree

Q6 Please rate how much you personally agree or disagree with these statements regarding demonstrability implementing the skills I gained in the eLearning Innovation Initiative professional development.

I would have no difficulty telling others how I implemented the skills I learned.	Strongly Disagree	Disagree	Agree	Strongly Agree

I believe I could communicate to others the consequences of implementing the skills.	Strongly Disagree	Disagree	Agree	Strongly Agree
The results of implementing the skills are apparent to me.	Strongly Disagree	Disagree	Agree	Strongly Agree
I would have no difficulty explaining why implementing the skills may or may not be beneficial.	Strongly Disagree	Disagree	Agree	Strongly Agree

Q7 Please rate how much you personally agree or disagree with these statements regarding visibility.

In my organization, I see other eLearning Innovation Initiative professional grant recipients using the skills I gained.	Strongly Disagree	Disagree	Agree	Strongly Agree
People who use the skills from the eLearning Innovation Initiative grant are not very visible in my organization.	Strongly Disagree	Disagree	Agree	Strongly Agree

Q8 Please rate how much you personally agree or disagree with these statements regarding the skills you gained in the eLearning Innovation Initiative professional development.

Before deciding whether to use any of the skills, I was able to adequately practice those skills.	Strongly Disagree	Disagree	Agree	Strongly Agree
I was permitted to use the skills on a trial basis long enough to see what I could do.	Strongly Disagree	Disagree	Agree	Strongly Agree

Q9 Please rate your adoption level on a scale from 1-5 with 1 being the last person to adopt and 5 being the first person to adopt.

How would you rate your adoption level using digital technology?	1 2 3 4 5
How would you rate your adoption level with regards to teaching blended courses?*	1 2 3 4 5

How would you rate your adoption level with regards to teaching fully online courses?**	1 2 3 4 5

* Blended courses are courses that have traditional face-to-face on campus instruction and some on campus activities have been replaced by online learning activities.
**Fully online courses are courses that have all content and course activities online. There is no traditional face-to-face on campus instruction.

Appendix B
Interview Guide

1. Which eLII group do you belong to?
2. Which eLII cohort do you belong to?
3. How would you classify yourself with respect to digital technology? On a scale of one to five, with one being not technologically savvy at all and five being very tech savvy, where would you rate yourself? Can you tell me a brief story that best exemplifies this rating?
4. Had you taught blended courses before your participation in the eLII professional development?
5. Had you taught fully online courses before your participation in the eLII professional development?
6. Have you taught blended courses after your participation in the eLII professional development?
7. Have you taught fully online courses after your participation in the eLII professional development?
8. How has your teaching changed since participating in the eLII professional development?
9. Do you feel that you are required to teach online?
10. Do you feel you were required to apply for the eLII grant? Please explain your answer.
11. What skills did you gain in the eLII professional development that you have now implemented?
12. Talk to me about how people in your organization who implement the skills gained in the eLII professional development are perceived?
13. Talk to me about how the eLII professional development is compatible with your needs, teaching style, and pedagogy? Can you give me examples?
14. Describe how easy or difficult it is for you to implement the skills you gained in the eLII professional development. Can you give me examples?
15. Describe the results of implementing the skills you gained in the eLII professional development. Can you give me examples?
16. Is the implementation of skills gained in the eLearning Innovation Initiative professional development visible in your organization? Can you give me examples?
17. How were you able to practice the skills gained the eLearning Innovation Initiative professional development? Can you give me examples?
18. What were your expectations for your professional development from the eLearning Innovation Initiative? Did it meet those?
19. Describe one aspect that was particularly beneficial to you?
20. Describe one aspect that was least beneficial to you? How would you change this aspect?
21. Is there anything else about the eLearning Innovation Initiative professional development or online teaching and learning that you would like to share?

From Discussion Forums to eMeetings: Integrating High Touch Strategies to Increase Student Engagement, Academic Performance, and Retention in Large Online Courses

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Abstract
Student engagement and group work are critical to developing competencies, deeper learning, and attributes that align with 21st-century skills. In an increasingly competitive and dynamic workforce, the ability for employees to engage in collaborative workgroups is essential. A new capstone group-work assignment using Online Human Touch (OHT) strategies was integrated into an Information Systems course at a regional university in the Caribbean. The course typically enrolls 250–300+ students per semester with one instructor. The assignment simulated a real-world business 'eMeeting' to proactively increase student engagement and retention. This action research study collected quantitative and qualitative data three years prior to and three years after the integration of the new 'eMeeting' group-work assignment. Quantitative data showed improved academic performance, higher scores on the standardized final exam, and decreases in attrition while qualitative data showed significant increases in student engagement. Integrating the 'eMeeting' assignment into the large online course provided students with the opportunity to apply the knowledge, skills, and experience gained throughout the semester. It also enhanced key soft skills sought by employers including problem-solving, ability to work in teams, communication, leadership, and time management.

Keywords: large courses, online instruction, online learning, distance learning, teacher presence, student engagement, attrition, retention, Online Human Touch, high touch strategies, group work, 21st-century skills

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From Discussion Forums to eMeetings: Integrating High Touch Strategies to Increase Student Engagement, Academic Performance, and Retention in Large Online Courses

Online enrollments worldwide have increased exponentially since the turn of the new millennium. In the United States, the proportion of higher education students enrolled in at least one online course increased to 33.1 percent in Fall 2017 from 31.1 percent in 2016. Concurrently, students enrolled exclusively online grew to 15.4 percent while students enrolled in a mix of online and in-person courses grew to 17.6 percent (Lederman, 2018). While cumulative online enrollment growth worldwide is more elusive to quantify, the global market for e-learning was estimated at $90 billion in 2002 (Yong, 2003 cited in Chawla & Joshi, 2012), $166.5 billion in 2016 (Yu & Hu, 2016), to a projected $275 billion by 2022 (Reuters, 2017). It is evident through global market growth and increasing enrollments that online learning is now a cornerstone in education worldwide.

As institutions of higher education (IHE) continue to expand online offerings, academic quality and the student experience must be central to course design and instruction. This is of particular importance for large online courses in which enrollments may reach 150 students per course with one instructor. Very large online courses, which enroll 150 or more students per course, are often managed by one instructor with one or more teaching assistants (Elison-Bowers, Sand, Barlow, & Wing, 2011). Therefore, instructing up to 150 students in a large online course or 150+ students in a very large online course is different than teaching the same online course with 20–60 students with one instructor or teaching the same course in a traditional on-campus classroom (Elison-Bowers, Sand, Barlow, & Wing, 2011; Berry, 2009).

One of the primary challenges of students enrolled in online courses is their feelings of isolation, lack of community, and experiences of limited engagement with the instructor (Boton & Gregory, 2015; Mokoena, 2013). These factors can result in higher attrition rates than traditional courses (Thomas, Herbert, & Teras, 2014). For courses with enrollments of 150+, students may be at an even greater risk of attrition if these factors are not considered as part of course design or addressed through high touch instructional strategies.

The University of the West Indies (The UWI), a regional university in the Caribbean, was established in 1948 on the island of Jamaica with 33 students. The UWI now enrolls over 45,000 undergraduate students and approximately 9,000 graduate students across three physical campuses and an online campus. Of these 54,000 students, over 20,000 are enrolled through the online campus (The University of the West Indies, 2016). As part of the three-year undergraduate management degree, the Information Systems course is offered online every semester to second year students with typical enrollments of 250-350+ students per course per semester. Each Information Systems course has one instructor and four to five tutors who support student-to-instructor and student-to-student engagement. While instructors teaching the Information Systems course may not be concerned with students finding an open seat in a crowded large lecture hall, they are concerned with how to actively engage each of the 250–350+ students while taking the course that semester.

Review of Literature

Online Instruction with Large Courses

Online education provides increased opportunities for students to enroll in many programs. Like on-campus programs, some online courses have increased student enrollments that mirror large lecture classrooms and may include 150 or more students. According to Berry (2009), "Teaching an online class session that has over 150 students enrolled is substantially different from teaching a face-to-face class on campus or an online class with 25–35 students" (para. 1). A key concern with large courses is that students may become disengaged or feel alienated which can "erode students' sense of responsibility and lead to behaviors that both reflect and promote lack of engagement" (Wilsman, n.d., para. 1).

As online education continues to grow worldwide, there is increasing literature on how to engage students in online courses. Strategies include keeping work relevant (Toney, 2017), providing opportunities for learner interaction (Briggs, 2015), and providing effective and timely feedback (Briggs, 2015; Toney, 2017). Creating opportunities for meaningful discussion and collaboration in a large online course is one of the biggest challenges of online instruction (Trammell & LaForge, 2017). Therefore, implementing teaching techniques becomes an important factor in course design and successful management of large online courses.

Group Work, Communication, and 21st-Century Skills

Collaboration through group work (i.e., team work) is critical to developing competencies and attributes that align with 21st-century skills and deeper learning. According to the organization P21 Partnership for 21st-Century Skills, collaboration is the "ability to work effectively and respectfully with diverse teams" (Framework for 21st century learning, n.d.). In reviewing deeper learning competencies, collaboration occurs when "students learn to work in teams to achieve shared goals" (Bitter & Loney, 2015, p. 3). Collaboration also supports the development of communication skills as students work together to collectively solve problems as a group.

Group work is an important attribute that prospective employers rate highly when employing graduates (Loughry, Ohland, & Woehr, 2014). This is evident in annual national studies and media publications which identify skills that employers are seeking. According to the *2018 Job Outlook Report*, the National Association of Colleges and Employers (NACE) reported that the top three attributes an employer seeks on a candidate's resume included: (a) problem-solving skills, (b) ability to work in teams, and (c) communication (para. 7). *Business Insider* in 2018 spotlighted what LinkedIn identified as the four most important soft skills employers are seeking, which included: (a) leadership, (b) communication, (c) collaboration, and (d) time management (Leighton, 2018). Recognizing that employers are seeking these critical soft skills, it is important that they are integrated into course design and instruction to support course and program outcomes.

As corporations become increasingly diverse, the ability to collaborate is critical whether employees are working onsite or virtually. Employees are expected to be able to communicate through email, discussion forums, and video conferencing. This study adapted the threads of a discussion forum to represent the phases of an online meeting conducted in the corporate sector. For the purpose of this study this capstone group assignment that simulated a business meeting is referred to as an eMeeting.

Online Human Touch

The Online Human Touch (OHT) conceptual framework builds upon five areas of research that support student engagement, retention, and completion. The five areas include:

- Student Engagement (Astin, 1984; Chickering & Gamson, 1987; Tinto, 1993)
- Personalized Communication (Faharani, 2003; Mehrabian, 1971)
- Community Development (Palloff & Pratt, 1999; Stanford-Bowers, 2008)
- Work-Integrated Learning (Milne, 2005), and
- Data Driven Decision-Making (Cranton & Legge, 1978).

Each of these areas, when integrated into program development, course design, and instruction, support student engagement through high touch strategies during the student lifecycle.

Student engagement. High touch *student engagement* strategies connect students to the instructor and other students through course orientation sessions, announcements, discussion forums, synchronous sessions, and group assignments. When students are fully engaged, focused, and present, they can experience flow, which is a state of optimal experience (Csikszentmihalyi, 1990; Spencer, 2017). Additionally, student engagement is an important factor in proactively addressing student retention and creating a lifelong bond with future alumni (Betts, 2008).

The literature has shown that students learn best when they have specific assessment guidelines, including a rubric (Rose & Smith, 2007). Furthermore, students learn better and faster through multimedia presentations that supplement text-based coursework, thus allowing them to review content at their own pace (Buzzetto-More, 2015).

Personalized communication. High touch personalized communication strategies encourage regular and ongoing interaction with the instructor (e.g., faculty, adjunct faculty), and students. It involves being active in the discussion forums, such as using students' names when responding to posts; providing customized feedback on graded assignments; and having meetings with students or groups via Zoom or Skype regarding activities, assignments, or as needed. Feedback using multiple modalities also supports personalized communication through text, voice, and video feedback on assignments and group work.

A 2018 study by the National Association of Colleges and Employers (NACE) revealed that students may have a higher perception of their own communication and collaboration skills than that of actual employers. For example, a NACE report showed that when asked to rate their oral and written communication skills as well as their ability to work with others in teams, students overall rated themselves 79.4% for oral/written communication and 85.1% for working with others in teams (Bauer-Wolf, 2018). However, for these same skill sets, employers rated students at 41.6%, and 77% respectively (Bauer-Wolf, 2018). Providing creative and personalized feedback can therefore be used to enhance students' written communication skills, while demonstrating to students that the instructor and tutors are interested in their contributions (Mokoena, 2013). Feedback by the instructor is also important since it could serve as a catalyst for students who have yet to join or engage in the discussion threads (Rose & Smith, 2007).

Community development. High touch *community development* strategies involve creating activities that support student-to-instructor and student-to-student engagement. Community development can be fostered through discussion forums that actively engage students with topics relevant to weekly/module content, current/emerging issues, and upcoming assignments. Discussion forums can also incorporate group assignments in which students collaborate

asynchronously or synchronously. "The starting point for learning occurs when knowledge is actuated by learners connecting to and participating in a learning community" (Goldie, 2016, p. 1065).

Collaboration skills are critical to today's workforce. According to Laux, Luse, and Mennecke (2016), "When students use a virtual community as a basis for learning, they are exposed to unfolding events similar to real life. This is different from a single exposure to a concept in one classroom session" (p. 289). However, there are some students who tend to participate in group discussions but give shallow or short responses instead of providing in-depth reflective responses that integrate their experiences with the material (Rose & Smith, 2007; Mokoena, 2013). The Partnership for 21st Century Skills organization suggests that when collaborating, students should develop the ability to work effectively and respectfully in their group, exercise willingness in making necessary compromises to accomplish a common goal, assume shared responsibility for collaborative work, and value the individual contributions made by each team member (n.d., para. 1).

Work-integrated learning. High touch *work-integrated learning* strategies assist students in understanding the connection between activities and assignments and real-world issues. It aligns with various instructional strategies that support providing student choice while adhering to the same learning objectives and rubrics. For key assignments, this high touch strategy could include having students select a topic of their choice, within identified parameters, which supports interest, relevance, and significance for assignments that align with real-world contexts on current and emerging issues related to the course.

Experiential and work-integrated learning are important when students are able to make content applicable to their real-world experiences and they are involved in assignments in which they use research and creative thinking skills, develop ideas, or solve a problem (Bigatel, 2016). In postsecondary education, "experience-based education has become widely accepted as a method of instruction" (Kolb, 2014). Learning experiences that expose students to a professional culture and workplace practice are needed to support this transition from study to employment (Betts, 2008).

Data-driven decision-making. High touch *data-driven decision-making* strategies involve formative and summative assessment. Diverse learning assignments actively engage students in becoming reflective learners and practitioners. This can be achieved through personalized feedback with scaffolded assignments as well as peer evaluation and self-evaluation (Betts, 2008). More so, it can also engage faculty in modifying, refining, expanding or replacing activities or assignments based on summative feedback from course evaluations or program reviews (Betts, 2008).

Collectively, the five research areas within the OHT framework support high touch strategies for student success and the transfer of learning across real-world contexts. This action research study, therefore, examined how the integration of an eMeeting design affected student engagement in the course. The following research questions were addressed:

1. How did the integration of an eMeeting designed using OHT strategies impact student success (i.e., academic performance, student engagement, attrition) in a large online course?

2. How did students perceive the eMeeting using OHT strategies in a required Information Systems online course?

Course Structure 2011–2013

The original course in 2011 had three individual assignments, which included (a) one orientation activity, (b) one database project, and (c) one essay assignment. There were also weekly discussion forums and a standardized final exam. The orientation activity involved getting familiar with the course and an introduction to databases. The database project included creating queries and reports while the essay assignment focused on responding to an information systems issue. Students were assigned to groups of approximately 20–30 with one tutor per group. Each tutor was responsible for their group's student orientation and for grading their students' submissions for the database project, essay assignment, and discussion forums. There was no capstone group work assignment in this course structure.

The assigned weekly discussion forums were designed to test fundamental concepts where students were required to read chapters from an online course manual and post responses to generic questions in the weekly discussion forum. Therefore, group work was incidental since students were placed in groups on registration and assigned a tutor. There were also limited guidelines on how to actively participate in the groups. According to the literature, a lack of guidance on how to effectively work as a group may cause a "sink-or-swim" approach (Vik, 2001). Moreover, research by Rose and Smith (2007) indicates that the stipulation for 'participation in group discussions' tends to be too vague in terms of what is required of students as well as the extent and level of participation. Having minimal guidance on what was generally permitted or expected in a group environment did not foster or optimize student interaction. Students therefore replied to the primary thread and to two other students in their group to meet the requirements, but the responses typically did not go beyond the initial prompt. The final exam was a proctored, standardized two-hour written exam that followed The UWI's regulations for course completion.

Course Structure 2014–2016 with the New eMeeting Design

The original Information Systems coursework in 2011–2013 and the revised coursework in 2014–2016 shared the same learning outcomes, weekly objectives, assignments, readings, and discussion forums. The orientation activity and database project still involved becoming familiar with the course and introduction to databases. However, the essay assignment was revamped as a capstone group-work assignment. It was now a two-week asynchronous discussion forum that was introduced to the students as an eMeeting. Additionally, a restructured and enhanced standardized final exam now focused on a case study.

The eMeeting was designed to simulate a real-world online business meeting as well as proactively increase student engagement and retention. The discussion threads of an eMeeting were sequenced, starting from student introductions though various tasks to the group's final submission. The sequencing provided guidance as students progressed through the threads of the eMeeting. Additionally, the eMeeting design integrated the strategies from the OHT conceptual framework to support student engagement and retention. The OHT framework asserts that students are more likely to persist in an online program if they are engaged in and outside of their courses; the educational experience is personalized; and activities support transfer of learning across real-world contexts (Betts, 2008).

While instructor presence and teaching were and are still important aspects of the course, the role of the tutor has shifted from primarily grading course assignments and providing feedback to guiding and engaging students with high touch strategies through the eMeeting. This new approach now provides students with extended opportunities to develop critical workforce skills, explore career interests, and build upon prior knowledge. Additionally, this new knowledge could allow them to gain exposure to 21st-century skills and align with The UWI's attributes in order to expand their network, increase their regional identity and global awareness, and identify innovative ways to transfer new knowledge and skills as socially, culturally, and environmentally responsible citizens.

Methods

Action research was selected for this study since this methodology is used in real-world contexts to solve problems and improve professional practice. Action research is typically conducted by practitioners to explore practical problems in which the research results in a desired change that is shared within an educational community (Norton, 2018; Efron, 2013). Parsons and Brown (2002) define action research as follows:

> Action research is a form of investigation designed for use by teachers to attempt to solve problems and improve professional practices in their own classrooms. It involves systematic observations and data collection which can be then used by the practitioner-researcher in reflection, decision-making and the development of more effective classroom strategies (p. 55).

Action research typically includes between three to seven or more steps. However, for the purpose of this study, there were five steps (see Figure 1).

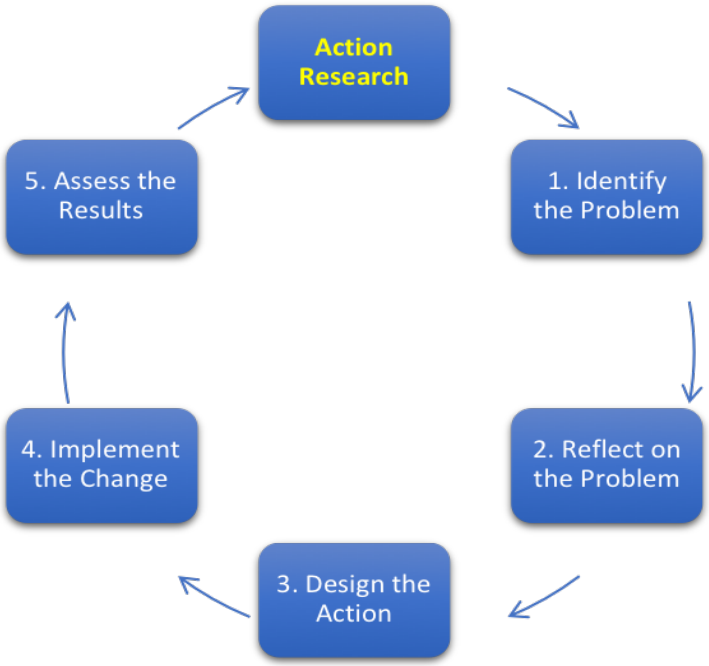


Figure 1. Action research steps for this study.

Both quantitative and qualitative data were collected three years prior to and three years after the new 'eMeeting' assignment. Quantitative data, including exam scores and student attrition before and after the introduction of the OHT strategies, was summarized and evaluated for trends in attrition. Qualitative feedback was also collected from over 2,000 posts during the eMeeting.

Context and Setting

One of the core undergraduate management programs in Social Sciences at The UWI is Information Systems. Like many IHEs, required courses in management programs can have very large enrollments. The UWI's Information Systems course typically enrolls 250–350+ students per course per semester and is offered online every semester to second year students pursuing a three-year undergraduate management degree. Each Information Systems course has one instructor and four to five tutors who support student-to-instructor and student-to-student engagement. Instructors therefore want to ensure that they are actively engaging the 250–350+ students enrolled in the course.

The Information Systems course model builds upon an instructor-tutor relationship. Students first register for the course that has one instructor. Within the course, students are then assigned to groups of approximately 20–30 with one tutor per group. The tutors are adjunct faculty, who are working professionals with content expertise. They are required to complete The UWI's online training courses on managing and facilitating online instruction. In their role as tutors, the adjunct faculty are actively involved in the discussion forums providing workforce-related perspectives. They are also responsible for grading their group's assignments and providing student feedback.

This method allows the instructor to focus on "managing the course" throughout the semester. This includes preparing and posting course materials and assignments, such as integrating supplemental materials related to current and emerging issues into the weekly course content and the discussion forums, preparing rubrics (mark schemes), leading synchronous sessions, and managing the student-tutor experience. The instructor also posts weekly reminders, course-related announcements, and any institutional-related announcements.

Interaction is paramount in this course. The instructor is also responsible for managing the instructor-tutor interaction, which includes required online meetings throughout the semester. The instructor first reviews the coursework for the upcoming semester and discusses any nuances regarding the new assignments with the tutors. Each tutor is required to complete the course assignments. This provides a unique collaborative opportunity for the instructor and tutors to discuss the assignments and make any needed modifications before they are approved for use. Although the tutors are responsible for grading assignments, the instructor "standardizes" the grading by randomly selecting samples from each group to ensure consistency of grading, and for quality control. The instructor also ensures that the tutors mark assignments and enter the marks within a two-week period. Students would then have the opportunity to reflect on the feedback prior to the next assignment submission. This approach, in many ways, fosters a student relationship with both the instructor and a professional within the field (the tutor).

Sample

Convenience sampling was used for This study and included 3,386 students who were enrolled in the Information Systems online course over a six-year period: 2,386 between 2011–2013, and 1,500 students between 2014–2016. All students were enrolled in the second year of

their undergraduate program. Table 1 provides an overview of student enrollments across the same course that was offered between 2011–2016.

Table 1

Student Enrollment

Year	Student Enrollment
2011	801
2012	834
2013	751
2014[a]	547
2015	484
2016	469

Note. [a] refers to the year of integration of the eMeeting design using OHT strategies.

The eMeeting Design with OHT Strategies

Students were sorted alphabetically by their first name and then assigned to sub-groups of five where they could only see their own small group's activity in the eMeeting. Five sequenced threads were created using "MoodleForums," which supports multiple sub-forums. This tool was used to monitor student interaction and ensure clarity about participation (see Figure 2).

These five threads played an important role in guiding students through the stages of their eMeeting with instructions on how to participate at each stage. For a two-week period, students had access to their eMeeting. Each thread replicated the instructions for the specific task along with the corresponding rubric and grades (mark allocations). The left half of Figure 2 illustrates the outline of the five threads of the eMeeting. The right half of Figure 2 illustrates a screenshot of the contents of thread one, with the assignment document (at top) and an accompanying 10-minute video created by the instructor (at bottom).

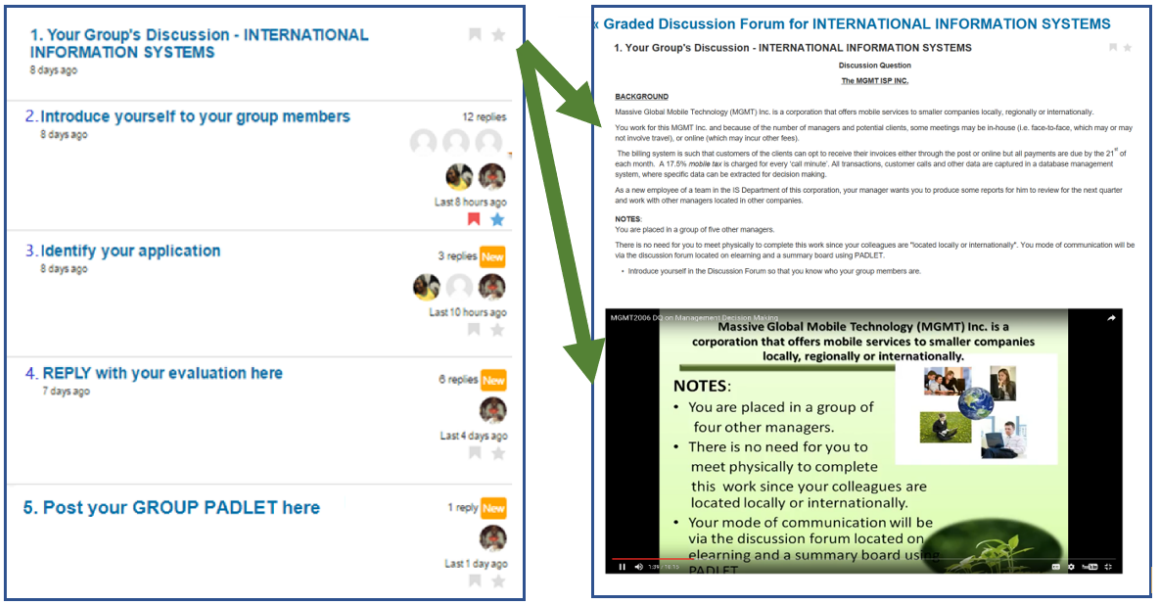


Figure 2. First thread of an eMeeting (upper left), comprising the course assignment document (upper right) and an accompanying instructor-led video (lower right).

Table 2 provides an overview of the content for the eMeeting threads with associated high touch strategies.

Table 2

Overview of eMeeting Threads with High Touch Strategies

eMeeting Thread 1	**Assignment materials:** Each group's assignment instructions are posted in this thread along with an instructor-led video explaining the requirements. **High Touch Strategy: Student Engagement (Instructor-Led Videos).** A video describing the approach and purpose of the eMeeting was developed to ensure that all requirements were clear. The video also integrated metacognitive approaches to learning by relating the direct connection between their eMeeting and business communication skills that can be readily transferred to the workforce. Additionally, the video referenced the assignment document that detailed the course work rubric, so that students were aware of how they would be assessed. Students were also advised that they would not be graded for partial, vague or general responses.
eMeeting Thread 2	**Introductions**: Each member is expected to greet each other and provide specific information identified in the instructions. **High touch strategy: Personalized communication (self-introductions).** This strategy required students to introduce themselves in preparation for interacting in an online business setting as opposed to a social situation. The instructor video provided in Thread 1 included examples of how students should introduce themselves in an online environment, so that they were able to gain marks for creating their personalized introductions for the eMeeting. The list of students was also sorted by first name before allocating them to their five-member groups. This intentional sorting resulted in students sharing similar names or initials, which could be used as an icebreaker to start interaction and build camaraderie.
eMeeting Thread 3	**Topic Selection Group Activity:** Students suggest and then agree on a common aspect from the case study that will be used throughout the e-meeting. **High touch strategy: Community development with agreement on application**. To foster this virtual community, Thread 3 required members to suggest and agree on a common application theme or topic from the case study that would be used throughout the eMeeting. Group members were expected to share similar interests and thus create free-flowing interactions among all group members.
eMeeting Thread 4	**Role Play Group Activity:** This main thread was used by students to engage their group members using key terminology, database queries, and reports from a prior assignment. They were expected to incorporate this information based on the case study from which they make real-world decisions. Students are encouraged to use information from their database project or provide links to Internet sources that supported their decision-making. **High touch strategy: Work-integrated learning across real-world contexts.** The eMeeting provided students with an opportunity to meet online regularly and discuss elements of their group assignment. This is similar to scheduled meetings within an organization when working on a project. This strategy also supported instructional strategies used by tutors to encourage further interaction in some groups, while creating friendly competition amongst members in other groups.

eMeeting Thread 5	**Summary Notice Board Group Activity:** Students were expected to access their group's private online notice board to post outcomes, decisions, or recommendations from their discussions, but the final product should reflect each group's collective summary. The completed summary board is then embedded in this discussion thread as evidence of the group final activity. **High touch strategy: Community development (student-student brainstorming).** Students demonstrate their collaborative skills by working effectively and respectfully throughout the eMeeting threads. Then, as they demonstrate willingness to assist group members to accomplish required objectives, it demonstrates the alignment with Partnership for 21st-Century Skills.

Evidence of High Touch Strategies: Data-driven Decision-making

Quantitative and qualitative data was collected prior to and after the integration of the new 'eMeeting' group-work assignment to determine the effect of the high touch strategies on student engagement. Quantitative data included examining course pass rate, course evaluations, and attrition. Qualitative data included instructor observations, student posts, and student feedback on the new capstone group-work assignment.

Results

This study provides summary quantitative data on academic performance and course satisfaction as well as qualitative student feedback. Examples of five high touch strategies that align with the OHT framework are provided in the following tables and figures. The screenshots of examples and associated strategies are illustrated using the January–April (Semester 2) 2016 cohort. Of the 469 students enrolled in the course with access to Moodle, up to 68 smaller groups were created using a "MoodleForum" format that supports multiple sub-forums. This also enabled the five tutors to each monitor and actively work with approximately 13 five-member groups.

Student Engagement

Data collected from this cohort showed an average of 5,536 student visits to the eMeeting threads and 2,502 posts by the eMeeting deadline. Each of the 13 groups was also provided with an instructor-led video relating to an eMeeting case study. These videos were viewed 1,037 times while students worked through the tasks (see Table 3).

Table 3

Summary of Interactions Among Students at End of Each eMeeting for Semester 2, 2016

eMeeting Case Study	Number of posts at deadline[b]	Video views	Average group mark out of 15
1. Management Reporting	498	263	14
2. Management Decision Making	771	190	14
3. Mobile Data Security	332	167	13
4. Systems Development	404	223	14
5. International Information Systems	497	194	14

Note. [b] Excluding private and miscellaneous posts

Most of the students systematically followed the sequenced discussion threads. Additionally, student engagement in a majority of the eMeetings went beyond the requirements posted with each thread. The applied high touch strategies, instructor observations and exemplars of student posts from each thread are discussed in the following sections. Students' names included in posts have been modified to ensure anonymity.

eMeeting Thread 1: High Touch Student Engagement Strategy

Assignment Materials

With instructor-led videos. The new eMeeting design for this thread resulted in fewer questions from the students asking for clarification on some aspect of the requirements. They were able to refer to the written instructions and the instructor-led video to assist each other during the eMeeting.

Instructor observation 1. Many students watched the video first before starting the tasks and referred to the video repeatedly to ensure that they understood the tasks and knew what was expected of them. This suggested that they made the effort to meet those expectations (Figure 3, top).

Instructor observation 2. The information provided in the video was useful in guiding students with the specific technology tools required, while keeping them on task as they brainstormed during the group activity (Figure 3 bottom).

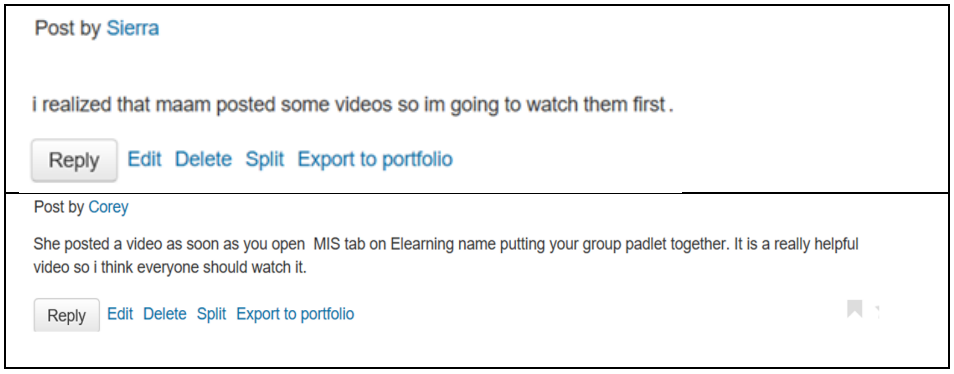


Figure 3. Students referring to the video in Thread 1.

eMeeting Thread 2: High touch Student Engagement Strategy

eMeeting with self-introductions. Students were not usually required to formally introduce themselves in discussion forums. However, it was a requirement for this eMeeting. For this thread, a few students posted a minimum response while others were professional, not only posting the correct information but reaching out to welcome their groupmates. Tutors also used this new self-introduction opportunity to guide students by posting private messages to those who did not meet the requirements for their introductory post.

Instructor observation 1. Some students used salutations in their greeting, such as "Hello, my name is...", which was an accepted and more formal style of communication. However, a few students greeted their colleagues using casual terms such as "Hey", or "Hi guys" which is often associated with informal social media types of greetings. (see Figure 4).

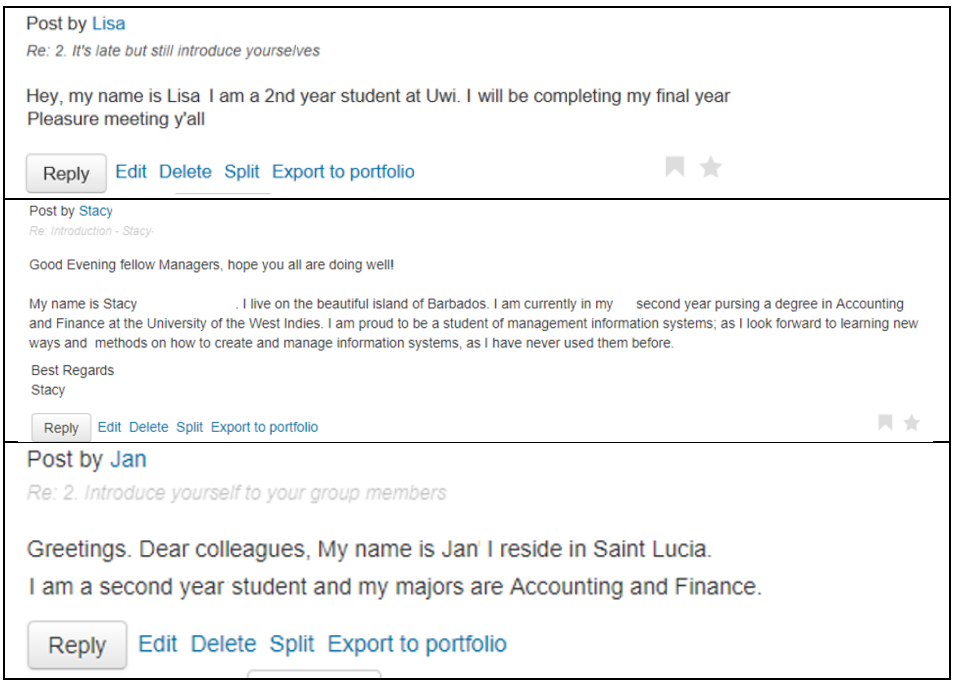


Figure 4. Examples of unsuitable (top example) and appropriate introductory posts (Bottom two examples).

Instructor observation 2. Several students reposted their corrected self-introductions (see Figure 5). The eMeeting also fostered a sense of community among members. For example, Figure 6 shows a sample of personalized communication from a student who reached out to a group member to direct her to the correct discussion thread.

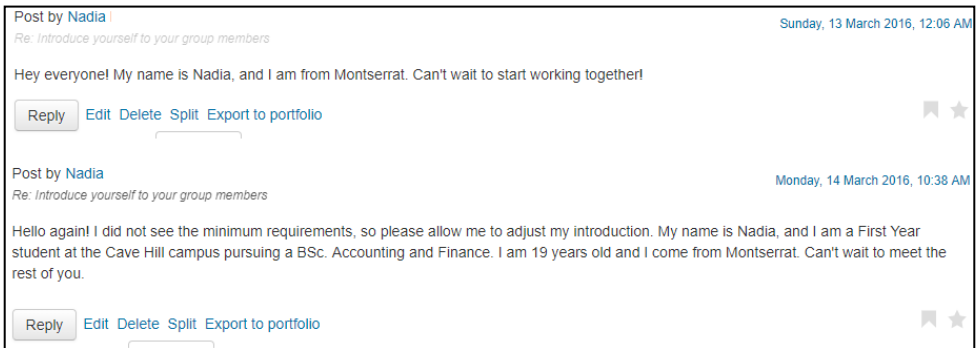


Figure 5. *Example of reposted self-introduction.*

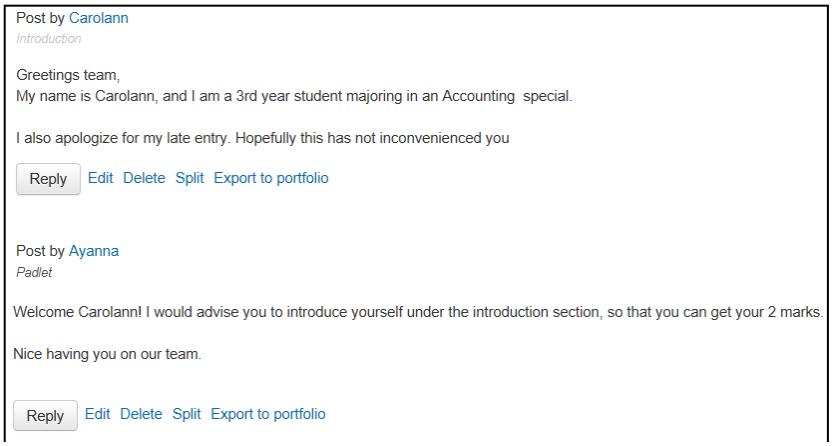


Figure 6. Example of personalized communication among group members.

eMeeting Thread 3: High Touch Community Development Strategy

Group decision-making with agreement on application. The requirements in this thread provided the structure for the eMeeting. It involved consensus for the selection of the application, theme, or topic. This thread was therefore designed to engage students in discussions as they collaborated on various components of the assignment.

Instructor observation 1. In one of the eMeetings, group members were required to post a suitable online application and explain their choice. In Figure 7, students recommended familiar video conferencing applications, thus integrating their previous experiences with the application to the activity in this thread.

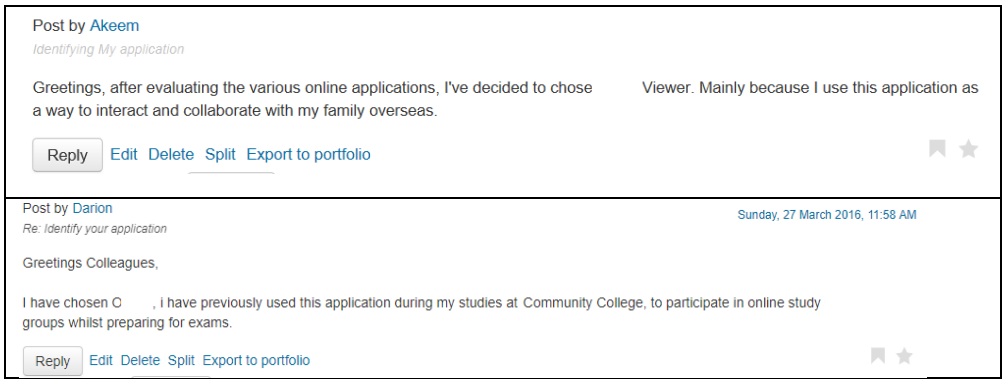


Figure 7. Students posting recommendations on a suitable application for video conferencing.

Instructor observation 2. In another eMeeting, students were required to choose a mobile phone and provide reasons why it would be appropriate for company employees to use that phone when travelling, given its cost and data plan. Some students posted their personal brand of mobile phone, stating generic reasons for their choice, while others compared various attributes of different phones showing that they conducted research and made informed decisions. The top post in Figure 8 shows examples of unsuitable posts. The bottom post in Figure 8 shows examples of well-researched posts.

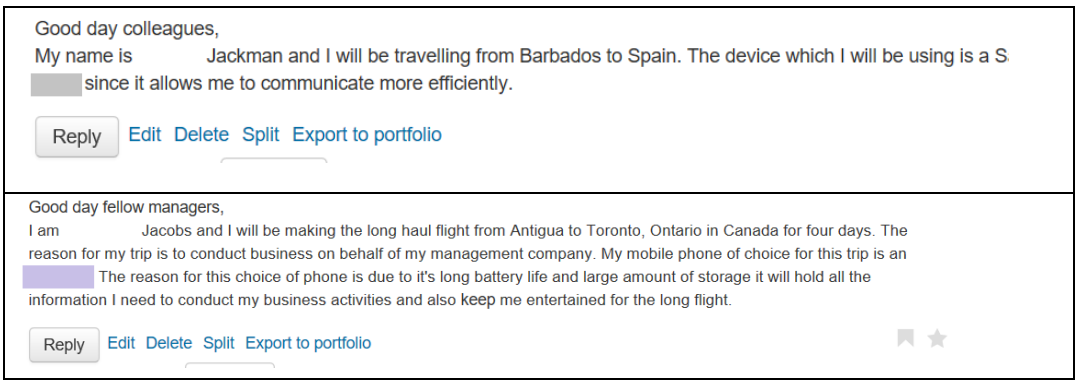
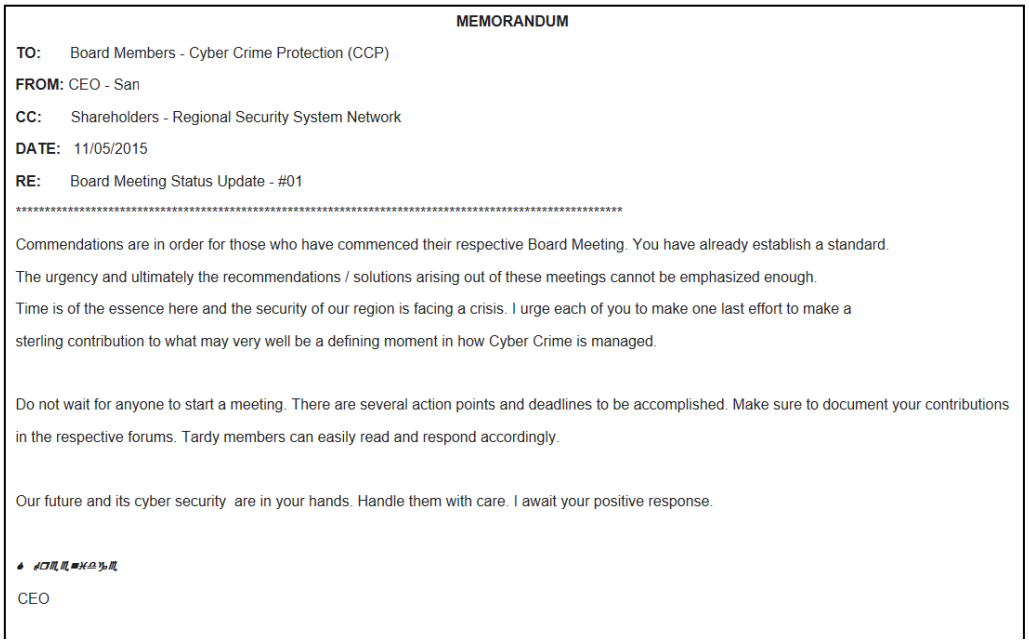


Figure 8. Students posting recommendations that were general (top) compared to well-researched (bottom) regarding a choice of mobile phone when travelling.

eMeeting Thread 4: High Touch Work-integrated Learning Strategy

Role play group activity across real-world contexts. Students communicated and progressed through the threads of the eMeeting while receiving valuable feedback from their tutor and group members. Additionally, the instructor and tutors used creative ways to maintain the momentum for those who were engaged in the discussion. A key strategy used by one tutor was to engage a group's members as though they were working as managers and the tutor was a supervisor, thus changing the group dynamic and enhancing the quality of responses. Another strategy used by a tutor was a summary post at the conclusion of each eMeeting, which shared the progress of all groups, and provided them with a comparison of their progress among their peers.

Instructor observation 1. Figure 9 illustrated a strategy used by a tutor to engage students in an eMeeting. As the number of student comments increased, it became necessary to summarize the information in such a way, that it became a creative resource. Initially, some groups spent too much time in an earlier thread trying to agree on a common theme. Other groups were not as active, indicating that they were waiting for all members to make an initial post. One tutor not only praised groups for starting their eMeeting but used a memo to provide guidance and encouragement to those who had not posted or were not posting within the required deadlines. The tutor's memo was also written with a tone of urgency to align with the group's cybersecurity theme thus encouraging members to complete their tasks by the deadline to avoid a 'security breach' (Figure 9).



MEMORANDUM

TO: Board Members - Cyber Crime Protection (CCP)

FROM: CEO - San

CC: Shareholders - Regional Security System Network

DATE: 11/05/2015

RE: Board Meeting Status Update - #01

****

Commendations are in order for those who have commenced their respective Board Meeting. You have already establish a standard.

The urgency and ultimately the recommendations / solutions arising out of these meetings cannot be emphasized enough.

Time is of the essence here and the security of our region is facing a crisis. I urge each of you to make one last effort to make a sterling contribution to what may very well be a defining moment in how Cyber Crime is managed.

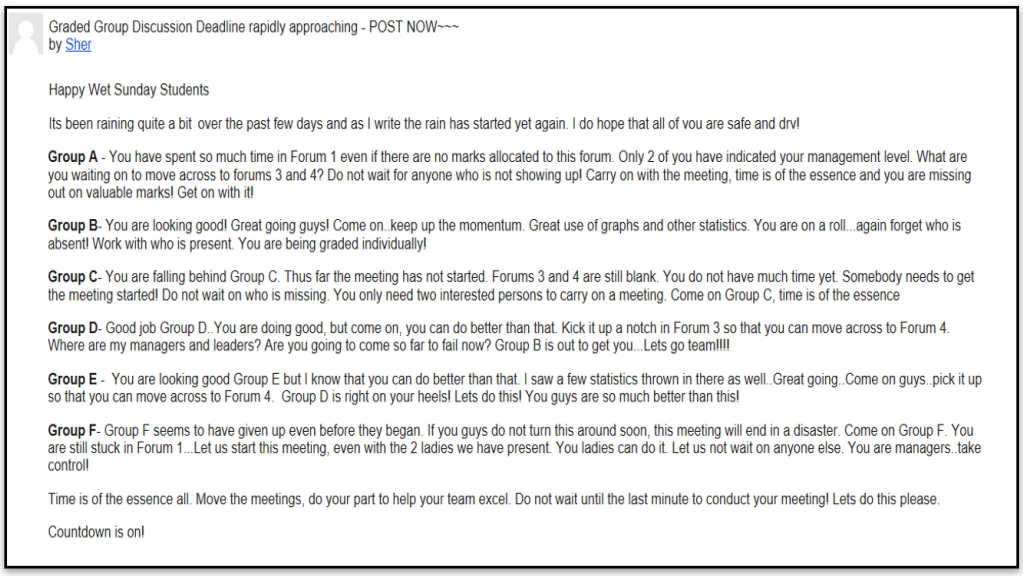
Do not wait for anyone to start a meeting. There are several action points and deadlines to be accomplished. Make sure to document your contributions in the respective forums. Tardy members can easily read and respond accordingly.

Our future and its cyber security are in your hands. Handle them with care. I await your positive response.

CEO

Figure 9. Tutor using a memo for role-play.

Instructor observation 2. Another tutor used a different strategy by posting a summary of the status of the groups' progression through the threads (Figure 10). This gave the students an overview of how well each group was performing without embarrassing or identifying anyone individually. In this summary post, groups B, D and E were progressing very well, and so the instructor used a competitive strategy to maintain their momentum. A teachable moment for groups A, C, and F from the memo was that the specific outcomes for the eMeeting were still required irrespective of the non-attendance of all group members.



Graded Group Discussion Deadline rapidly approaching - POST NOW~~~
by Sher

Happy Wet Sunday Students

Its been raining quite a bit over the past few days and as I write the rain has started yet again. I do hope that all of you are safe and dry!

Group A - You have spent so much time in Forum 1 even if there are no marks allocated to this forum. Only 2 of you have indicated your management level. What are you waiting on to move across to forums 3 and 4? Do not wait for anyone who is not showing up! Carry on with the meeting, time is of the essence and you are missing out on valuable marks! Get on with it!

Group B- You are looking good! Great going guys! Come on..keep up the momentum. Great use of graphs and other statistics. You are on a roll...again forget who is absent! Work with who is present. You are being graded individually!

Group C- You are falling behind Group C. Thus far the meeting has not started. Forums 3 and 4 are still blank. You do not have much time yet. Somebody needs to get the meeting started! Do not wait on who is missing. You only need two interested persons to carry on a meeting. Come on Group C, time is of the essence

Group D- Good job Group D..You are doing good, but come on, you can do better than that. Kick it up a notch in Forum 3 so that you can move across to Forum 4. Where are my managers and leaders? Are you going to come so far to fail now? Group B is out to get you...Lets go team!!!!

Group E - You are looking good Group E but I know that you can do better than that. I saw a few statistics thrown in there as well..Great going..Come on guys..pick it up so that you can move across to Forum 4. Group D is right on your heels! Lets do this! You guys are so much better than this!

Group F- Group F seems to have given up even before they began. If you guys do not turn this around soon, this meeting will end in a disaster. Come on Group F. You are still stuck in Forum 1...Let us start this meeting, even with the 2 ladies we have present. You ladies can do it. Let us not wait on anyone else. You are managers..take control!

Time is of the essence all. Move the meetings, do your part to help your team excel. Do not wait until the last minute to conduct your meeting! Lets do this please.

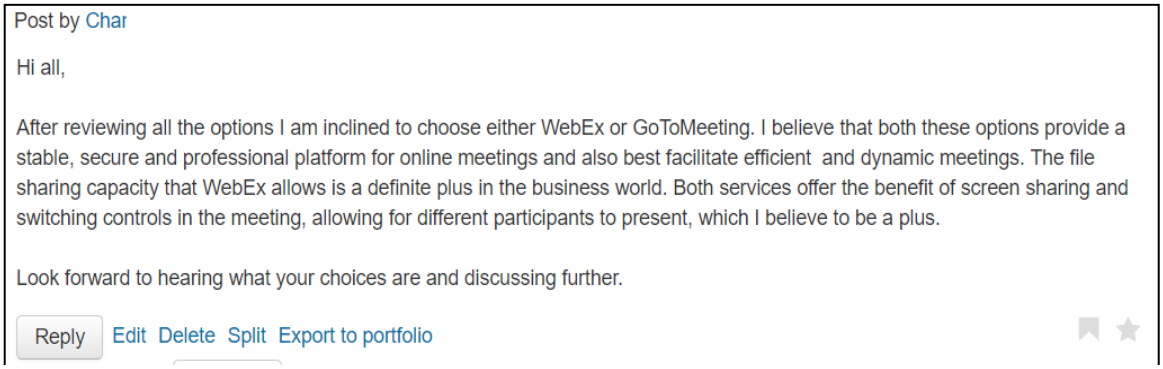
Countdown is on!

Figure 10. Tutor using group summaries for role-play.

eMeeting Thread 5: High Touch Community Development Strategy

Group Submission with student-student brainstorming. In previous threads, students were expected to collaborate and agree on a common application, theme, or topic from the case study that would be used throughout the eMeetings, and then actively engage each other in a discussion. This last tasks of the eMeeting required students to assume shared responsibility for collaborative work. Students were expected to contribute ideas in order to create an online poster that reflects a cohesive summary of their group assignment.

Instructor observation 1. Students were observed posting messages, reminders, and questions as they worked effectively in their group. There was evidence of students' interacting respectfully with their members, making necessary compromises, and assuming shared responsibility in collaborating on the final group poster (see Figures 11 to 13). Suggestions on improving the final product was also observed as an indication that members valued the individual contributions made by other team members



1Figure 11. Student summarizing a series of posts for the group.

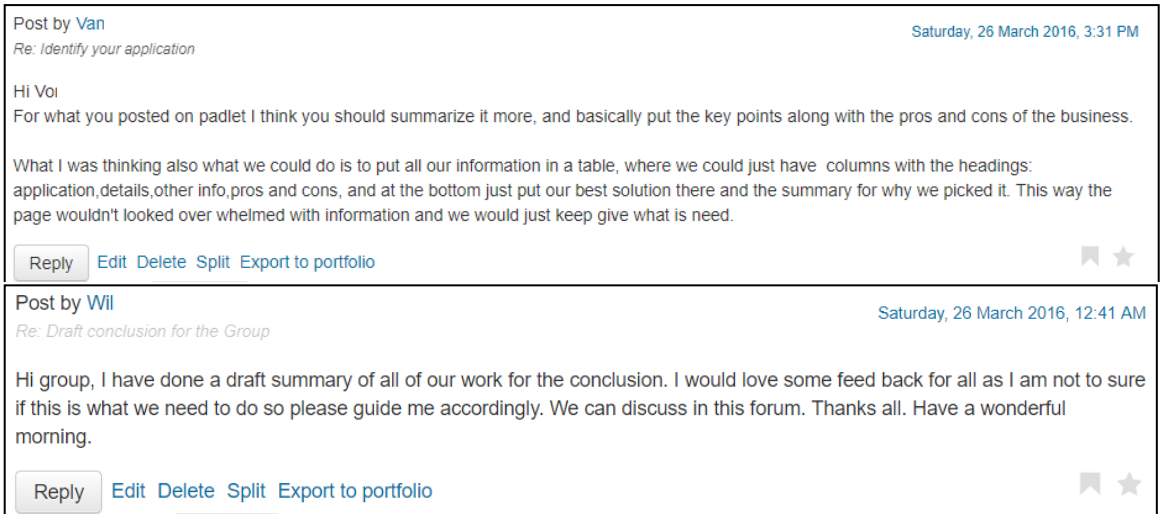


Figure 12. Requesting feedback from other group members.

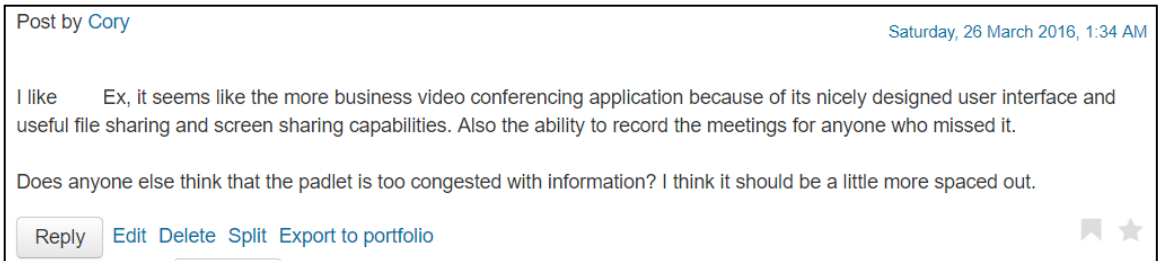


Figure 13. Communicating new ideas to other group members.

Instructor observation 2. Most groups completed their summary poster by the two-week deadline, thus achieving the final objective of the assignment. Samples from the posters shared in Figures 14 and 15 demonstrated creativity and innovation through working together and brainstorming in an online environment.

Figure 14. Submission of final online poster by a group–Example A.

Figure *15.* Submission of final online poster by a group–Example B.

Results

Course Evaluations, and Student Feedback

Overall data collected showed an increased pass rates, increased student satisfaction, and decrease in student attrition. The following sections provide further details on these results.

Course pass rate. Historically, the overall pass rate for the course ranged between a low of 69% to a high of 88% between 2011–2013. While there are fluctuations in these early years, since the integration of the eMeeting with the high touch strategies, the pass rate shows a steady increase with a low of 90% and a high of 93% between 2014–2016. Table 4 presents the comparison of overall student pass rates from 2011–2013 and 2014–2016 for each semester.

Table 4

Overall Pass Rates from 2011 to 2016 for Students Who Had Both Coursework and Exam Marks

Year	Semester 1	Semester 2	Average
2011	69%	83%	76%
2012	79%	75%	77%
2013	86%	88%	87%
2014[c]	**91%**	**90%**	**91%**
2015	**91%**	**93%**	**92%**
2016	**93%**	**93%**	**93%**

Note. The UWI refers to the fall and spring semesters respectively as Semester 1, Semester 2. [c] indicates the year that the eMeeting design was integrated into the course.

Course evaluation. The course evaluation is based on a 5-point Likert scale with 1 being Strongly Disagree and 5 being Strongly Agree regarding workload, learning outcomes, and clarity of instructions for completing course work. Data provided from 2014 to 2016 indicated a high level of agreement across three key areas of the evaluation: (a) Lecture's Communication (see Table 5), (b) Learning Activities with the Lecturer (see Table 6), and (c) Feedback from the Lecturer (see Table 7).

Table 5

Instructor's Communication

I understood…	**2014**	**2015**	**2016**
the course learning outcomes (learning outcomes = what students should know/ be able to do by the end of the course)	4.56	4.56	4.74
how I could use the knowledge/skills developed during this course to achieve other goals (e.g. career, further study)	4.71	4.64	4.79
the instructions for completing assignments/assessments	4.57	4.74	4.88
the criteria that the instructor used to grade my assignments/coursework	4.61	4.77	4.83
Overall	**4.61**	**4.68**	**4.81**

Table 6

Learning Activities with the Instructor

Learning Activities with the Lecturer…	**2014**	**2015**	**2016**
were varied (that is, involved different types of activity)	4.56	4.56	4.63
were interesting or intellectually stimulating	4.71	4.64	4.81
encouraged me to interact/collaborate with other students about course topics	4.57	4.74	4.42
helped me to develop the knowledge, attitudes and skills specified in the course learning outcomes (learning outcomes = what students should know/be able to do by the end of the course)	4.61	4.77	4.81
required me to apply my new knowledge and skills to problems/new scenarios	4.48	4.78	4.77
Overall	**4.61**	**4.68**	**4.71**

Table 7

Feedback from the Instructor

Statement	**2014**	**2015**	**2016**
Feedback on assignments/in-course assessments was provided in sufficient time to be useful	4.56	4.56	4.83
Feedback helped me to develop/ improve my knowledge or skills	4.71	4.64	4.78
Grades for assignments/in-course assessments were based only on the criteria that the instructor had specified	4.57	4.74	4.98
Overall	**4.61**	**4.65**	**4.86**

Student feedback. As part of course evaluations, students could provide written feedback through open-ended questions. These include additional thoughts or information regarding (a) what they liked best about the course, (b) what they liked least about the course, and (c) how the course could be improved. The last section on lessons learned provided an opportunity for students to share their overall experiences of the course. While most comments were based on experiences with maintaining focus throughout the course or the overall workload, comments from a few students each semester shared the impact of the eMeeting assignment. There were no comments or negative experiences posted specifically regarding with the revamped eMeeting design.

Examples of student feedback from 2014–2016 included:

- The graded group discussion on recycling was effective in its intent to stir up a need to be part of a recycling action, rather than a passive bystander. I feel more confident about what I have to offer in relation to company decision making the impact on the environment (2014).
- In going forward, I would try to implement the knowledge I have gained from the course in my business to enhance its performance (2014).
- I would like to say that from the initial tasks to the project and e-meeting in the board room have all contributed to my learning and the e-meeting definitely had an impact as it provided guidelines as to what I can expect in a meeting, as this was my first "e-meeting experience" (2015).
- This course has thought me a lot about teamwork and I enjoyed every moment of it. For some reason, this course has been the first I have felt so passionate about hence the reason why I felt obligated to participate in every forum in this course (2016).
- I found I was able to directly apply some areas of this course to other courses and in so doing enhanced my understanding of those interconnected areas. I feel ready to apply what I have gleaned to my job and other areas of my life (2016).

Decrease in student attrition. The course has historically had attrition rates of around 5%. Since the integration of eMeeting design with high touch strategies, the attrition rate dropped to approximately 1%. Table 8 shows the retention rates from 2011 to 2013 before the new group assignment with high touch strategies was introduced in 2014 to 2016. Table 8 also highlights the overall decrease in student attrition from 5% to 1%.

Table 8

Summary Data on Number of Students who Dropped the Course Between 2011 and 2016

Year	Student enrollment	Number of students who completed course	Number of students who dropped course	Percentage of students who dropped course
2011	801	760	41	5.1%
2012	834	790	44	5.3%
2013	751	715	36	4.8%
* 2014	547	534	13	2.4%
2015	484	476	8	1.7%
2016	469	464	5	1.1%

Note. Data was obtained from final exam mark sheets for both course work and final exam marks.

Recommendations

There are five recommendations from this study that align with the OHT conceptual framework. Each recommendation builds upon the literature and makes a connection to the context and results of this action research study. The recommendations can be used in courses whether they range from low to very large enrollments to support engagement and retention.

1. **High Touch Student Engagement Strategy: Enhance Directions with Instructor-Led Videos**

It is recommended that instructors develop supporting materials beyond the syllabus. These materials can include instructor-led videos and useful examples used in this study, which describe the approach and purpose of an assignment to ensure that all requirements are clear. The instructor-led videos should reference the assignment document and detailed course work rubric, so that students are aware of how they would be assessed.

2. **High Touch Personalized Communication Strategy: Provide Examples for Self-Introductions**

It is recommended that as part of the requirements, students introduce themselves in preparation for interacting in an activity. Examples could also be shared on how students should introduce themselves in an online environment. Similarities in students' names, if sorted, could be used as an icebreaker during initial introductory posts. Instructors should also be aware that it is important to provide creative and personalized feedback to students whether individually or as a group. Apart from demonstrating that that they are interested in students' contributions, personalized posts can also serve to encourage students who have yet to join or engage in the threads for various reasons.

3. **High Touch Community Development Strategy: Require Collaborative Agreement**

It is recommended that instructors integrate strategies that actively engage students with topics relevant to weekly/module content, current/emerging issues, and prior or upcoming assignments. These assignments in which students collaborate could include tasks that require interaction asynchronously or synchronously.

4. **High Touch Work-Integrated Learning Strategy: Integrate Role Play Using Real-world Contexts**

It is recommended that assignments align with real-world contexts, to support transfer of learning. This offers opportunities for communication, critical thinking, problem solving, and collaboration.

5. **High Touch Data-Driven Decision-Making Strategy: Review Quantitative and Qualitative Data**

A consistent review of quantitative and qualitative data from assessments and evaluations is recommended. Thus, monitoring various aspects of the course can assist in modifying current assignments or integrating new course assignments into courses with large student enrollments.

These five high touch recommendations are provided to instructors as they seek to actively engage students in large classes. The eMeeting-type assignment, as shared in this study, has shown to assist students in developing the knowledge, skills, and experience needed as they transition from the educational classroom to the corporate sector.

Conclusion

The UWI is committed to providing all students with the same high-quality courses across all instructional modalities, and alignment with the program outcomes, 21st Century Skills, and The UWI's attributes. This study has demonstrated that an online discussion forum can be successfully designed and introduced to students as an eMeeting or other real-world group activity. The results show that since the integration of the new eMeeting format using OHT strategies, significant increases were observed in student engagement and academic performance, while a comparison between the pre- and post-integration revealed decreases in attrition, and higher scores on the standardized final exam. Course evaluations between 2014–2016 also reflect increased student satisfaction with the course.

The integration of the new eMeeting design using high-touch strategies was successful for students in this assignment. Future research could involve using these strategies in other course assignments requiring group work to further evaluate learning outcomes and capture students' experiences. Monitoring of student attrition obtaining feedback could determine if these types of strategies influence student satisfaction and retention. eMeetings can be used, by students and instructors alike, as a valuable teaching tool especially simulating real-world group meetings. Integrating group assignments in large courses with real-world requirements, not only provide students with the opportunity to apply the knowledge, skills, and experience gained throughout the course, but enhance key soft skills sought by employers including problem-solving, ability to work in teams, communication, leadership, and time management.

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Postgraduate Online Teaching in Healthcare: An Analysis of Student Perspectives

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Abstract

The use of online learning in postgraduate teaching has increased dramatically in recent years. Health-care professionals can benefit from the flexibility afforded by online learning to fulfil their continuing professional development goals. Understanding student expectations, concerns, and experiences of such courses is crucial for the development and successful facilitation of this education modality. The aim of this paper was to examine student perspectives of an online postgraduate certificate in clinical exercise prescription. A set of recommendations based on these findings was also created which may serve to inform those involved in online education.

Students expressed their expectations and concerns about taking the course before it began, and completed surveys on their experience after module completion. A multi-method approach using both qualitative content analysis and quantitative survey analysis was used to analyze student responses on the online modules in the virtual learning environment.

Students (n = 19) had a combination of academic, personal, and clinical expectations entering the course. Concerns entering the course included ability to reach academic standards set by the course due to personal circumstances or lack of academic ability; the ability to manage time and workload; and the online nature of the course. Students felt supported throughout the course, although some had difficulties keeping up with the workload or managing their time. Results of this study can be used to inform the structure and coordination of online modules, in particular in the postgraduate healthcare setting.

Keywords: online education, postgraduate, recommendations, student perspectives, student support

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Postgraduate Online Teaching in Healthcare: An Analysis of Student Perspectives

Recent years have seen an increase in the number and types of courses in higher education being offered online (Allen et al., 2016). At postgraduate level, online teaching (or e-learning) is particularly suited to healthcare professionals, as they are required to engage in continued professional development (CPD), yet cite time and lack of provision of study leave as barriers to attending traditional face-to-face classes (Haywood et al., 2013a; Haywood et al., 2013b). Many online courses have been developed specifically for healthcare professionals (Brown & Bullock,

2014; Field, 2002; Gardner et al., 2016; Murphy et al., 2015; Wolbrink & Burns, 2012) and this delivery method can help overcome some of the challenges for healthcare education (Ruckert et al., 2014).

As a teaching method, online education in its various forms has been hailed for its potential to promote higher level thinking. This stems from the fact that theory can be learned at a time that suits the student, enabling synchronous and asynchronous interactions between academics and students, to be used for debate, discussions, case scenarios, and problem-solving (Ally, 2004). In general, student and staff acceptance of such courses has been very high, with effective use of financial and time resources as well as effective learning being cited as positive benefits to e-learning (Bergold et al., 2013; Fisher, 2015; Gummesson, 2012; Macznik et al., 2015).

However, health-care students have varied perceptions of using information communication technology in relation to education (Costello et al., 2014), and incorporating new pedagogical models can challenge the student learning experience (McDonald et al., 2014). Understanding student perceptions as online learners in health sciences education can help health science educators address students' concerns and expectations, tailor the online modules or information imparted accordingly, and as previous research has shown, can help build more effective online courses (Howland & Moore, 2002; Song et al., 2004). It can also provide evidence to the wider discipline on the concerns, needs, and expectations of health-care professionals undertaking further education in this space. This can support the development of more online courses and help guide educational and professional institutions in future efforts.

The purpose of this paper was to expand understanding of student perspectives in this field, specifically in health science courses. The main research questions explored in this study were

1. What expectations do health-care students have prior to starting a postgraduate online course?
2. What concerns do health-care students have prior to starting a postgraduate online course?
3. What perceptions and experiences do healthcare students have during and after modules on a postgraduate online course?

Finally, for the information gathered as part of this study to be of most use, it was an aim of the authors to develop a set of recommendations for online educators that would serve as a guide for online course development and facilitation.

Background on the Course and Aims of this Study

The online Postgraduate Certificate in Clinical Exercise was delivered online over one academic year via four modules with a total of 27 teaching weeks. Teaching included weekly asynchronous lectures (interactive slides with a voice over), weekly synchronous tutorials (webinars), self-directed reading, discussion board posts that were moderated by academic staff, reflective journal entries and multiple-choice questions. Assessment consisted of essays, case scenarios, engagement with online material (equivalent to attendance), and multiple-choice questions. Each module had the same week-by-week structure whereby students began the week with an asynchronous webinar followed by multiple choice questions. Students were then required to carry out a task (e.g., write a reflective journal entry) and the week ended with a synchronous webinar that addressed any issues with the material that were presented during the week and encouraged discussion and debate on the topic at hand. The length of each of the four modules depended on the credits that were attributed to it (in line with the European Credit Transfer and

Accumulation System) and ranged in length from 10 weeks to 4 weeks. The course had a total of 27 active teaching weeks, one revision week, and three exam weeks. There was a four-week break for Christmas holidays. Students were expected to log in during each active teaching week. In order to gain marks equivalent to attendance, students had to be present during the live webinar and to have engaged with the asynchronous material during the week preceding the live webinar.

The structure of the certificate was determined by staff developing and teaching on the course in collaboration with the online education team at the university. It was considered imperative during the development of the course that there would be both asynchronous and live components and that the students would be required to contribute to the course in the form of a blog post or reflective journal entry during each active teaching week. The main difference between these online learning tools is that a blog post is shared with all members of the class whereas a reflective journal entry is between the academic and student and is not shared with the class. This structure was hoped to encourage continuous engagement with the course material and a high level of learning.

Twenty students registered for the Online Postgraduate Certificate in Clinical Exercise and seventeen students completed the course in 2016. All three students who left the course did so during the first module. The average student age was 35 (SD = 8) years. The youngest was aged 24 and oldest aged 50. Twelve female and eight male students registered for the course. Of these students 12 were physiotherapists, four were nurses, and four were other allied health scientists. All students had English as their mother tongue or had completed a higher intermediate English language exam within the previous 2 years. The majority of the students (18) lived on the island of Ireland (from where the course was being hosted) and were working full time in clinical positions.

As part of the course orientation students were asked to write a short introduction about themselves, to contribute to a discussion board about their expectations of the course, and to write a journal entry about their apprehensions or concerns taking the course. After each module, students were asked to complete a simple feedback survey with five Likert style questions and one open-ended question that served to assess the basic structure of the online modules and whether students believed that it succeeded in meeting learning objectives.

Methods

This study used both qualitative content analysis and quantitative survey analysis to analyze student contributions in the virtual learning environment (VLE) and post-module surveys. Content analysis is a method for analyzing written, verbal, or visual communication messages (Hsieh & Shannon, 2005). Its purpose is to produce a condensed description of a phenomenon and to generate concepts used for theoretical categorization (Elo & Kyngas, 2008). Qualitative data, which included open-ended comments/suggestions from the feedback surveys as well as relevant discussion posts, reflective journal entries, were analyzed using NVivo 11 software (see Table 1). Table 1 outlines data sources for analysis. This software aids qualitative analysis of large amounts of text-based data, and has been successfully used to support similar research (Anaf & Sheppard, 2010; Lefmann & Sheppard, 2014; Moore et al., 2003). Text can be coded with themes, and also provides a useful audit trail of the analysis where temporal changes in categorical interpretation and coding can be seen. Thus, NVivo 11 provided the framework for analysis and consolidation of themes. For the qualitative analysis an inductive method was employed. Initially, several broad

themes were identified relating to our research question (student expectations and concerns), but on further synthesis, more complex themes were integrated into main themes and themes that led to a more concise view of student's experiences. A reflective iterative approach by two researchers facilitated this process. All coding was completed in NVivo 11 and grouped into two categories: "pre-course" and "during course." Codes were compared within the NVivo system software and any differences were resolved through consensus discussion. Any remaining difference were resolved through discussion with a third researcher not directly involved in the study.

All contributions from students were collected after the course was completed and final marks had been awarded. All students provided written informed consent. Ethical approval for this study was granted by the Trinity College Medical Research Committee. Individuals could not be associated with any information given, and this study was designed retrospectively.

Results

Table 1.

Data Sources for Analysis

Course period	Question posed	Resource type	Number of codable items	Number of words
Pre-course	What are you most looking forward to with regard to the course?	Blog	15	2,060
Pre-course	What are your concerns surrounding taking this course?	Learning Journal	15	1,817
Pre-course	Hello Class Thread	Discussion Board	29	2,740
During course	Open-ended questions at end of each module survey	Survey	28	954

A summary of themes and subthemes that emerged from qualitative data analyses are outlined in Table 2.

Table 2

Themes and Subthemes Emerging from Analyzed Qualitative Data

Temporal period	Theme	Subtheme
	NOTE: Only subthemes with the largest number of coded entries have been included under each theme due to space constraints and to provide a concise representation of data analysis	
Pre-course	**Expectations**	
	Learning (*n* = 87)	Improve exercise prescription skills (n = 33)
		New knowledge (n = 19)
		Broaden or deepen knowledge (n = 8)
		Develop evidence-based knowledge (n = 14)
		Multidisciplinary learning (*n* = 6)
	Achievements (*n* = 34)	Complete course (*n* = 1)
		Connecting with others (*n* = 19)
		Improve confidence (*n* = 8)
	Change in clinical practice (*n* = 50)	Patient benefit (*n* = 14)
		Career benefit (*n* = 13)
	Looking forward (*n* = 11)	
	Studying online (*n* = 10)	
Pre-course	**Concerns**	
	Personal (*n* = 14)	Personal circumstances (*n* = 9)
		Communication (*n* = 4)
	Time and Workload (*n* = 11)	
	Academic (*n* = 11)	Personal ability (*n* = 10)
		Lack of evidence base (*n* = 1)
	Technology (*n* = 10)	Internet (*n* = 7)
		Online learning (*n* = 3)
During course implementation	**Survey feedback after completion of each module**	
	Positive	Online nature of course
		Support
		Relevance of material covered
	Negative	Time or workload
		Online nature of course
		Practical classes required

Pre-course Expectations.

The following themes emerged for pre-course expectations: learning, achievement, change in clinical practice, and looking forward and studying online themes.

Learning. Within the learning theme, identified subthemes were to improve skill at exercise prescription, to learn new knowledge, to broaden or deepen knowledge, to develop evidence-based knowledge, and to learn from the multidisciplinary student base. Detailed analysis of this theme revealed a focus on learning exercise prescription as a skill through the acquisition of knowledge. The subtheme of improving exercise prescription skills was often cited with reference to clinical populations and students expressing a lack of confidence in this area. This finding indicates that the students did not feel confident prescribing exercise to certain patient populations.

> My main interest and expectation surrounding the course would be to develop knowledge and confidence regarding the prescription of exercise for the prevention and treatment of chronic diseases.

The second-most prominent subtheme was to acquire new information. Students expressed an expectation of learning about exercise prescription in clinical populations that could be helpful in their clinical settings. For example:

> I plan to develop a specific area of my practice, namely health promotion in the over 60s, and I believe a more in-depth understanding of the effect of exercise will help me to deliver a quality service to my clients.

The third subtheme, broaden or deepen current knowledge, was highlighted through students curiosity to learn about the new research emerging in the area of exercise prescription: "I am hoping to learn the latest research and methods in prescribing exercise as a physiotherapy intervention." Results clearly show that healthcare professionals expected this course to have a strong evidence base.

The final learning subtheme was to learn from the multidisciplinary student body. One student remarked: "I'm looking forward to learning from the many different backgrounds and disciplines that has already been posted here." Research has shown that teamwork and collaboration between all health professionals is essential for high quality patient care (Chaboyer & Patterson 2001; McPherson et al., 2001). It is encouraging to see a desire for multidisciplinary learning extending into online opportunities for continued professional development.

Achievement. The second-most referenced "expectations" theme was identified as achievement. Upon commencing the online certificate, students were expecting to be able to connect with academic staff and their classmates, as well as sharing their knowledge beyond the classroom environment. Furthermore this was something that they were clearly looking forward to. Comments that highlight this theme include:

> I'm looking forward to meaningful discussions with fellow course mates and clinical educators so as to learn from their experiences and expertise

One student in particular expressed this theme very succinctly, stating that they: *"*Can't wait to chat to you all and learn from other people's experiences." This theme highlights the fact that students expected to interact with each other despite the online nature of the course which may traditionally have been considered to be more isolated than traditional face-to-face teaching.

The second subtheme relating to achievement was to simply complete the course. This theme seemed to stem from the concern of having not engaged in formal education for some years. For example, one student remarked that their expectation of themselves was to "get through the course after years working in the clinical environment." This theme is of particular importance in postgraduate clinical education and highlights the fact that clinicians may regularly take part in different forms of continued professional development and still perceive formal education as a significant personal challenge. Although personal barriers such as family commitments, resistance from peers, and time constraints (French & Dowds, 2008) have been identified in the literature, the challenge of returning to formal education after a large temporal gap in completing undergraduate education has previously not been identified in this space (see O'Donnell et al. [2009] for a discussion of this theme within the social science discipline).

Change in clinical practice. The third theme to emerge from student expectations was that of changes to clinical practice. Students expected to change their clinical practice through introducing or improving exercise prescription. The subthemes in turn were to benefit patient health and develop their own career. The caring nature of healthcare professionals was evident in this theme with the most referenced subtheme being that of expected benefits to patient health. For example, one student stated:

> I was drawn to this postgraduate certificate as I have a special interest in rehabilitation and believe that as clinicians we should lead the way in improving quality of life for individuals through exercise especially for those with chronic conditions who find it more difficult and lack the confidence to exercise safely.

Results indicate that students expected the changes they made to result in improved outcomes for their patients. For example one student remarked:

> We know as clinicians why patients need to engage in exercise, I hope this course will deepen my own understanding of the subject. I anticipate that in turn, this theoretical knowledge will inform my practice and help me to have more positive outcomes with service users. My goal is to effect long term change in the lifestyles of my patients, thereby improving their current physical and mental health, life expectancy and prognosis

Students also expressed an expectation that the course may benefit their careers:

> Due to unforeseen circumstances I was away from work for a significant time so I have decided that undertaking this particular … online course would be an essential step forward to refresh and regain my career ambition.

Looking forward and studying online themes. The final two themes which emerged from student expectations were looking forward and studying online. Students expressed positive expectations regarding studying online: "I am excited by the online interactive setup of this post grad certificate" and "It is my first time pursuing online education and I'm enjoying the format so far."

Pre course Concerns.

Before course teaching began, students were asked to voice their concerns about the course in their online learning journals. Four main themes emerged, which are listed in Table 2: personal concerns, academic concerns, time management and workload, and technology.

Personal concerns. As with any student body, those taking the online postgraduate certificate in clinical exercise had concerns around the theme of balancing their personal and academic lives. Many of the students were working full time in clinical environments and also had family commitments.

> Organisational skills with regard to all the weekly tasks is my main concern at present, making sure that I can keep up with all the reading requirements and also keep family life as sane as possible.

> My biggest concern about taking on this post graduate study is that it will take away from quality time with my 14 month old.

Several students also expressed concern over being able to express themselves and their opinions concisely.

> Another concern that I have is around my reflective writing skills. I am very good at reflecting in my head and verbally but have struggled in the past to get it down on paper succinctly. I feel that as a result I have lost some confidence in this area so this will be a good challenge for me.

Academic concerns. Students expressed concern about engaging in an academic course. Some had not been engaged with formal education for several years:

> However, regarding my initial concerns—the main one is that it has been over 10 years since I have had to do any scientific or academic writing, and I am nervous about my ability to research and access material, and reference it accurately.

This is similar to the theme of achievement where students expressed a wish to complete the course. On further examination of this theme, academic writing in particular was stipulated by students as a concern.

The second subtheme with regards to academic concerns was expressed by only one student; however, it is important to note. This student in question was concerned that the body of evidence and learning material available would not meet their academic needs. This reflects the fact that the area of clinical exercise prescription is a complex and ever-evolving one.

> My main concern is that I am expecting that their [sic] will be research that will allow my [sic] to prescribe exercise intensities based on specific physiological processes, or biological changes that in turn decrease the patients symptoms. I am in some way expecting that these levels will be physiologically measurable and patient specific. I think that I will find that the research is lacking in this area, and will ultimately be disappointed by this.

Unfortunately, there are frequently times when the research to date is not capable of answering specific clinical questions. This student's concerns highlights the fact that we do not yet have all the answers in the area of exercise prescription, but that in a learning environment we can share our concerns and questions and strive to make informed evidence based decisions in clinical care with available resources.

Time management and workload. The third main theme to arise from students' concerns is related to, but distinct from the first two. Students were concerned about their ability to manage time and achieve the workload expected of the postgraduate certificate in clinical exercise. Although this was not the most referenced concern, it was cited as the main concern by some students which emphasizes its importance. For example: "The main concern I have for this course

is the amount of time and dedication it will take to achieve a high mark" and "My main challenge will be managing my time effectively."

Technology. The final theme to emerge was that of technology. Some students were concerned about their internet connection while others expressed some apprehension about the online nature of the course and their ability to engage with a course delivered entirely on an online platform. Ireland has a large rural community. One advantage of online learning is that students don't have to make long journeys to cities to avail of learning opportunities. However, there are also potential shortcomings related to connectivity: "There have been some teething problems, namely internet access, as I live in a very rural area with no high speed or fibre optic broadband connection." In healthcare, learning as part of a group has been shown to have significant advantages (McPherson et al., 2001), whether this could be achieved through an online format was a source of concern for one student:

> While I am enjoying the online format, it will be unusual to not be in a physical classroom with real live classmates. The Collaborate forum is surprisingly personal though, and I do think we will get to know each other as the year goes on.

Learning online is a skill in itself, and therefore ample orientation is required, especially for those who are concerned about their ability to navigate an online learning platform or those who may feel uncomfortable contributing to one, this concern was expressed by some students:

> While I was somewhat apprehensive starting an online course, it had more to do with my previous experience than the fact I am not techie enough for it all to go smoothly. So far, things have gone great and I have managed to be introduced to the online platform and even engage, as I am now doing.

During course: Feedback.

Table 3 outlines results of the quantitative survey analysis. Overall results show that students considered topics covered during online modules met learning objectives and learning outcomes to a good or very good standard. As a group, students considered the number of lectures as "just right." The vast majority of students, approximately 90% of survey responders, felt that the organization of lectures and module timetables were organized or very organized and over 90% felt that learning materials provided were either good or very good. Overall modules were rated as being either good or very good.

The final question on the survey was open-ended and simply asked students to contribute any comments or suggestions related to the module. These answers were analyzed for all modules and results are categorized into positive and negative comments.

Table 3

Results of Post Module Surveys

Question and response options	**Average overall (%)**
Q1: To what standard did the topics covered meet the objectives and learning outcomes stated in the course handbook?	
Very good	58
Good	40
Average	0
Poor	0
Very poor	0
I am unaware of the learning outcomes in the handbook	0
Unanswered	2
Q2: Was the number of lectures sufficient to meet the course objectives and learning outcomes?	
Too many	3
Just right	80
Too few	17
I am unaware of the learning outcomes in the handbook	0
Unanswered	0
Q3: How do you rate the organisation of lectures and timetabling for this module including availability of resources on Blackboard	
Very organised	37
Organised	53
Average	11
Not organised	0
Very poorly organised	0
Unanswered	0
Q4: How do you rate the learning material (from presentations to webinars) provided during the module?	
Very good	51
Good	44
Average	4
Poor	0
Very poor	0
Unanswered	0
Q5: How would you evaluate the overall module?	
Very good	58
Good	39
Average	0
Poor	3
Very poor	0
Unanswered	0

Positive themes. Subthemes that emerged from positive comments related to the relevance or applicability of the learning material to student's clinical environments, and personal interest. For example*:* "All in all this module was highly informative and topics for example re limiting sedentary behaviour were adaptable in most situations for us as healthcare professionals, even pregnancy!" and "I'm looking forward to reading those articles for personal interest and guidance."

Online delivery. Students also commended the online nature of the course and its organization with comments such as: *"*Excellent module well presented and organised" and

> I have to say there is massive benefits to education when you don't have to get into a car or public transport and race to … your lectures. I am really enjoying this element of flexibility. So I can just log off right now and finish doing what I was earlier - technology is great!

Quality of online learning content. The quality of the online content was also highlighted as a strength of the course: "The online material provided is excellent."

Support. The final positive theme to emerge from the anonymous survey was that of support. Students felt engaged and supported throughout their learning journey online. This is reflected in comments such as: "Thanks for the motivation everyone in posting all your discussions, I was thinking that i wouldn't have a chance to complete these tasks this week but you all spurred me on!!" and "I am really enjoying the content and engagement with lecturers and other classmates."

Negative themes. Negative comments were also collated. Subthemes that emerged echoed some of the main concerns expressed by students before starting the course. The most referenced negative comment related to time management and workload.

Time management and workload. Some students felt that the workload was too much: "I have found the amount of material to pre-read and the level of exercises in the pre read a lot along with the assessments which seem to leave little time to breath with doing ordinary work and life" and "The workload was very heavy…All very relevant and interesting but hard to keep up with everything" while one felt that more learning material was needed: "I actually expected the lectures to be more in depth in terms of physiology and how it affects exercise."

Online delivery. There were also negative comments regarding the online nature of the course, in particular the lack of any practical teaching. One student remarked: *"*A disadvantage of the online format was evident for this module as a session in a lab or gym would make facilitate better understanding of the concepts" while another stated that "Some practical sessions would be invaluable." A suggestion on how to address this issue was also provided with one student commenting that "… one weekend module where one can see exercise testing and a few different types of exercise prescription in action would be a great addition and ideally a follow on practical module :)."

Technical difficulties. Finally, one student had technical difficulties that resulted in a negative experience and that were considered to be a problem specific to online learning as it would not have happened in a face-to-face situation:

> I have been very unfortunate to have my MCQ crash twice during this module which was really very upsetting at the time when I was all geared to take the exam and on both occasions [sic] disrupted my work day. This would not happen in a sit down exam.

Limitations

A notable limitation of this study is that only one course was analyzed. It is possible that courses of a different nature would require different student supports and result in different online student experiences. Data presented in this paper is in relation to a postgraduate health sciences course and therefore may not be applicable to undergraduate or other postgraduate courses/students. However, although data was taken from a specific course, case studies such as these can enrich the literature on healthcare student experiences in a virtual learning environment, help improve teaching methods, and ultimately ameliorate student experiences. Another limitation to this paper is that although post-module analysis was gathered, there was no detail on overall course experience gathered from students after completion of the entire course.

Discussion

Recent years have seen a surge in the number of online courses offered to healthcare professionals. Courses being offered online come with the advantage of offering clinicians more flexibility in reaching their continued professional development goals and have been reported as successfully leading to improvements in both knowledge and skill (Bello et al., 2005; Hopper & Johns, 2007; Hugenholtz et al., 2008; Rohwer et al., 2013). This paper details the expectations, concerns, and experience of 19 students enrolled on an online postgraduate certificate in Clinical Exercise.

Ten general recommendations are proposed as supplemental material to this paper based on the analysis carried out and the experience of the researchers involved. Understanding students' expectations and concerns as they begin an online course can greatly help academic staff to tailor the learning experience in a way that supports students in reaching their learning goals.

The most prominent theme to emerge regarding students' expectations of the course was that of learning and gaining or deepening knowledge. This highlights the fact that healthcare professionals may not feel confident in exercise prescription (Hayes, 2009; Heath & Stuart, 2002), despite a large amount of evidence that has proven exercise to be an effective treatment method for many clinical conditions that healthcare professionals may encounter on a daily basis. The gap in knowledge expressed by students may stem from the fact that much of the evidence in this area is new. It is likely that when many of the students on this course graduated, the role of exercise as a treatment tool for those with cancer, depression, communicable diseases, and other such conditions was not part of their curriculum. This is not a fault of any curriculum per se but highlights the need for continued professional development in areas where research is evolving rapidly. This finding highlights the opportunity for online courses to be used to keep professionals up to date on evolving research in their area.

What is perhaps most interesting about the student expectations was that students expressed an expectation that the knowledge gained would lead to an improvement in their prescription skills. It has been shown that fully online courses imparting knowledge can lead to an improvement in clinician skills (Bello et al., 2005; Edrich et al., 2016; Rohwer et al., 2013).

It is important for academic staff to be aware of concerns that students have as they engage in further education. The flexibility afforded by online learning enables students who would be unable to attend traditional face-to-face teaching to engage in formal and informal education. However, the physical ability to log on and participate in a course does not remove other barriers

to further education, such as family and work commitments (Muilenburg & Berge, 2005; Sorensen & Donovan, 2017). This was evident from the results of the current study where students were positive about the online nature of the course but concerned about their ability to fully engage with and complete the course due to their personal commitments.

High dropout rates are often reported in online courses (Bawa, 2016). The reasons for such high dropout rates are often unclear since the students of interest are those who are no longer engaging with the course (Fetzner, 2013). However, results of this study give some insight into the concerns and difficulties expressed by online learners. Students were concerned about the workload and time commitment that the course would require. In line with this concern, some students reported in the post-module surveys that the course had a heavy workload. This issue may be indirectly related to the online nature of the course whereby students were able to continue working clinically full time due to the flexibility provided by the online course, whereas with face-to-face teaching they would likely have had to reduce their working hours to attend classes during working hours.

Another concern was students' ability to express themselves. This concern was at times linked to the fact that the course was online. Some students were anxious about their ability to navigate and engage with the online platform. A greater concern, however, seemed to be the ability to meet academic standards. This stemmed from the fact that many students had not taken part in formal education for a number of years. It is possible that the online nature of this course finally afforded them an opportunity to do so.

Results of post-module surveys showed students highly rated the teaching resources and found them to be relevant and informative. All four modules were rated as being good or very good. Learning material seemed to appeal to students' clinical/professional as well as their personal interest. Since the majority of students would have been working in a specific clinical area (e.g., mental health, cardiovascular medicine or a community setting) it is assuring that material which may not have been directly related to their speciality was viewed positively and enjoyed. The online nature of the course was also received positively.

Feedback from the post module surveys also revealed limitations to this course. Most notably, students expressed a desire to have a practical teaching session. This finding highlights the limitation of online learning in the area of clinical exercise and has been previously expressed by students studying anatomy and physiotherapy-specific courses online (Harvey et al., 2014; Swinnerton et al., 2016). Previous research has shown no difference in the course results of students who engage with course material online compared to those who engage in the traditional face-to-face method (Bello et al., 2005; Cook & Steinert, 2013; Edrich et al., 2016; Matzie, 2010; Pourmand et al., 2013). However, studies have also shown that a blended learning approach where both methods are used could leverage even better results (Edirippulige et al., 2012; Eksteen, 2011). The examination of a blended learning approach was beyond the scope of this study.

Many, but not all, courses involving the acquisition of skills have taken a blended learning approach, combining both traditional and e-learning methodologies in order to optimise face-to-face time to impart skills. While the literature would suggest that blended learning is effective at undergraduate level, students at postgraduate level can be successful at enhancing both their knowledge and practical skills through online learning alone (Rohwer et al., 2013). Few studies have examined the efficacy of teaching clinical skills through e-learning alone. Of those that have, Edrich et al. concluded that web-based training was just as effective as traditional methods at

teaching anaesthesiologists lung ultrasound skills (Edrich et al., 2016), and Roesch et al. advocated a computer assisted learning program for the provision of both theoretical biomedical knowledge and clinical skills in the area of dermatology (Roesch et al., 2003). Other studies have shown positive results from teaching airway management (Bello et al., 2005) and paediatric rheumatology (Manners, 2013) fully online.

Investigating the concerns, expectations, and experience of a cohort of online postgraduate students in clinical exercise has contributed valuable knowledge to the discipline. Understanding key themes can support future development in online modules in this space, and has added to the body of literature on online learning within the health sciences. It appears that overall students were highly appreciative of the learning resources available to them in an easily accessible and flexible format, the quality of teaching, the support received by peers as well as teaching staff, and the relevance of the material presented to their clinical settings and learning goals. The online nature of the course was perceived as a challenge by some students and not without its limitations. However, students also saw it as an advantage and as something which enabled them to reach their learning goals despite work and family commitments.

Overall analysis of the findings presented in this paper provide evidence for the success of teaching clinical exercise online. However, it should also be noted the workload may be perceived as heavy for students who choose to continue to work full time and there may be a need to support some online learning in practical subjects with face-to-face practical teaching sessions. Online learning results in student expectations and concerns that are unique to the VLE. The evidence-based recommendations provided as supplemental material to this paper may help online clinical educators and students to maximize the success of their teaching and learning experiences, respectively.

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Appendix A: Recommendations

Each recommendation below was informed by results derived from this study, however they have been developed to reflect general situations in an attempt to be useful to those teaching in other subject areas and with other student bodies.

Recommendation	Explanation
1: Inter-professional learning should be encouraged between students	In this study students had positive expectations about learning from each other, especially those in other health care disciplines. In medical education, inter-professional learning is encouraged at all levels. Results of this paper suggest that qualified professionals expect to be able to learn from each other, even in an online format, and are positive about sharing knowledge across disciplines. Students also expressed a desire to get to know one another. In this course, students were provided with discussion boards, blogs and virtual rooms which they were encouraged to use as informal spaces to discuss course material and share views.
2: Do not limit learning outcomes to the acquisition of knowledge - strive to encourage students to apply this knowledge and develop practical skills	The expectation that the knowledge gained would lead directly to skill acquisition was interesting since the course offered was fully online. This shows how students have an expectation to directly apply knowledge gained in their work place. This finding is encouraging and supports previous research which has demonstrated the ability for health care professional to acquire practical skills through online learning. This may be particularly relevant at postgraduate level where students already possess a clinical skill set and interact with patients on a daily basis.
3: Support evidence based learning with digital resources and online orientation of web-based learning materials	In line with best practice, it is advised that online courses are evidence based. Results of this study indicated that students expected information presented to be heavily evidence based. It can be argued that the online space is well equip to present information in an evidence based fashion. Active links can be provided to reference texts, ensuring students have easy and quick access to relevant sources of information. From the authors experience running this course, it is recommended that students are provided with digital resources including journal articles and e-books, and that this material is easily accessible within the course learning platform. It is also recommended that students are familiarised with the electronic databases and how to use them, as well as electronic libraries (where available) prior to commencing the course. Despite the majority of students living within easy reach of the college's physical library, anecdotal evidence suggests that digital resources were used by all students as primary resources, over the physical

	library. All students were obliged to attend an hour long orientation of the electronic library prior to commencing the course. During this time lead academics demonstrated how to use electronic databases and the college's electronic library. It is recommended that ample time be given to orientation and familiarisation with the learning platform including any digital resources that are available in order for students' to gain the most from the course material.
4: Provide flexible student supports	Despite initial concerns, students reported feeling supported by their class and academics teaching on the course. This is important as lack of support can be a barrier to online learning (Muilenburga 2005). Support was provided formally by academic staff in the form of open office hours, whereby a member of staff was present in an online room during specific times each week. Students did not need an appointment, but could simply access this room to speak with the academic during the allocated time. Students were also encouraged to email or ring academic or technical staff if they encountered any problems. Furthermore, being fully registered, online students could avail of the same college supports as any other student including their student union, medical and counselling services. Of all the services and supports that were put in place, students typically stated encouragement they received from one another through discussion posts as a valued source of support. Peer support is highly valued in university settings (Dennis 2005). This study illustrated that it is also possible to garner peer support informally in an online course.
5: Be cognisant that online students may also be working full time and therefore perceive the course workload as 'heavy'	Online learning provides a flexibility of learning, however it is subject to the same academic rigour and structures as face to face teaching. As such the online Certificate in Clinical Exercise carried the same number of credits, or workload, as other certificate courses. This uniform workload may have been perceived as 'heavy' by those who choose to remain in full time employment. It is important to highlight the expected workload of the course prior to student's enrolling. The authors encourage a realistic approach to this issue. Online education affords flexibility to students and while students can 'catch up' on material they missed during periods where they could not dedicate time to the course, the authors suggest that there is a limit to this flexibility. For example, students may be awarded a small number of credits to be present during live webinars (online classes), and assignments set during the course should be submitted by a pre-determined date before the course ends. These arrangements reflect traditional face to face teaching and render it impossible to complete the entire course in a very short space of time.

6: Those who have had a break in their formal education may need additional support.	Several students expressed concern over having not engaged in formal education for many years. It is recommended that at the beginning of a course students are supported and encouraged heavily and that as the course progresses this support can be reduced. It is worth noting that those students who expressed concern over a gap in their education performed very well academically. This experience can be used to encourage other students in similar situations who are concerned about re-entering formal education.
7: Provide resources on writing skills	Interestingly, students expressed concern about their writing skills. It is important to note that academic writing is not a requirement of continued professional development. Resources to aid students with their academic writing can easily be put in place to support students and address this concern.
8: Clearly outline time commitments	A key concern students had before they commenced this course, which remained an issue throughout the course, was time management. It is recommended that a detailed timetable is provided to students before they commence the course and that the number of hours of expected engagement with the course are outlined before students begin. The degree of flexibility should also be detailed. For example in some online courses students can engage with the material in their own time (for example at the weekend) while in others there is a requirement to be online at a given time. The level and structure of the engagement required for the course should be clearly specified before students enrol to enable them to realistically determine whether they can afford the time needed to undertake the course. One method could be to ask students to create a timetable of their usual week and determine whether they can dedicate the required number of hours to the course before they begin.
9: Consider blended learning	Feedback from this course suggested that a practical element may have been helpful to students. Blended learning combines online with face to face teaching and has been well received by both students and staff in the field of medical education (Eksteen 2011, Gardner et al. 2016). It should be noted that students felt the need for a practical component of the online course rather than the course being delivered completely in the traditional face to face method. Students also felt that very little practical teaching would be required, with one student suggesting a weekend would suffice, and another mentioning a single practical session. This finding is noteworthy, especially since students felt that the learning materials were of a high quality and that course learning objectives were met.

10: Learning online is a skill in itself – let students know this so that they allow themselves time to acquire it

For students who are nervous about learning in an online environment it is worth letting them know that learning to be an online learner will take some time and effort but that it is a life skill in itself. Once they are competent in the VLE they will then be equipped with the skills needed to engage with other online resources, for example professional society blogs and learning spaces online. A student does not have to be a 'techie' to be an effective and efficient online learner, however they do need to set aside some time to acquire the necessary skills. Course coordinators should consider students becoming online learners as a goal of their courses and work this into the course orientation time. The model we used to support students in becoming independent online learners was the five stage model by Professor Salmon (Gilly 2013).

Student Preferences for Learning Resources on a Land-Based Postgraduate Online Degree Program

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Abstract
Creating engaging online resources is an important part of the rapidly changing discipline of e-tutoring. There is increasing use of a wide range of media for online training but only a limited number of studies assessing their effectiveness. This study involved an educator working collegiately with cohorts of online students studying a specialist land-based postgraduate degree program (n = 79). The opinions of these mature online students, on current and potential learning resources, informed two interventions that provided novel online resources to the course. Student opinion on these new resources was captured and subjected to thematic analysis. The results identify that these students' favored resources were online lectures, course notes, primary literature, and tutors' opinion pieces because they were perceived as accessible, easy to engage with, assignment-related and/or provided something akin to a 'university campus experience'. In contrast, podcasts and knowledge review quizzes were strongly disfavored by the majority of respondents. The implications of this study in relation to online teaching practice are discussed.

Keywords: learning resources; online learning; online lectures; podcasts

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Student Preferences for Learning Resources on a Land-Based Postgraduate Online Degree Program

Part of the international market in Higher Education (HE) is an increasing number of highly specialist postgraduate programs whose feasibility depends on global recruitment. For specialist colleges, in this study in land-based studies, maximizing involvement in this global postgraduate market enables sufficient "economies of scale." Further, the global recruitment enables a large enough cohort of students to be recruited to ensure a "learning community" of peers. The program on which we focus links together individuals working in a similar profession (urban forestry) in

order to develop mastery in their professional role. It is worth noting that these postgraduate students are often already *the local expert*. The development of internet associated technologies (IATs) has supported the improvement of such courses. Here we report on a review of the resource preferences for a group of such students. The students, drawn from six countries, are work-based and are enrolled on one of very few specialist master's level programs in the field. Although they all have sufficient English skills to access the course, individual levels of English ability and opportunities to use English are variable. For most of the students the choice of distance learning results from a lack of viable alternatives rather than a commitment to distance learning per se. Although not unique, this type of program and student cohort characteristics are in need of further, more specific research. In this paper we focus on students' perspectives on online learning resources.

For online vocational courses to be effective, ongoing review of their online learning resources is essential (Anderson, 2008). Such reviews need to engage with students' perspectives and consider the impact of a range of online learning resources in relation to the students' study behaviors (Palloff & Pratt, 1999; Means et al., 2009; Redmond et al., 2018). Here we report on a two-stage design to elicit students' perspectives on the use they make of the present resources and what other resources they would use. In stage one, four cohorts of students (n = 79) completed a questionnaire and a sample (n = 15) were interviewed to ascertain students' views on the present resources. In stage two, we designed two interventions in relation to two different submodule learning units. The first offered the same content in multiple, different online formats. The second offered different content in different online formats. Students used these resources as a normal part of their learning and were invited to comment on the usefulness of the resources in a postintervention questionnaire.

Following a review of the extant literature related to online learning, we will set out more formally our research design. We will then review the data from stage one and then stage two of the study before identifying some key implications for course leaders and learning designers for these types of programs and students.

Review of Related Literature

The Experience of Studying Online

If you are part of that minority that chooses to take your degree online, what is the learning experience like? Much research has reported that online study is often seen as a poorer form of delivery of HE courses than on-campus study, both by students and tutors (e.g., Picciano, 2002; Vonderwell, 2003; Song et al., 2004; Muilenberg & Berge, 2005; Weller, 2007; Cole et al., 2014; Gillett-Swan, 2017). A key factor contributing to this perception, of online study being a 'lesser experience', is the isolation of the online learner (Selwyn et al., 2006). Another major consideration is that regular communication between student and tutor is considered critical for the success of an online course (Beaudoin, 2002; Beuschel et al., 2003; Augar et al., 2006). Previous research, particularly in the 1990s and early 2000s, highlighted that online courses can suffer from high drop-out rates when compared to their on-campus equivalents (Fisher, 2003; Palloff & Pratt, 2003; MacDonald, 2006). Withdrawals from programs are associated not only with feelings of isolation and lack of communication with tutors, but also whether the course is relevant to the learner and whether student support systems are put in place (Lee et al., 2011).

Specialist literature on e-learning seeks to address these issues of isolation, lack of communication and subsequent student drop-out. For example, several authors point to the potential for online students to have greater autonomy for their studies (e.g., Lockwood & Gooley, 2001; MacDonald, 2006; Smith, 2008) and the flexibility of asynchronous online delivery is highlighted as giving more choice and more control of their learning to the online student (Inglis et al., 2002; Gillani, 2003; Conrad & Donaldson, 2004). In addition, some authors speculate that online learning, if developed in a suitable way, can be more student-centered than typical on-campus teaching at a university (Forsyth, 2001; Richardson, 2006; Weller, 2007). Some key characteristics of an effective online student and her/his online learning community that emerge from educational literature are presented in Figure 1.

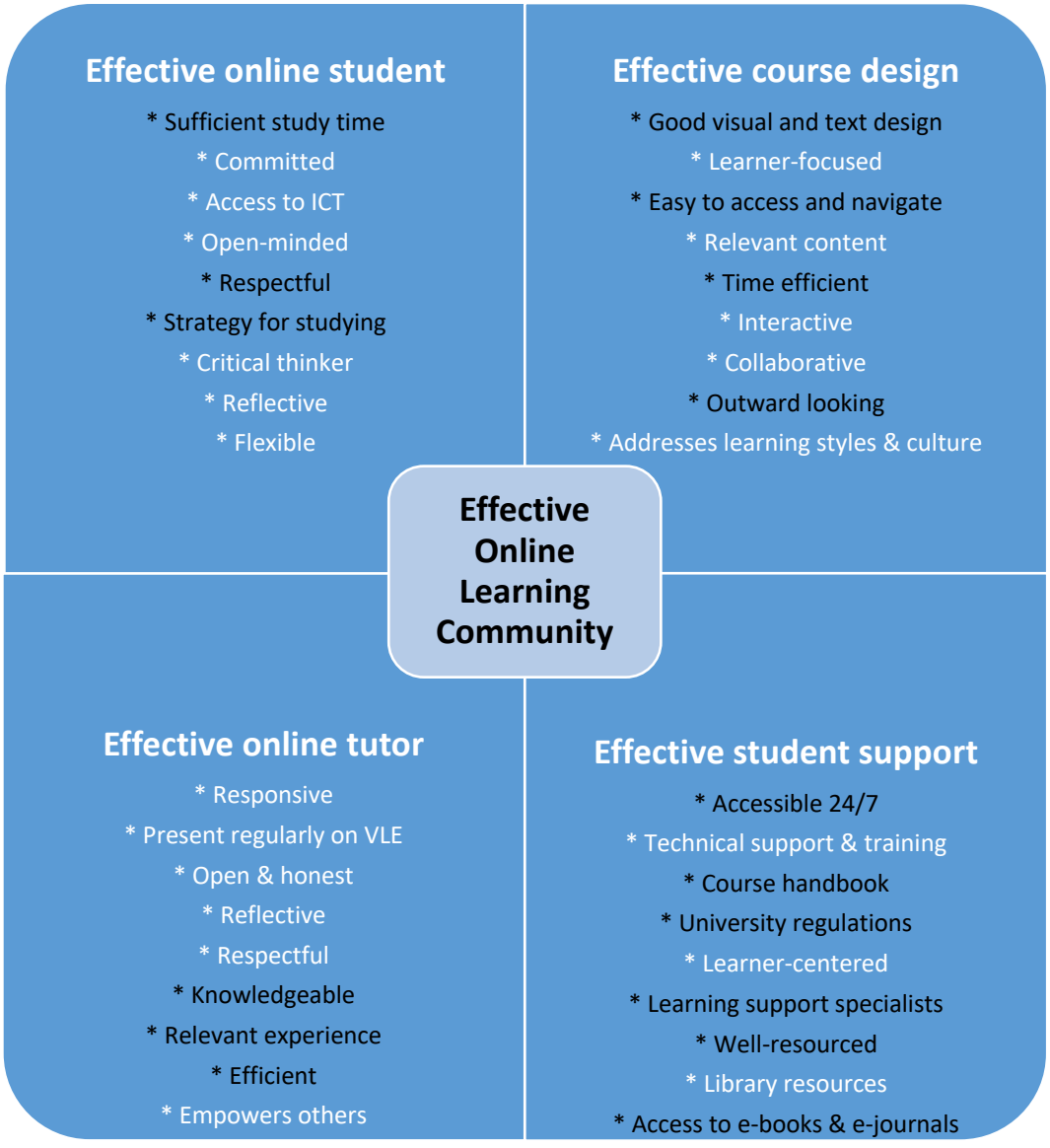

Figure 1. Key factors in building of an effective online learning community. Adapted from Palloff & Pratt (2003). Amendments are displayed in black text.

Creating Effective Learning Resources for Online Courses

There are a considerable number of instructional texts, aimed at tutors and course managers, on the creation of engaging online learning materials (e.g., Palloff & Pratt, 2003; Race, 2005; Bonk & Zhang, 2008; Garrison & Anderson, 2011). Unfortunately, due to the fast pace of change in software and virtual learning environment (VLE) capabilities, some sections of such texts become rapidly dated. This fast-developing method of course delivery presents a considerable number of challenges to both the provider and to the cohorts of students engaged with online learning (McVay-Lynch, 2002). For instance, the last decade has seen a move towards compatibility of online resources with mobile technology which results in students having their university courses 'in their pocket' (Sharples et al., 2006; Bell, 2008). Creating bespoke resources, ensuring there is formative assessment, and providing motivational rewards for undertaking these formative assessments is recommended (Gillani, 2003). Seale et al. (2007) see the challenge of creating new online learning resources as three-fold, they should be designed for learning, highly accessible & highly reusable. In addition, Martin and Bolliger (2018) emphasise that interactions between the learner, other learners, course resources and tutors is of critical importance for good student engagement.

There are several studies that found the use of audio/visual learning resources for online learners to be effective, especially the use of instructional video and online lectures (MacPherson & Nunes, 2004; Mitra et al., 2010; Borup et al., 2011; Carmichael et al., 2017; Crook & Schofield, 2017; Scagnoli et al., 2017). Although now a popular delivery format in online courses, moving away from a high level of reading content, Pomales-Garcia and Liu (2006) warn against providing overlong videos or lectures. Their research highlights that online learners were less likely to complete modules with resources that took longer for them to work through. For some online provision, the use of synchronous webinars has become more common. These allow students to interact whilst an online lecture is being delivered (Moore & Kearsley, 2012). It is a format which comes closest to simulating an interactive lecture hall environment. In addition to these audio/visual offerings, some researchers have assessed the impact of podcasts as online learning materials (Richardson, 2006; Salmon, 2008; Lawlor & Donnelly, 2010). Lawlor and Donnelly (2010) found that podcasts were extensively used by a proportion of postgraduate students taking an online course, making them a valuable form of differentiation.

Although there is a consensus that students gain from a planned program of high quality, well-tested online learning resources, Bonk (2001) found, through surveying online tutors, that less than 40% of sampled online courses contained the interactive elements that the tutors themselves stated would be valuable for their students. In addition, Kinash et al. (2015) state that there is a lack of empirical evidence in relation to the effectiveness of the technologies used for online teaching. They concluded, from their meta-analysis of online student experiences, that this is a key knowledge gap. This study explores aspects of this identified "knowledge gap" within the specific context of an educator providing bespoke online learning resources to students on a specialized postgraduate course.

This action research study was framed around two interrelated research questions:

RQ1 Of the current online resources on a selected postgraduate course, which did the students use most frequently, and for what reasons?

RQ2 Of the newly generated online resources created for the two interventions in this study, which did the students use more frequently, and for what reasons?

Methods

Participants in this study were enrolled on a specialist online master's degree course in arboriculture and urban forestry, delivered by Myerscough College on behalf of the University of Central Lancashire (UCLan). In addition to present students, a cohort of ex-students who had just completed the qualification were invited to be involved with the interview phase of the study. Details of the student cohorts are provided in Table 1.

Table 1

Breakdown of Participating Student Cohorts in terms of Year Groups, Numbers of Students in Each Cohort, Nationalities in Each Cohort and Gender Mix

Student Cohort	Number of Students	Student Nationalities	Student Gender
First Years	35	9 British; 25 Hong Kongese: 1 Singaporean	14 Female, 21 Male
Second Years	11	5 British; 1 Canadian; 4 Hong Kongese; 1 Irish	3 Female, 8 Male
Third Years	15	5 British; 2 Canadian; 1 Croatian; 7 Hong Kongese	7 Female, 8 Male
Ex-Students	18	8 British; 1 Canadian; 9 Hong Kongese	7 Female, 11 Male

An initial online questionnaire (created within SurveyMonkey® and provided in Appendix 1) asked participants about their views of the learning resources they had previously had access to on the course (Table 2).

Table 2

Current Learning Resources used in this Postgraduate Course.

Learning Resource	Form of resource	Accessibility
1. Online lectures	Slideshows with accompanying audio, most with a script to view. These were created in Adobe Presenter®, OfficeMix®, or Powerpoint®.	Not downloadable—could only be viewed when the student was logged into the VLE.
2. Academic papers	Journal papers—typically in PDF format—selected by the tutors to be the most relevant for the topic being covered in that teaching session.	Downloadable & could be viewed on a range of devices.
3. Knowledge review quizzes	Created within the VLE, these quizzes focused on reviewing knowledge gained from reading the academic paper(s) highlighted in each session.	Not downloadable—could only be undertaken when the student was logged into the VLE.
4. Tutor's viewpoints	A concise, illustrated article by the tutor on a contentious and contemporary topic—typically in PDF format.	Downloadable & could be viewed on a range of devices.
5. Further reading	A range of documents, mainly PDF and Word® documents.	Downloadable & could be viewed on a range of devices.
6. Tutor's own papers	Some module tutors have authored their own research papers. Where these are relevant to modules, they are provided to students (typically as PDF files).	Downloadable & could be viewed on a range of devices.
7. External links	Links to other websites and external learning resources selected by the tutor.	Would initially have to be accessed via the VLE but then can be saved and accessed independently.
8. Discussion board	In-built discussion board within the VLE, where students and tutors can create, read and answer discussion threads.	Could only be accessed via the VLE.
9. Announcements	A messaging system used by tutors to contact the whole of an online class of students, in-built to the VLE.	Announcements are viewable within the VLE but are also sent out to student email addresses.

This initial questionnaire finished with a question to ascertain students' preferences for new learning resources that the tutor could create for them. This was a closed question of predefined options scored by participants using a Likert scale. Further, fifteen students across the four cohorts participated in an online, semi-structured interview to obtain more in-depth views on their learning experience on the course and their reasons for favoring some learning resources over others. The framework of questions asked in these interviews is provided in Appendix 2.

Data from both these processes fed into the creation of new learning resources for two distinct interventions during the delivery of the course program. The first intervention involved supplying the same content in a range of different formats (online lecture, course notes, video, streamed video, and podcast) for students to trial. The second intervention involved supplying a wider range of formats for learning materials with each new resource distinct from any other in terms of content (Table 3). The rationale behind this approach was to seek to separate the students' preferences for different media formats from the effectiveness of unique learning objects due to their form and content.

Table 3

Details of the Learning Resources Produced for the Second Intervention of this Study, Providing Learning Resource Titles, Type, and File Format.

Learning Resource	Resource Type	Resource Format
The urban forest of downtown Singapore	Online lecture	Also made available as a downloadable video (MP4)
Trees as biotechnology	Academic paper	PDF file
People love trees	Tutor's Viewpoint	PDF file
Landscaping of Birchwood Park, Warrington	Video taken outdoors	MP4 file Available for download
The urban forest of Aarhus, Denmark	Online lecture	Also made available as a downloadable video (MP4)
From the front line (concerning recent science about urban forests)	Podcast	MP3 file Available for download
The urban forest of Pistoia, Italy	Online lecture	Also made available as a downloadable video (MP4)
Hopping on one leg	Academic paper	PDF File
People loathe trees	Tutor's Viewpoint	PDF File
Landscaping of Deepdale Retail Park, Preston	Video taken outdoors	MP4 File Available for download
External Links	Links to other websites	Links embedded in the VLE session page

These two interventions were followed up with a final questionnaire (created within SurveyHero® and supplied in Appendix 3) sent to all students who had participated in the intervention (n = 63), which asked them to evaluate their experience of the new online resources provided via the two interventions. A timeline for the key actions in this study is provided in Figure 2.

Data Collection and Analysis

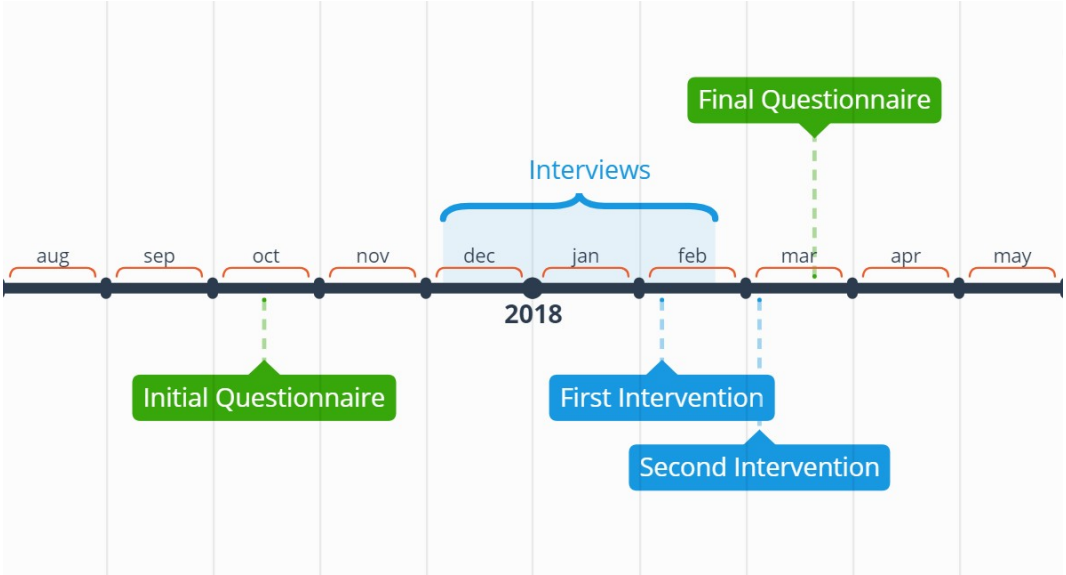

Figure 2. Timeline illustrating the four key phases of this study: an initial questionnaire, semi-structured interviews, two interventions, and a final questionnaire.

This self-reporting approach to data capture was considered effective in answering our research questions. The respondents in this case were all mature learners in professional roles who had a good rapport with the lead researcher. The discussions during the interviews where consistent with the responses in the questionnaire, with previous module evaluations and reflections of the course team. Answers were also consistent with known VLE metrics of students' use of existing resources. The research itself was articulated to participants as part of the resource development for the course. Care was taken to ensure that participants were aware that there was no "correct" answer and that involvement in the study would not impact on their learning or assessment. The study gained ethical approval at UCLan.

The responses from the semi-structured interviews and open questions within the questionnaires were first coded then themed (Burton et al., 2008). The theming of responses was reiterated three times to achieve conjoining of similar themes and to identify emergent and more specific themes that were initially placed within broader themes (Tracy, 2013). Relevant insightful quotes were selected to provide supporting evidence for the thematic analysis (Galletta, 2013). The closed, Likert scale questions were analyzed utilizing nonparametric, one-way analysis of variance.

Results and Discussion

Initial questionnaire

The initial questionnaire received forty responses across the three cohorts of current students, representing a response rate of 54.8%. Figure 3 provides the outcomes when students were asked which current online resources they found most efficient and effective for their learning. A Kruskal-Wallis and post-hoc Mood's Median test identified that there were significant differences in the rating of these resources by these respondents ($H = 69.21$; $df = 6$; $p < 0.001$).

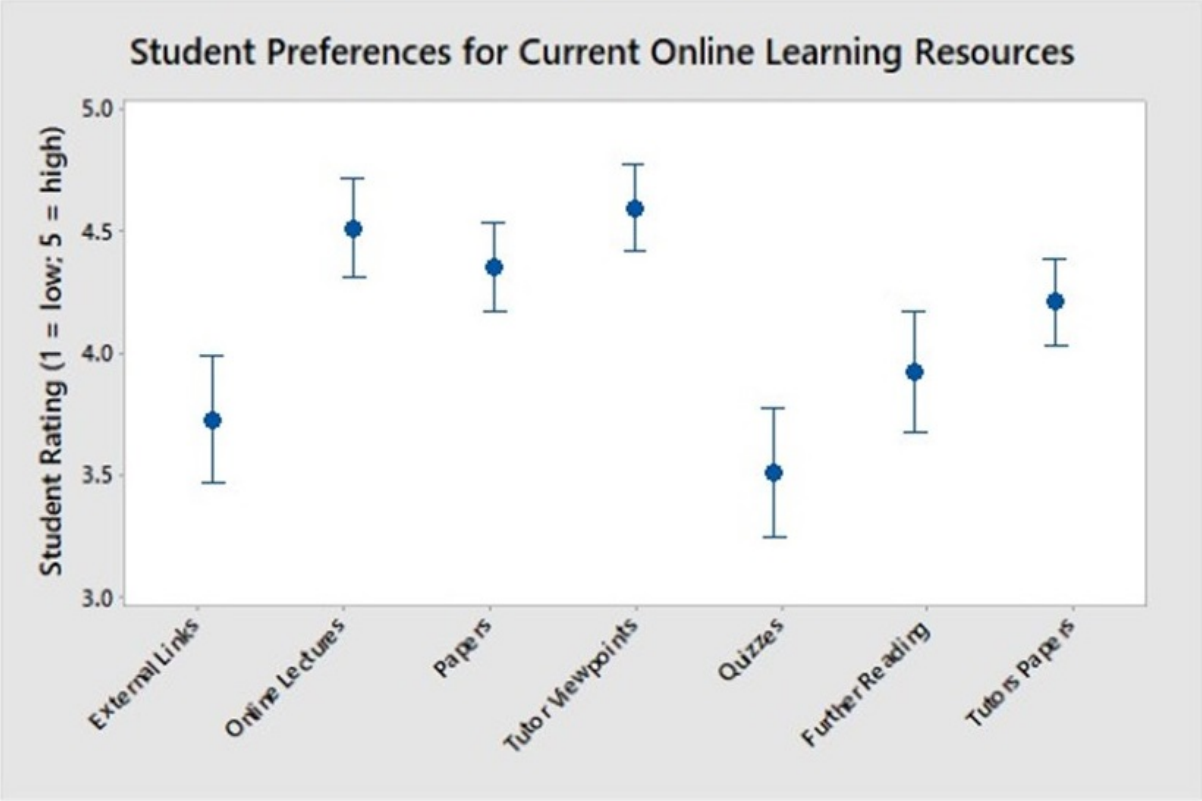

Figure 3. Student preferences, expressed via a rating scale from 1 (low) to 5 (high), for the range of current learning resources offered on the postgraduate course.

Knowledge review quizzes scored the lowest in terms of preferences, so, without highlighting this to the participants, these quizzes were omitted from the learning resources created for the two interventions. As we note shortly, students did not mention missing these resources during the intervention.

An open question about student preferences in terms of existing resources elicited a clear preference for the online lectures (Table 4), but the creation of course notes was the highest-scoring preference for new learning materials. This latter preference is probably best explained by this course being predominantly delivered via online lectures at that time. Therefore, the addition of course notes had the potential to diversify the learning materials. In addition, some students stated a preference for more reading materials rather than for further audio/visual resources to be created. They cited that their high reading speeds made this form of learning resource efficient for their learning and that they could read away from their computer.

Table 4

*Students' Stated Most-used Current Online Resources (*n *= 40), Showing Frequency of Preference, Coded Themes, and Selected Student Comments*

Most used resource	Frequency	Coded themes	Selected student comments
Online lectures	25	Ease of use Key information Relevant Concise Guide to learning Enjoyable Unique Like attending Uni	"Because I am in full time employment and this is the easiest format to use." "It gives me an introduction into the topic/subject matter and helps explain key elements." "This kind of resource is a more interesting learning material, which summarize the content of the lesson." "It cannot be found elsewhere." "Mimics a real lecture. I learn best from either physically doing something (difficult with an online course!) or verbal communication. Online lectures are as close as one can get to real life university."
Academic papers	11	Research links Key information Specific Assignment-related Accessibility Up-to-date	"It provides a strong basis to the study of the particular topic. Other references and searches can then be undertaken." "It can be accessed anytime, anywhere." "Very informative."
Tutor's viewpoints	3	Specific More usable Assignment-related	"Tailored to the specific module and provides a good overview and insight into the key elements that are being explored."
Further Reading	1	Scientific evidence	"Good for knowing the latest research."

Note. Coded themes are ordered such that the most frequently-occurring themes are at the top of each list.

Semi-structured interviews

The interview process gave rise to much "rich data" and only a small proportion can be reported here. Three main learning resources were mentioned as the students' most-favored resources: the online lectures (n = 13), tutor's viewpoints (n = 8), and the academic papers (n = 6).

The knowledge review quizzes were mentioned as helpful by two interviewees and no other online resources were mentioned (i.e., external links and further reading).

Key themes relating to online learning resources are provided here, with example quotes from interviewees.

- A limited use of the online discussion board: "I didn't tend to contribute, but I read all the contributions to the discussion board. It was interesting to see what the other students were thinking. Most of the student contributions were well-written and they had quite interesting perspectives. I could not often add to what was being said."
- A preference for online lectures: "I mostly use online lectures, tutor viewpoints and related research. Most of all I favor online lectures as they guide you through the topic and they are easier to consume than written text, especially scientific articles."
- Low usage of knowledge review quizzes: "Quizzes—I use the least. When I am time-poor, these are not essential."
- Mixed views on suitable formats for future learning resources: "I already listen to podcasts—usually when I am doing something mundane like the washing-up—so I can take it in. If you do sit down to study, though, you want the audio/visual—something to look at as well as to listen to. Videos could also be good, for clarifying things further."; Respondent B: "I am not used to using podcasts—they are not needed for me—I wouldn't use them. The slides and online lectures work well for me. I can see video being of some use—for example, to look at hazardous trees" (Respondent A).

Final questionnaire

The final questionnaire was completed by eighteen students on the course program. Their responses on preferred learning resources from Intervention One are provided in Table 5. In this intervention the same content was provided in several different formats.

In the first intervention, the online lectures were most-favored and received no critical comments. The podcast received the most criticism as a learning resource. Downloadable video received the most mixed reviews. It required the largest data allowance on the students' devices, but some respondents felt that it gave the best viewing performance. Some of these differences can be traced to the level of English language of the students. Students whose reading and comprehension ability was higher than their oral comprehension preferred written texts. It was also clear that in some contexts certain resources could more easily be used, surreptitiously, in "work time," and hence were preferred.

Table 5

*Student Views on the Formats of Learning Resources—Intervention One (*n = *18)*

Positive Responses	**Frequency**	**Coded themes**	**Selected student comments**
Course Notes	5	Accessible Efficient Supporting	"I used less than five minutes to read the new learning resource PDF. While I watch the video, although I change the speed to 2x, I still have to use fifteen minutes. Reading is always more efficient for me." "As a foreign student, understanding of English might be difficult at some point. The course notes will be a great help to understand both presentation and video."
Online Lecture	10	Effective Like attending Uni Note-taking Stimulating Tutor emphasis	"It is the closest imitation mode to being in the class physically." "I preferred the audio/visual presentation as this is the most like a lecture and got me in the mindset of studying."
Audio Podcast	2	Accessible Convenient	"I enjoyed the ability to listen to the podcast whilst doing my day-to-day work."
Streamed Video	1	(No specific positive comments)	"I think the audio/visual presentations were of equal merit. They were clear and well-structured."
Video Download	7	Accessible IT compatibility Technically superior	"Smooth watch experience." "My first choice would be the MP4, which had the best resolution and works on all devices."
Negative Responses	**Frequency**	**Coded themes**	**Selected student comments**
Course Notes	2	Not essential	"I avoided downloading the course notes. I prefer using audio/visual and making my own notes which I find easier to reference for assignments."
Online Lectures	0	(No comments)	*No comments received*
Podcast	6	Lesser resource No images Not effective	"No pictures and no words to read." "Podcast—not funny." "Had no need to listen to them on the move/remotely."
Streamed Video	2	Poor screen size Poorer format	"Just preferred resources that are better for using."
Video Download	3	Data uploading Not essential	"Time consuming to download, used much of my internet data allowance." "Didn't use the downloadable videos - didn't see the advantage when the audio/visual presentation works fine."

Table 6

*Student Views on the Learning Resources—Intervention Two (*n = *18)*

Positive Responses	Frequency	Coded themes	Selected student comments
Academic Papers	1	Assignment-related	"Academic paper helps us to have a better direction on what we should include in our assignment."
Online lectures	9	Effective Good quality Knowledge Like attending Uni	"Online lecture with script - easier to follow and get the points easier." "Audio and video more suits my learning style from which I can make my own notes for future reference."
Outdoor Video	4	Engaging Real World	"Encourages myself to process what I am seeing and filter it in my brains, as I understand that ideas are linked and can be organized and associated."
Podcast	0	Ineffective	"Podcasts require the lecturer to be more descriptive to fill in the gaps to be effective."
Streamed Video	0	(No comments)	*No comments*
Tutor's Viewpoints	5	Accessible Critique Efficient Good Content	"Tutor's viewpoint - in this case, the alternative, thought-provoking take on the topic was very useful as it helped in forming a more objective standpoint."
Video Download	4	Accessible Technically better	"I prefer the MP4 due to the quality and flexibility of the format."
No Preference	3	Does not matter Liking all formats	"Not specific, all formats would be acceptable as long as it is necessary for the modules."
Negative Responses	**Frequency**	**Coded themes**	**Selected student comments**
Academic Papers	1	Difficult to use	"I use academic papers but I struggle to maintain focus in trawling through lots of written information."
External Links	2	Not academic Not specific	"Time consuming to search for specific information."
Online Lectures	0	(No negative comments)	*No negative comments*
Outdoor Video	2	Outdoor noises Quality of content	"The outdoor lecture was a bit more difficult to listen to because of the environmental conditions and the content seemed a bit thin compared to the more prepared lectures in other formats."
Podcast	8	Ineffective No images Potential to misunderstand Too long	"This is too casual and cannot get enough of my attention." "No script and without illustration, I may very likely misunderstand the meaning."
Streamed Video	1	Lower quality	"I did not like the low resolution of some of the embedded video options."
Tutor's Viewpoints	1	Not assignment-related	"Tutor's viewpoints I have read before have been interesting and thought provoking but have not been directly relevant to the assignment."
Video Download	0	(No negative comments)	*No negative comments*
No Preference between formats	2		"I have no need or desire to use the resources whilst on the move."

Table 6 (above) gives the students' views on the resources made available to them in the second intervention.

A very similar pattern of feedback was received for both interventions: that online lectures were most favored (supporting the findings of MacPherson & Nunes, 2004; Mitra et al., 2010; Borup et al., 2011; Carmichael et al., 2017; Crook & Schofield, 2017; Scagnoli et al., 2017) and that the podcasts were the most criticized (Lawlor and Donnelly, 2010). Views were mixed on the use of outdoor videos to assess urban trees in the second intervention, some students wanted higher production values in terms of technical content and sound recording. Similar comments were received about the streamed videos, where lower quality was a key limitation.

No respondents commented on the absence of the knowledge review quizzes that had been consistently provided in all previous eleven teaching sessions of this module. This strongly suggests that these formative assessments were not a highly valued learning resource for these students.

Conclusions

The findings of this study should be understood in the specific context of a specialist online course on a technical topic at postgraduate level. It is considered likely that the ages, previous educational backgrounds, and English language ability of the students who participated in this study will have had a strong bearing on the results reported here.

The initial questionnaire in this study identified three current resources that were significantly more favored than the others: online lectures, academic papers, and tutor's viewpoints. These resources were conceived to be key elements of the teaching provision for this MSc course program by its tutors—so this instructional design was strongly supported by the students' views (n = 40). A continuing preference for these resources was shown after both interventions (n = 18), identifying that successful course delivery should involve a mix of audio/visual resources with ample written resources. The responses received provided a clear answer to our two research questions. These postgraduate students appreciated the mix of learning resource types made available to them but showed strong preferences toward the use of online lectures, reading primary literature and having bespoke course-related notes or articles.

In terms of creating an effective online learning community (Figure 1), this study elicited responses in a number of key areas that may be relevant to other practitioners. At this postgraduate level, critical thinking is a key expectation of students' work. Students valued the "Tutor's viewpoints" in the course materials because this learning resource always provided a critical stance on key topics from which students could develop their own views and opinions. Provided in written form (PDF files), it was the critical content that the students valued; there were no comments on this being a less valuable learning object because of its medium. A number of responses on a range of learning resources provided, showed there was a clear focus on relevant content over medium. Students valued the flexibility of their studies but only a few expressed an interest in the use of the podcasts. Those that did emphasized that they "freed them from the screen." The majority of these students, however, did not like this medium. We would recommend that it should only be provided as a means of minor differentiation, providing the same content as, say an online lecture or course notes in a format that suits only a minority.

Other suggested key attributes of an effective online course, in terms of its learning materials, are that they should be learner-focused, interactive and collaborative (Figure 1). The most interactive elements of the current course were considered by the tutor to be the review quizzes and the discussion board but these were not favored by the students. They often stated a strong, individualistic focus on gaining new knowledge for themselves rather than on interaction or collaboration. The quizzes in their current format were clearly ineffective learning resources. They were both rated low on the initial questionnaire and were not missed by students when they were omitted from the second intervention. This may be because they were provided as knowledge reviews on specific reading material. We are intending to trial alternative interactive quizzes with different foci to see if it was their original specificity that was off-putting to students. Likewise, adjusting the "rules" of the discussion board may lead to a better level of interaction. For example, we are considering allowing anonymous postings or pseudonyms for students so they feel less daunted about using this collaborative tool or by making engagement with the discussion board compulsory (Malkin et al., 2018).

An online course designer or tutor should act to empower their students by creating flexible, interactive, attractive, and content-rich learning resources that leads to stronger engagement by the students on the course (Redmond et al., 2018). This study has reported on one: an iterative cycle of learning object creation, appraisal, and user feedback. The knowledge acquired has provided a more nuanced understanding of the ways in which individuals, on this program, value and utilize the resources made available to them. Our findings have resonated with tutors delivering other online postgraduate programs to mature, work-based learners. The broad learning from this work is twofold. Firstly, that care is needed in transferring general research in online learning to specialist, atypical, groups of learners. Secondly, that an iterative cycle of reviewing resources brings educational and financial benefits to tutors delivering online courses. As a result of this work time and effort has been more effectively directed towards the generation of appropriate and engaging online learning resources.

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Appendix A:
Template of the Initial Questionnaire used in this study

Question Number	Question Text	Possible responses
01	What year of study are you in, on this MSc course?	1st year, 2nd year or 3rd year.
02	Rate the extent that you have used the listed online learning resources provided by this MSc course.	Rating of 1 (low use) to 5 (high use) for all named resources.
03	Rate the existing online learning resources in terms of their usefulness to you as a student on the MSc course, based on how efficient and effective your learning is from these resources.	Rating of 1 (low use) to 5 (high use) for all named resources.
04	Of all existing online resources, which do you use the most?	Students could only select one type of named resource.
05	Why did you use this particular resource the most?	Open question (textbox).
06	My research work this year will involve creating new online resources for learning which you will have access to. Some options are "downloadable", in that you could download a file and use it when not connected to the internet. Other options are not downloadable because an internet connection is needed at all times for these resources to work. What online resources would you prefer to see created?	Rating of 1 (low use) to 5 (high use) for all named options for new resources.

Appendix B:
Template for the semi-structured interviews used in this study

Your motivations:

- Reasons for taking the course
- Deep or strategic studier?

Your study behavior:

- Study time spent during the week—and pattern
- Your mix of reading, creating and interacting
- Your use of the discussion board
- The biggest benefits from studying online
- The problems with online study that you would like to highlight

Your favored resources:

- What resources do you personally favor to use?
- Why did you favor these?—what was it about them that made them better to use or learn from?
- What course resources were more valuable to you for putting together assignment work, if any?
- What resources do you find you are using the least?—and why is that the case?
- Highlighting essential resources for assignments?
- Rating resources—student ratings? Tutor's guidance?

Future learning resources:

- Would more accessible resources be more useful to you in your studies?—If so, why?
- Would resources you can keep after you leave the course be more attractive to you? If so, why?
- From your perspective, what is a good balance between written materials and audio materials? 50/50?
- In terms of audio materials, do you have a particular preference for audio recordings, audio/visual lectures or videos? If so, why?
- Is there any benefit in having a mix of audio resources, or is it better to standardise these to just one or two types, for consistency in delivery?
- Is there any benefit in putting any audio on a more stable platform (e.g., YouTube)?—or would you find that off-putting?

Appendix C:
Template of the Final Questionnaire used in this study

Question Number	Question Text	Possible responses
01	Did you use any new online resources that were created for MR4001 this year? If yes, continue to question 3. If no, please just answer question 2.	Yes/No.
02	What factors caused you **not** to engage with these new online resources?	Open question (textbox).
03	Intervention One: Which formats of this resource did you attempt to use?	List of formats to tick.
04	Intervention One: Please state the format for this resource that you preferred and why you had a preference for this format.	Open question (textbox).
05	Intervention One: If there were one or more formats of Alternative Urban Forest Futures that you avoided using, please explain why you chose **not** to try to use that format/those formats.	Open question (textbox).
06	Intervention Two: Which formats from Session 12 did you attempt to use?	List of formats to tick.
07	Intervention Two: Which resources did you find most useful in terms of ideas or citations for your assignment work for MR4001?	List of resources to tick.
08	Intervention Two: Which resources did you prefer in terms of their content?	List of resources to tick.
09	Intervention Two: Which resources did you prefer in terms of their format/media?	List of resources to tick.
10	Intervention Two: The audio presentations did not come with a script in this trial. Would you have preferred the presentations to also be supplied with a script?	Yes/No.

11	Intervention Two: What format of resources that you tried during this intervention would you want to see used regularly by tutors of this online MSc course?—and why did you find them effective for your learning purposes?	Open question (textbox).
12	Intervention Two: What resources provided by this intervention did you **not** find helpful or that you did **not** use at all?—and why did you **not** think them effective for your learning purposes?	Open question (textbox).
13	Intervention Two: Did you think there was anything missing from this session, or something that should be added? If so, please contribute what other resources you would have liked to be part of this final session for MR4001.	Open question (textbox).
14	Intervention Two: If you would like to contribute further thoughts on learning resources that could be effective for students studying this online MSc course, please use the comments box provided below.	Open question (textbox).

Factors Influencing Programming Expertise in a Web-based E-learning Paradigm

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Abstract
Modern internet technologies have revolutionized traditional education by providing flexible and resourceful e-learning opportunities in all fields of life. Programming is an integral part of the undergraduate curriculum in computer sciences where an adequate level of programming expertise is expected from the graduates. In this paper, we explore and examine the key factors that contribute to developing programming skills among undergraduate students in e-learning. We propose that programming education follows the Technology Acceptance Model (TAM), which affects the students' attitude toward learning. We extend the TAM by integrating the factors of teaching practices, intrinsic factors, perceived usefulness, and efficacy problems with the learning intentions in our research framework.
This research involves the responses of the 460 final year students studying for a Bachelor of Computer Science and Software Engineering at an e-learning institution. Structural Equation Modelling (SEM) and Confirmatory Factor Analysis (CFA) have been employed to evaluate the relationship between factors of the model. Experimental results demonstrate that teaching practices, intrinsic factors, and perceived usefulness play a key role in endorsing learning intentions in the students. Further analysis reveals that learning intentions positively influence the programming expertise whereas an adverse impact has been observed from the efficacy problems. The results proclaim that perceived usefulness, teaching practices, and intrinsic factors develop adequate learning intentions in the students which overcome the efficacy problems and lead to better programming expertise. This research provides critical implications for policymakers to effectively implement computer science programs in an e-learning paradigm.

Keywords: e-learning, programming, web, expertise, teaching, programming education, barriers in programming.

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Factors Influencing Programming Expertise in a Web-based E-learning Paradigm

E-learning has been extensively introduced in higher educational institutions due to the rapid development in information and communication infrastructure (Hung & Chou, 2015). Many universities have started to offer online degree courses in addition to traditional study programs. Online services provide immense opportunities for effective implementation of e-learning. They offer the flexibility for e-learning providers to host their Learning Management Systems (LMS) online. Moreover, it enables students to access the course material independent of location and time constraints (Jose & Christopher, 2018). Additionally, web technologies provide the ability to support big data and multimedia streams that provide independence to the e-learning providers from bandwidth limitations, computation resources, storage concerns, and many other issues. Figure 1 explains the architecture of a web-based e-learning education system. It illustrates that the e-learning stakeholders interact with a web-based e-learning management system equipped with virtual machines and physical hardware. Students, tutors, and the administrators interact with the LMS using the interface provided by the service providers. LMS stands at the core of e-learning as it provides all the educational interactions to the students.

Due to a wide proliferation of web technologies, a huge number of free online courses are available hosted by YouTube, Coursera, Udemy, Edx, and many others. A wide range of e-learning courses has been available in every field of life including history, social sciences, natural sciences, engineering, and medicine. Computer science has been one of the most popular education disciplines because of an ever-increasing demand for IT professionals. Programming is the fundamental aspect of computer science programs where most of the universities start computer science curriculum with the programming courses all over the world (Raigoza, 2017).

An adequate level of programming expertise has been expected from the graduates in computer sciences. Programming education is demanding because it involves logical reasoning, mathematical skills, and extensive domain knowledge; moreover, it becomes more challenging in e-learning (Lam, Chan, Lee, & Yu, 2008). Programming education requires extensive efforts from students because they must solve complex program logic and develop a procedural algorithm to develop the code for the underlying problem. Because of these complexities, a higher dropout ratio has been observed in the computer science degree programs (Sarpong, Arthur, & Amoako, 2013). Similarly, a huge number of students complete their undergraduate studies in computer science by getting a sufficient amount of general knowledge in programming but lacking in specific skills to develop high-quality computer applications (Kelleher & Pausch, 2005).

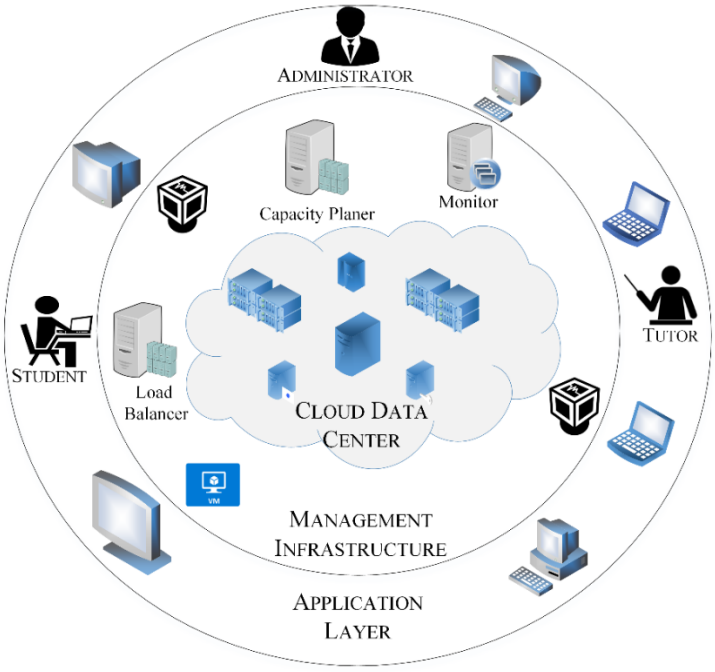

Figure 1. A web-based e-learning system model.

In e-learning, the students become frustrated when they try to execute their code without a correct understanding of the problem and forcing the entire program to run without modular development and testing (Raigoza, 2017). Therefore, programming education in e-learning becomes a critical challenge. Previous studies in this context, mainly focus on the motivational factors that affect programming education in computer science students (Law, Lee, & Yu, 2010). Although a wide range of research is available in determining problems faced by e-learning students in general, there is a lack of literature available on identifying issues in programming education. Hence, it becomes a noticeable challenge for the practical envisioning of the e-learning (Liaw, 2008). To address these challenges, we aim at designing this study to identify and analyze the fundamental factors that involve in the development of programming skills in e-learning. We perform the analysis from the perspective of both the student and the tutoring environment. A holistic approach has been used in programming education ecosystem to identify the core factors that affect programming skills development in e-learning. Moreover, the interdependence of these factors has been analyzed. This research can be implemented to facilitate policy makers and administrators to effectively develop, deliver, and manage e-learning in solving the problem of programming education. The main contributions of this study are as follows:

- We perform an extensive literature study and identify Teaching Practices (TP), Intrinsic Factors (IF), Perceived Usefulness (PU), Efficacy Problems (EP), and Learning Intentions (LI) as key factors contributing toward programming expertise development in e-learning.
- A research model has been proposed by extending the Technology Acceptance Model (TAM), which measures the dependency of these factors on overall programming skills development.
- A set of detailed validation and evaluation experiments have been performed on the survey-based data to demonstrate the data validation. Moreover, Structural Equation Modelling (SEM) and Confirmatory Factor Analysis (CFA) have been employed to evaluate the effectiveness of the proposed research model.

Review of Related Literature

Computer science constitutes one of the most important degree programs offered by e-learning institutions due to an ever-increasing demand for IT professionals. Programming is the fundamental skill expected from computer science graduates (Lam et al., 2008). It requires analytical and problem-solving skills from the learner that involve describing processes and procedures, developing algorithms, and the implementation in the desired programming language (Law et al., 2010). E-learning students lose interest and face problems during the coding tasks; therefore, there is a strong need to improve programming education in the e-learning. We perform an extensive literature survey and find that five factors greatly affect programming expertise in e-learning, which includes TP, IF, EP, PU, and LI. We devise a research model by extending TAM and explain how these factors influence the programming expertise in e-learning.

Nganji (2018) reveals that education providers must focus on learners to increase their participation in the learning process, which can improve their knowledge and skills. Therefore, the medium of instruction plays an important role in the learning process. The communication strategy (e.g., synchronous, asynchronous) strongly influences the students' understanding of the subject. In synchronous communication, direct interaction among teachers and students provide the basis for the academic discussions that help the students assimilate the course content. Alternatively, asynchronous communication is adopted in the e-learning where the discussion forums and emails are used for the student-teacher interaction. Offir, Lev, and Bezalel (2008) demonstrate that asynchronous communication yields an adverse impact on the performance of the students. They propose that asynchronous communication does not produce a student-teacher dialogue that deprives the students of asking questions. Boelens, De Wever, and Voet (2017) devise a strategy to arrange face-to-face meetings at the start of the course so that students get an introduction of their mentors and their classmates. This introduction provides the e-learning students a sense of community later in the course. The impact of student-teacher interaction on the final year project has been discussed by Dos Santos and Cechinel (2018); their findings reveal that face-to-face meetings yield positive results. Hence, the student-teacher interaction is at the core of e-learning for effective implementation.

Programming is challenging in a way that it requires both a theoretical understanding of the concepts and hands-on experience in specific programming languages (Lam et al., 2008). Numerous techniques have been devised to facilitate the complex programming environment including pair programming, shared code, and tools to facilitate the debugging process. Sarpong et al. (2013) suggest that extensive lab work under the guidance of a tutor for programming tasks help students to master programming skills and decrease the retention rates. Celepkolu and Boyer (2018) discuss the importance of a shared coding system in a hybrid pair programming environment to overcome the common mistakes performed by the students. Zin, Idris, and Subramaniam (2006) introduce a virtual pair programming solution where one student performs the coding and the other proofreads simultaneously. However, this technique consumes a lot of time; moreover, it requires constant interaction between the students, which sometimes becomes difficult in e-learning. Lam et al. (2008) propose an automatic debugger to solve the problem of the mentor providing hints on the mistakes during the coding process. Students submit their code to a debugger which identifies common errors and offers suggestions for improvement; however, this tool only works for smaller programming tasks.

One of the primary medium of communication in e-learning is LMS, which facilitates the student-teacher interaction; moreover, it enables effective follow-up of the course activities.

Yunkul and Cankaya (2017) present the importance of Edmodo LMS which provides a secure environment for student-teacher interaction and feedback. It also incorporates the social media platform with LMS that creates a social environment among the students. Ateş Çobanoğlu (2018) explores the preferences of students in an information technology course to learn in a blended learning environment, which involves both traditional education and e-learning. Their results proclaim that the use of LMS for blended learning increased student's performance. Similarly, the usefulness of the underlying e-learning course for a student is also an important factor in achieving programming skills. B.-C. Lee, Yoon, and Lee (2009) suggest that the students who perceive that the e-learning course is beneficial in their future try to perform better during their studies.

Different solutions have been proposed for solving problems faced by the students during programming. However, there is still a lack of research available on ascertaining factors which involve programming education. The proposed tools in the research facilitate the specific aspects of programming education; however, a holistic approach in the programming education ecosystem is still not available. Therefore, we provide an empirical study and design a research framework for the identification and analysis of factors that affect programming expertise in e-learning.

E-learning Research Framework

We present a research framework after an extensive literature review and identify TP, IF, EP, PU, and LI as the key factors involved in programming skills development in e-learning (Martín-Rodríguez, Fernández-Molina, Montero-Alonso, & González-Gómez, 2015). E-learning acceptance follows TAM (Venkatesh & Davis, 2000) for effective implementation in different countries. After a thorough review of the literature, it has been established that TAM offers the key factors for effective acceptance of e-learning by the students. In the TAM framework, the flexibility exists for adding more factors (variables) depending on the contextual scenario (Pituch & Lee, 2006). Similarly, TAM predicts an individual's attitude toward using ICT technologies and it owns a widespread background in the field of e-learning (Alharbi & Drew, 2014). The use of TAM toward the perceptions of the teachers while teaching online has been studied by Wingo, Ivankova, & Moss, 2017. The EP factor in our research framework moderates the programming expertise, which is strongly associated with the Perceived Ease of Use (PEU) factor in TAM where the problems in PEU can negatively affect the intentions to use. The intention factor in TAM corresponds to the LI in our framework, which demonstrates the motivation to learn programming. Finally, the usage behavior in the TAM assimilates to the programming expertise in our framework which corresponds to the effectiveness in adapting to the programming education in e-learning. A critical review of the research in the field of e-learning demonstrates that TAM has not yet been studied in the e-learning paradigm to learn computer sciences. Therefore, we utilize PU and IF to predict the behavioral intention of programming education, moreover, we add TP to develop those behavioral intentions which are aligned with the TAM framework requirements. Furthermore, we add computer self-efficacy in performing programming tasks to show the impact on the programming expertise of students. Due to the above-mentioned reasons, we adopt TAM to ascertain the impact of students' intentions toward the continuous use of e-learning for programming expertise development. Figure 2 illustrates the configuration of all the factors in the framework. We discuss the development of the research hypothesis below.

3.1 Learning Intentions (LI)

LI can be defined as the extent to which continuous effort has been directed toward achieving a specific goal (here the goal corresponds to learning how to code effectively).

Programming requires constant effort where LI is comprehended by the intuition of students to learn and practice the programming tasks (Xia & Liitiäinen, 2017). LI depends on the effectiveness of TP, the PU of the studies, and IF to study in an e-learning course (Pugh, 2019). As discussed in the literature review, that TP greatly enhances the LI of the students, hence students perform well in understanding the concepts through TP. These motives serve as an impetus for learning plans that supports students in knowledge acquisition and academic success (Linnenbrink & Pintrich, 2002). The quality of the education system plays an essential role in determining the success of the students moreover, the mentoring process and support increase the LI of the students (Dorner & Kárpáti, 2010). Hence, as this study proposes that LI positively impact the programming expertise in e-learning, we formulate the hypothesis H3.

H3: LI positively impact the programming expertise of students in an e-learning system.

3.2 Intrinsic Factors (IF)

IF constitute the motivation of a student toward the learning process; moreover, it involves the individual's personal rather than environmental setting (Hendijani, Bischak, Arvai, & Dugar, 2016). Students need to be motivated in e-learning because it is easy to lose self-evaluation in the state of isolation (Galusha, 1998). Khan and Nawaz (2013) argue that when intrinsic motivations are high, learning outcomes are positive, which demonstrates that IF play a positive role in developing LI. Most of the IF in higher education involve students' satisfaction in the current studies and their interest in the current course (Bouhnik & Marcus, 2006). When students are satisfied with their studies, they learn effectively, which yields a positive impact on their overall skills development in e-learning (Eom, Wen, & Ashill, 2006). Considering the above discussion, we hypothesize that the effect of IF is positively related to the LI. From this discussion, we devise hypothesis H1 and H6.

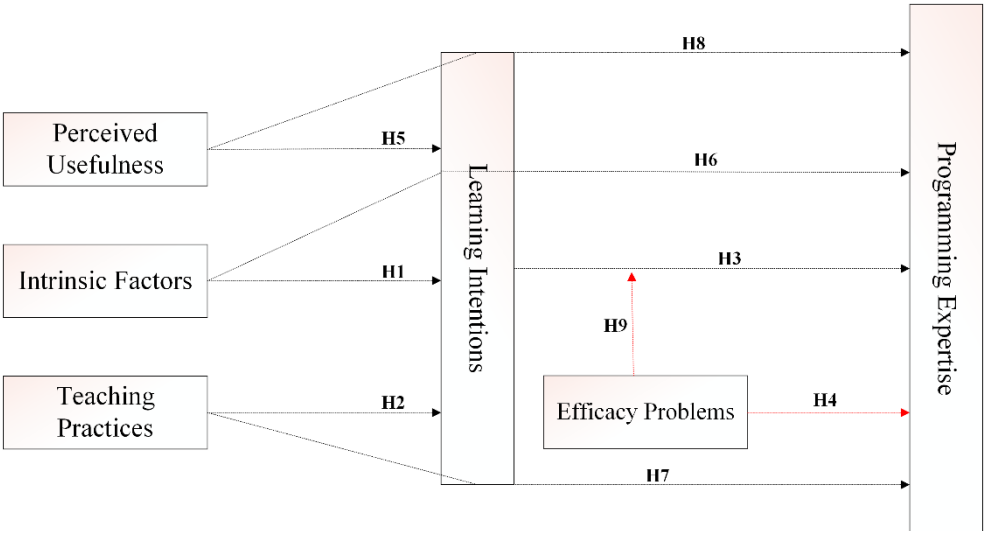

Figure 2. E-learning research model indicating all the hypothesis of the research.

- **H1:** IF positively affect the student's intentions toward programming education.
- **H6:** The impact of IF on LI positively transcend toward the programming expertise via an indirect passage of LI.

3.3 Teaching Practices (TP)

TP constitutes the teaching methodologies adopted in the e-learning (Martin, Budhrani, Kumar, & Ritzhaupt, 2019). In e-learning, TP involves the course content delivery methods including video lectures, handouts, and LMS discussions for mentoring (Valentine, 2002). Students perceive that programming is effective and enjoyable in the presence of a mentor providing hints on their mistakes. However, it is difficult to provide such mentors in e-learning. Offir et al. (2008) posits that direct interaction between students and the teachers positively affect the students' learning process, which helps them to discuss their problems and get immediate feedback from their mentors. TP greatly affects the programming expertise of students because a positive correlation exists between the attitude of a learner and the mentoring process (Dahalan, Hassan, & Atan, 2012). When students keep constant interaction with their tutor, they grasp more concepts and discuss their issues with their mentor, This results in a positive impact on students' learning process (Berry, 2019). This study categorizes TP as one of the key factors that influence programming expertise and measures the effect of TP on students' LI. Hence, we hypothesize the following.

- **H2:** TP in e-learning positively influences students' LI.
- **H7:** The impact of TP positively trends toward the programming expertise via an indirect path of LI.

3.4 Efficacy Problems (EP)

Efficacy is a self-belief to execute a course of action to attain the desired learning outcome in the e-learning system, factors that negatively impact efficacy have been denoted as EP. It is natural that the students face problems during the programming tasks hence. Immediate support can help them get out of the programming complications where they tend to plunge. Most of the times students lose interest in programming while they practice by themselves and experience failures in the learning process. Jenkins (2001) reveals that special mentoring arrangements are required to teach programming in e-learning to enhance efficacy. Allen, Cartwright, and Stoler (2002) suggest that it is difficult for some beginners to start programming. Automated Integrated Development Environments (IDEs) can be used to assist them in writing the code. The PASS program submission system has been developed to facilitate beginners learning programming, which incorporates an easy-to-use IDE to assist students in programming education (Law et al., 2010; Yu, Poon, & Choy, 2006). The isolation also contributes to EP; students feel the sense of isolation due to the non-availability of face-to-face interaction with their peers. This obscures their learning process. Taking these arguments into consideration, we hypothesize that EP negatively affects the programming expertise and moderates the influence of LI on student programming expertise. Hypothesis H4 and H9 have been formulated from this discussion.

- **H4:** EP adversely impacts programming expertise.
- **H9:** EP moderate the impact of LI on programming expertise.

3.5 Perceived Usefulness (PU)

PU means the extent to which e-learning students find their course beneficial (B.-C. Lee et al., 2009). PU has widely been used to predict the adoption of e-learning (Tarhini, Hone, & Liu, 2014; Y.-H. Lee, Hsiao, & Purnomo, 2014). It is also pertinent to note that the PU has a positive influence in developing the behavioral intention of the students (Jan & Contreras, 2011). When the students

find that their studies are beneficial to them in the future they put in more effort; hence, their LI increase (Cheng, 2011). Keeping this in mind, we hypothesize the following.

- **H5:** PU has a positive impact on developing LI in programming education.
- **H8:** The impact of PU on LI trends positively toward programming expertise in e-learning.

Methods

Figure 3 describes the workflow of current research, which includes extensive background study, factors identification, questionnaire development, data collection, validation acceptation, and finally the results and discussion. The participants in this study include students of the Virtual University of Pakistan (VU) that employs a web-based LMS to facilitate e-learning. The LMS enables students to submit assignments, check results, follow the class schedule, participate in the discussions, and contact the course tutor for the discussions. The video lectures have been recorded and delivered to the students who attend them according to the schedule provided on LMS. Every tutor regularly creates a discussion topic for each lecture where students discuss their issues and problems via text messages. We employ a random sampling procedure to select participants in the current study. The original sampling frame of this study consisted of 550 students majoring in different fields of computer science. We used Google forms to conduct the survey, which made it easy to directly import the data in the analysis tools. We distributed the online survey using emails and repeatedly sent bimonthly reminders to the participants to complete up the survey. Finally, out of the total population, we were able to collect responses from 460 respondents (response rate = 83%). We used five-point Likert-scale comprising of strongly agree, agree, neutral, disagree, and strongly disagree for all items (except item 3, 7, 8, and 10). Alternatively, we measure the items 3, 7, 8, and 10 on a five-point Likert scale of strongly satisfied, satisfied, neutral, somewhat satisfied, and not satisfied.

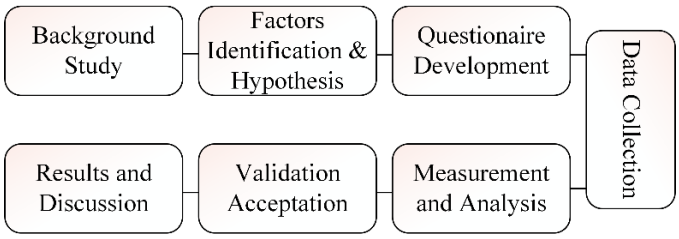

Figure 3. The workflow of research.

The data analysis was performed in the two phases. In the first phase, the demographics and the reliability study of the measurement model were performed. In the second phase, the hypothesis testing, CFA, and SEM were conducted. The research group of this study consisted of students who were in their final year of Bachelor of Computer Science (n = 309) and Software Engineering (n = 151) degree. Students in the final year develop independent projects that need extensive programming skills. The reason behind selecting these students was that they have extensive experience of studying in the e-learning system and their programming skills should have been actively developed to accomplish their final year project. The responses include students' demographics information, TP, IF, EP, LI, and programming expertise. Table 1 shows the demographic information of the students involved in the study.

Table 1.

Demographic information of the participants.

Variables		Value
Age	Range (years)	20-43
Gender	Male	47.8%
	Female	52.2%
Major	Computer Science	67.2%
	Software Engineering	32.8%

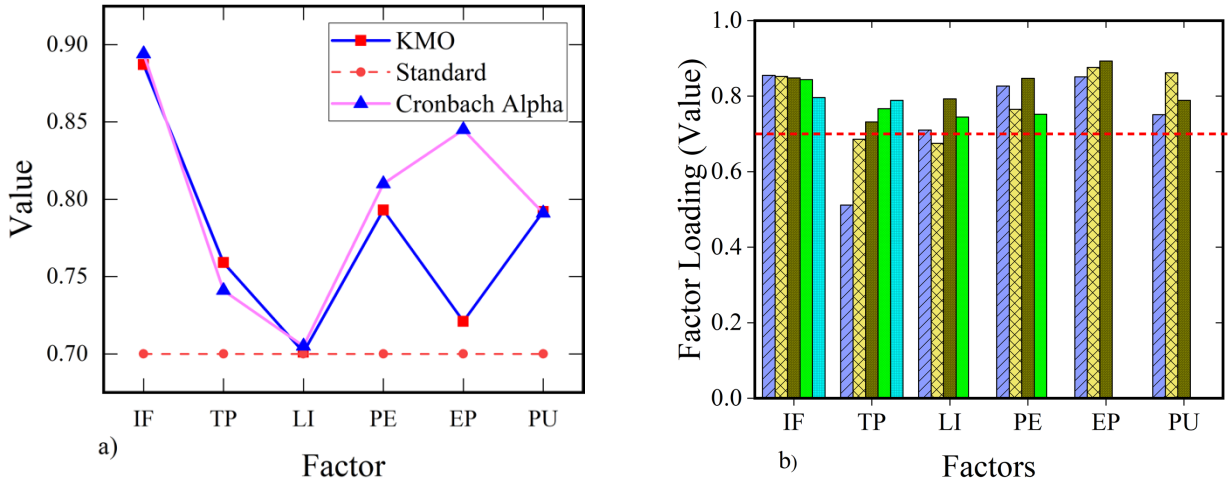

Figure 4. (a) Values of KMO and Cronbach's Alpha; (b) Factor loading for all the variables where the dotted line demonstrates the acceptable range in both the figures.

4.1 Model Validation

In this section, we present the experimental evaluation of the proposed research. We analyze the data with Statistical Package for Social Sciences (SPSS-version 22.0) and Mplus version 8.1 to measure the Exploratory Factor Analysis (EFA) and reliability coefficients (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005; Chin, 1998). We initially verify data for the reliability and validity before testing the proposed hypothesis. All the measurements in this research have been newly developed. Therefore, the efficiency of these measures has been established by performing the EFA. The results of EFA are presented in Table 2, which indicates that all the measurement scales fulfill the requirements of the recommended standard. According to Hair, Black, BABIN, Anderson, and Tatham (2010), the data must be analyzed for Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity before proceeding to EFA. The values of KMO should be higher than 0.7 and Bartlett's trial should be significant to meet the cut-off criteria. Figure 4 elaborates the validation of the dataset; we observe from Figure 4a that the values of Cronbach's Alpha and KMO are greater than 0.7. Similarly, Figure 4b demonstrates that the values of factor loading are greater than 0.5 which verifies the suitability of the data for the current research. The result of Bartlett's test is also substantial, which shows the adequacy of the data for EFA. We evaluate the results using Principal Component Analysis (PCA), which is a highly reliable technique to measure EFA. Results in Table 2 demonstrate that the output of all the measurement

scales was a single factor; moreover, the eigenvalue of the first indicator is also higher than 1.0. Hence, we choose one element for each measurement scale. Moreover, Hair et al., (2010) and Sekaran and Bougie (2011) state that the factor loadings of individual elements of each measurement scale should be higher than 0.5 to meet the criteria of convergent validity. Correspondingly, all the other items successfully loaded on the selected portions.

The factors of PU, LI, and EP are adapted from the study of the Davis and Venkatesh (1996). The IF conforms to the study of Eom et al., (2006). Similarly, TP was adapted from Hung and Chou (2015), whereas the factors of PE were extracted from Kelleher & Pausch, 2005. We used five measurement scales and factor loading of all the items on these scales was higher than 0.5, which shows the adequate convergence of the measurements. The reliability of data was measured with Cronbach's Alpha, which is the most common and statistically superior test for measuring the internal consistency of the data. Finally, Table 2 illustrates that the Cronbach's Alpha for all the measurement scales is higher than 0.7 which shows the robust reliability of measurement scales for further analysis (Hair et al., 2010; Sekaran & Bougie, 2011).

Table 2.
Statistics of EFA on the Dataset

Variables	Item No.	Items	Factor Loading	KMO Value	Eigen Value
Intrinsic Factors	1	Did you enroll in an e-learning institution because of its flexible accessibility?	0.855	0.887	3.521
	2	Will you like to take another higher degree course in computer sciences at an e-learning institution?	0.852		
	3	How do you rate your satisfaction level in the e-learning studies?	0.848		
	4	Did you follow-up the course material along with your other schedules regularly?	0.844		
	5	Did you find the computer science course fruitful in your career before enrolling?	0.796		
Teaching Practices	6	Do you wish to have step by step guidelines for the complex coding tasks?	0.512	0.759	2.480
	7	How do you rate the content quality of the course material?	0.686		
	8	How do you rate the lecture delivery of the tutors during the lectures?	0.732		
	9	Do you like to have face to face conversation with the tutor during coding tasks?	0.767		
	10	How effective was the instructor's response to LMS when you interact with them?	0.789		
Learning Intentions	11	Are you intending to join or already working in a software development company?	0.710	0.701	2.144
	12	Do you try to start coding and fail?	0.675		
	13	Are you motivated toward learning programming?	0.793		
	14	Do you explore online tutorials other than course material for programming help?	0.745		

Programming Expertise	15	Do you have sound knowledge of basic programming skills?	0.827	0.793	2.553
	16	Have you developed your final year project by yourself?	0.765		
	17	Do you have excellent skills in a reputed programming language, e.g., Net, Java, python?	0.847		
	18	Did you complete your programming assignments by yourself during your studies?	0.752		
Efficacy Problems	19	Do you think that if you stuck on a programming task, you are not able to get out of it, because of lack of support?	0.851	0.721	2.291
	20	Do you think that it is difficult to access right programming help on the internet?	0.876		
	21	Do you think integrated software development tools (IDE) are complex?	0.893		
Perceived Usefulness	22	Do you think that this e-learning course will earn you a good job?	0.751	0.792	2.312
	23	Do you think that you will find a good career after getting the degree?	0.862		
	24	Do you think that career-oriented learning is the need of current rapid development environment?	0.789		

4.2 Model Fitness

The hypothesized paths have been tested with the SEM technique using Mplus version 8.1. Before the SEM, we validated the data with confirmatory factor analysis (CFA). The model fitness indices for both CFA and SEM demonstrate an acceptable fit of the data with the proposed model. Five measurements of fitness indices were utilized including Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), and chi-square to degree freedom ($\chi 2$ /d.f) as presented in Table 3. Fit indices suggest that the values of CFI and TLI should be near to 0.95 for a good fit, moreover the values of RMSEA and SRMR should be less than 0.10 for an adequate fit (Hu & Bentler, 1999). Additionally, the chi-square to the degree of freedom ratio should be less than 3.0 for an acceptable fit (Amemiya & Anderson, 1990). Table 3 demonstrates the findings of the CFA and SEM indices where the values of CFI and TLI are 0.942 and 0.931, respectively. These values are aligned with the threshold described by Hu and Bentler (1999) for an acceptable fit. Additionally, the values of SRMR and RMSEA are also following the Hu & Bentler (1999) criteria of the SEM model fitness. Similarly, the value of chi-square is 1.62 which follows the criteria proposed by (Amemiya & Anderson, 1990).

Table 3.

Model Fitness Indices used in the Research.

Fitness Indices	**Values**	
	CFA	**SEM**
CFI	0.966	0.942
TLI	0.958	0.931
RMSEA	0.045	0.056
SRMR	0.048	0.058
Chi-Square $\chi 2$ /d.f	1.40	1.62

To fulfill the requirements of validity and reliability, we carried out CFA of the collected data before proceeding to structural analysis. The model fit indices as presented in Table 3 indicates that the model fits well with the data. The factor loadings of individual question indicators of all the variables as shown in Table 4 are higher than 0.5, which satisfies the requirements of convergent validity (Hair et al., 2010). We deleted two question items, one from teaching practices construct and one from learning intentions scale because of lower factor loadings. The factor loading of these two items was lower than 0.5, which was not meeting the cut off criteria; hence, we carried out further analysis on the remaining items. The Cronbach's Alpha reliability test indicates that all the measures used in this study are reliable as these values are higher than 0.70 for all the constructs (Hair et al., 2010).

Table 4.
Confirmatory Factor Analysis

Construct	No. of Items	Factor Loading (Range)	Cronbach's Alpha
Intrinsic Factors	05	0.740 – 0.813	0.894
Teaching Practices	04	0.559 – 0.743	0.741
Learning Intentions	03	0.504 – 0.649	0.705
Programming Expertise	04	0.648 – 0.801	0.810
Efficacy Problems	03	0.735 – 0.880	0.845
Perceived Usefulness	03	0.613-0.793	0.791

Results

The results of the structural model have been presented in Table 5, which shows the hypothesized paths and their respective coefficients. H1 explores the relationship between IF and LI where the items measuring IF include student's intentions of joining the e-learning program, student's follow-up of the course, and intrinsic desire to learn the course. The results demonstrate that H1 has significantly been accepted, which affirms that IF has a positive impact on the LI (β = 0.743, p = 0.000) as it can also be observed in Figure 5 which shows the path performance of all the hypothesis. The plausible reason behind this is the fact that when the students join the programming course because of their interest, they follow-up the course regularly and thus are satisfied with their studies. Furthermore, their learning motivation develops higher. In the same context, H6 suggested that the impact of IF on LI positively trend toward programming expertise. This hypothesis was also supported by the results (β = 0.703, p = 0.001), it implies that students with high intrinsic motivation of joining the computer science degree programs will be able to gain good programming expertise in the future.

H2 proposes an affirmative impact of TP on LI which has been significantly revealed during the evaluation (β = 0.564, p = 0.000). The items measuring TP include help in programming tasks, course content quality, lecture delivery, and effective student-teacher interaction. Similarly, H7 recommends that the impact of TP on LI positively transcends toward the improved programming expertise (indirect effect; β = 0.937, p = 0.002). Our results provide the evidence that TP are one of the most critical factors in determining students' LI, which further contributes to programming expertise. It implies that effective TP help in developing intentions of learning, which in turn helps them in effectively grasping the programming knowledge.

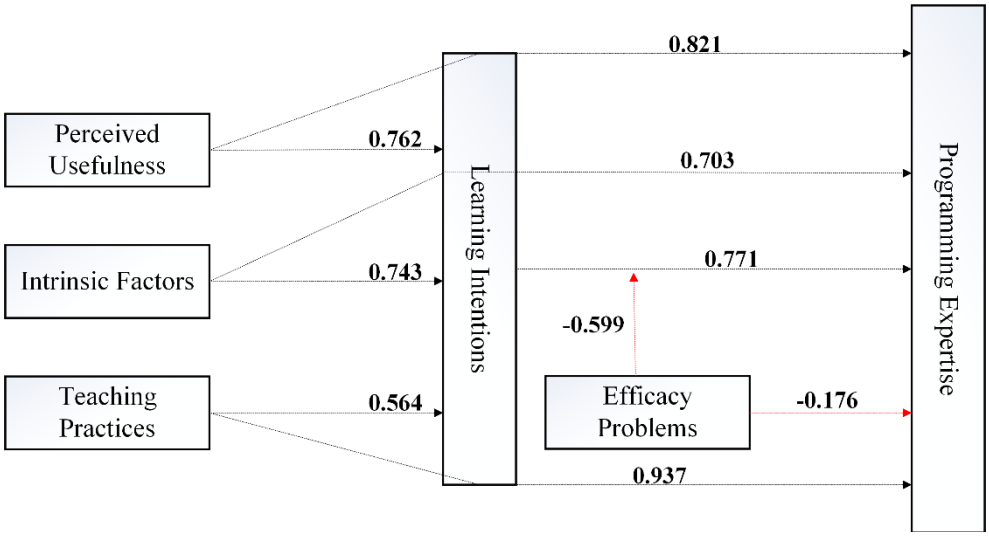

Figure 5. Coefficients of path of the research framework.

Moreover, H7 suggests that LI significantly affects programming expertise, which has also been accepted by the results (β = 0.771, p = 0.000). However, EP hinders the students' ability to learn programming by undermining their potential of learning. The impact of H4 has also been successfully established during the evaluation (β = -0.176, p = 0.017). Increase in EP result in lower programming performance demonstrated by the students. The plausible reason behind this is the students' inability to select relevant information from the internet. Due to the heap of information provided over the internet, deducing timely information is a challenging task. The lack of real-time feedback is a critical problem in programming. Sometimes students find themselves plunged into a programming problem where some support can help them out; however, students lack this support in e-learning. Hence, real-time feedback and support should be provided for effective learning. Recent developments in interactive programming languages and tools can be used to assist learners in writing and compiling their code.

Even students who show high LI may face the issues of lack of real-time support, problems with the complex interface of IDEs, and correct information selection on the internet. In this regard, these factors were supposed to weaken the relationship between LI and programming expertise. Although e-learning provides immense opportunities for the students still, these opportunities may not yield desired results. In this regard, we postulated that students' EP might also moderates the relationship between LI and programming expertise (H9); however, we could not find the significant results for this hypothesis (β = -0.599, p = 0.139). The reasons might embed in the fact that students' LI have a powerful impact on their programming expertise and the impact of EP became insignificant. Considering the evidence that EP adversely influences students' programming expertise, most of the students are successfully achieving programming education and joining the ever-increasing hub of programming experts. The reason behind this is that the students are motivated enough to learn the programming skills and they overcome EP and continue learning programming until they achieve a specific level of expertise whether it takes them more time and energy to assimilate.

H5 implies that PU positively influences LI, which has also been supported by the results (β = 0.762, p = 0.000). Similarly, H8 suggests that the impact of PU on LI trends positively toward programming expertise. This hypothesis has also been successfully accepted during the evaluation

($\beta = 0.821$, $p = 0.001$). This impact corresponds to the fact that students who contemplate that e-learning is beneficial to them are able to perform better in their academic studies and will be able to learn more programming skills.

The above empirical evidence led authors to deduce that in e-learning, IF, TP, and PU are the key factors that serve as an impetus to foster student's LI, which will further contribute in the development of their programming expertise. Mentoring and real-time support will help students to get out of the isolation that students endure during e-learning and will assist them in engaging in programming tasks. By applying this empirical research, human development organizations, government, and the education sector can use web-based e-learning to generate an exceptional pool of talented individuals who can serve effectively to alleviate the poverty and social imbalance. Moreover, they can fulfill the need for human resources in the software sector.

Table 5.

Standardized Coefficients of Structural Model

Hypothesis	Causal Path	β	SE	T-Value	Significance
	Direct Effects				
H1	IF → LI	0.743	0.137	8.353	0.000
H2	TP → LI	0.564	0.141	4.000	0.000
H3	LI → PE	0.771	0.081	9.555	0.000
H4	EP → PE	-0.176	0.074	-2.285	0.017
H5	PU → LI	0.762	0.129	1.456	0.000
H9	LI*EP → PE (Interaction term) student EP negatively related to PE and LI relation with PE weaken the relation	-0.599	0.068	-1.487	0.139
	Indirect Effects				
H6	IF → LI→ PE	0.703	0.171	4.312	0.001
H7	TP→ LI → PE	0.937	0.309	3.036	0.002
H8	PU→ LI → PE	0.821	0.297	0.292	0.001

LI ($R^2 = 0.503$), PE ($R^2 = 0.579$)

Conclusion

In this study, we identify and evaluate the factors that influence programming expertise in e-learning. We ascertain teaching practices, intrinsic factors, perceived usefulness, efficacy problems, and learning intentions are the key factors in developing programming skills. A research model has been proposed by extending the technology acceptance model, which integrates all the identified factors. Empirical evidence indicates that effective teaching practices, perceived usefulness, and correct intrinsic motivations are the bases to instigate the aspiration to learn programming. Students' efficacy problems undermine their ability to learn; however, they do not impact their programming skills significantly. At the institutional level, effective learning management systems should be provided that may encompass the features of face-to-face communication in e-learning. Moreover, effective student-teacher interaction needs to be established as students need immediate help during the programming problems. The availability of quick response can be highly effective as the students sometimes plunge into problems and lose motivation. Specifically, when students confront complex programming tasks, they need spontaneous help to grasp their motivation for learning and to complete the programming tasks.

Step-by-step programming tutorials with the formal lectures can also help students to grasp a basic understanding of the programming activity discussed during the lectures.

Furthermore, the mentoring and support staff can help students in completing their complex programming tasks. It will benefit the student to come out of the problem of isolation and break the self-centered view of learning which will result in broadening their knowledge horizons. Moreover, students' support will be beneficial to overcome the stress of learning everything by themselves. Therefore, an interactive teaching environment and immediate assistance can help students in enhancing learning intentions of the students, which will overcome the efficacy problems and facilitate them in attaining right programming expertise in the web-based e-learning environment.

Discussion

The experimental analysis presented in the results section demonstrates that TP plays a pivotal role in instigating learning motivations for programming. These findings have been aligned with the research of Dos Santos and Cechinel (2018), which supports that effective teaching style yields better learning outcomes in students. Effective TP involves more interaction between students and teachers, which leads students to grasp the contents of the lectures adequately. The interactivity of the e-learning system can help in solving the face-to-face learning issue in the e-learning paradigm. This outcome is associated with the findings of Pituch and Lee (2006) and Chen (2011) who reveal that the interactivity of the LMS and immediate response motivates the learner in e-learning.

We propose that IF positively affects LI where the essential elements in the IF include the student's perception and motivation toward learning. The empirical results of our study claim that these factors have a positive impact on the student's LI. This finding is in line with the results of Pugh (2019) who argues that the student's motivation is the key success factor in higher education. This impact has also been demonstrated by Venkatesh (2000) who states that IF positively impacts the learner's motivation. However, in e-learning, it is difficult to have interactive sessions with the mentor; thus, LMS should be developed in a way that it can provide a platform for face-to-face discussions with the tutors along with the text discussions. In this regard, our study proves that IF also positively affect the LI of students toward programming.

This study demonstrates that PU plays an important role in developing LI that further contributes to programming expertise. The items in PU correspond to the fact that career-oriented professionals grasp more knowledge in e-learning. This hypothesis is consistent with Nganji (2018) and Wingo et al. (2017) who argue that career-oriented learners use strategic methods to complete their tasks in time and perform well during examination and thus are able to get the valuable learning outcomes. Similarly, the impact of PU is also aligned with the Park (2009) and Van Raaij and Schepers (2008) who demonstrate that the success in e-learning is dependent on the usefulness of the e-learning system.

The result of H4 suggested that EP negatively affect the programming expertise. Here, efficacy is concerned with the contextual problems faced by the student during programming including difficulty in using IDEs, getting online help, and lack of support. Although numerous interactive IDEs have been developed, however, students still face problems while using them. The research of Altınay (2017) demonstrates the effectiveness of peer learning that can improve

the online learning process. Peer learning uses the experience of other students, their motivation, and social interaction to help the other students in e-learning. In this regard, the feedback and support for e-learning students are necessary; Tsai (2013) conducted an empirical analysis of e-learning students and demonstrate that students who receive immediate feedback on their learning process perform better than other e-learning students. Tang, Tang, and Chiang (2014) demonstrate the positive impact of learning from the online resources; moreover, they demonstrate that students continue visiting a website/blog if they get required help from it. In addition to student-teacher communication, student-student interaction should also be provided because students can communicate easily with their peers as compared to their teachers. Providing students with step-by-step solutions for the programming tasks will increase their interest in programming tasks. Online advising and mentoring services can also help e-learning students to discuss their problems. Finally, the students need to be satisfied enough about their study program before joining a course in the e-learning. Moreover, interactive LMS and responsive teaching facilities should be provided to the students, which can highly contribute to the programming skills development in e-learning.

Web technologies have been providing immense opportunities for students worldwide to learn state-of-the-art courses using e-learning. For effective programming education, the practitioners should provide more support to the students using LMS that may include video conferencing services for real-time student-teacher interaction.

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Purposeful Interpersonal Interaction in Online Learning: What is it and How is it Measured?

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Abstract
Despite extensive studies surrounding the topic of interaction in online learning, faculty are often still relegated to an attempt at replicating their face-to-face course interactions in the online environment. Interpersonal interaction is a necessary yet nebulous concept in online learning. This paper attempts to build a quality lens to view interpersonal interaction in online learning through, called purposeful interpersonal interaction (PII) by exploring types of interpersonal interaction demonstrated in the literature to lead to better student outcomes. PII encompasses three main types of interaction: purposeful interpersonal instructional interaction, purposeful social interaction, and supportive interaction. These interaction types have been associated with important student outcomes like perceived learning, satisfaction, and academic achievement. Robyler and Wiencke's (2003) rubric for assessing interactive qualities of distance courses (RAIQDC) includes many of the concepts identified as important to PII and has been established as a valid and reliable tool for assessing the amount of quality interpersonal interaction that occurs in an online course.

Keywords: online learning, interaction, instructional design, online pedagogy

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Purposeful Interpersonal Interaction in Online Learning: What is it and How is it Measured?

Interaction has long been a popular topic of research in online learning. Since the beginning of cyber education, many have been skeptical of its potential to devolve into an electronic form of correspondence education, lacking sufficient interaction between faculty and students. Moore's (1989) seminal work on interaction in online learning identified how interpersonal interaction can decrease transactional distance and thus provide a more robust educational experience for the learner. Moore's three types of interaction included student-content interaction, student-student interaction, and student-faculty interaction. Interpersonal interaction includes both student-student and student-faculty interaction (York & Richardson, 2012) and is generally accepted as a critical element for all educational settings.

The use of social constructivist (Vygotsky, 1997) based online course designs has been leveraged in order to promote greater interpersonal interaction. Educators often seek to replicate the dialogue that is easily achievable in their face-to-face courses in the online setting by utilizing discussion boards and similar technologies. Despite this quest for sufficient interpersonal interaction, educators still lack consensus on which interpersonal interaction strategies best promote effective student learning and satisfaction. Often, faculty are pressured to increase the quality of their online courses but are not aware of strategies to encourage students to interact (Paquette, 2016). In other cases, faculty have been teaching in the face-to-face environment for years and are being asked to convert their courses into the online format without pedagogical and technical support (Lane, 2009).

Additionally, many of the studies on interaction in the online environment do not consider the qualitative aspects of interaction and instead only measure the number of interactions, which typically occurs through methods like counting discussion board posts or course updates.

This lack of clarity of what types of interpersonal interaction are most effective warrants exploration into the types of interpersonal interaction that have been demonstrated to lead to better student outcomes. A comprehensive review of the pertinent literature related to interpersonal interaction in online learning as it relates to important student outcomes follows. This review allows for a qualitative view of interpersonal interaction, called Purposeful Interpersonal Interaction (PII). Lastly, recommendations for evaluating existing courses for PII using an established rubric are given.

Review of Related Literature

Interpersonal Interaction is Beneficial

Since interaction in online learning has been extensively studied in the last few decades, studies demonstrating the positive benefits of interpersonal interaction are plentiful. Interpersonal interaction in online environments has been associated with increased perceived learning (Richardson & Swan, 2003; Sher, 2009; Swan, 2002), higher levels of student satisfaction with the course (Cole, Shelley, & Swartz, 2014; Fedynich, Bradley, & Bradley, 2015; Khalid & Quick, 2016; Richardson & Swan, 2003; Sher, 2009; Swan, 2002), higher levels of faculty satisfaction with the course (Su et al., 2005), and improved student academic achievement (Long et al., 2011).

Open-ended responses in Sher's (2009) study determined that students valued opportunities to interact meaningfully with their faculty and their peers. Berge (1999) elaborates on the reason behind the benefits of interpersonal interaction: "When students have the opportunity to interact with one another and their instructors about the content, they have the opportunity to build within themselves, and to communicate, a shared meaning to 'make sense' of what they are learning" (p. 8). In a study conducted by Northrup, Lee, and Burgess (2002) that investigated the interactions students perceived to be important in online environments using the online learning interaction inventory (OLLI), students strongly expressed that prompt feedback from faculty and their peers was essential. Clearly, learners value interpersonal interaction opportunities and feel they are important to their successful outcomes in online courses.

Chickering and Gamson's (1987) widely cited Seven Principles for Good Practice in Undergraduate Education was designed to improve undergraduate education and endorse concepts that incorporate the different types of interaction. Four of Chickering and Gamson's principles

correspond to the critical student-faculty interpersonal interaction types in the online environment: (a) "Encourages contact between students and faculty," (b) "Develops reciprocity and cooperation among students, (c) "Gives prompt feedback," and (d) "Communicates high expectations" (p. 2).

Lack of Interpersonal Interaction

Not only have studies shown the interpersonal interaction generally leads to better outcomes, but they have shown that a lack of interpersonal can be detrimental. A three-year study by Cole, Shelley, and Swartz (2014) that examined graduate and undergraduate student satisfaction with online instruction at a university discovered lack of interaction with faculty and with classmates as the main source of student dissatisfaction. This is supported in a study of higher education students in Kenya conducted by Muuro, Wagacha, Oboko, and Kihoro (2014), who identified lack of feedback from faculty and lack of feedback from peers as major perceived challenges by the students. From students' perspectives, interpersonal interaction can not only lead to a more satisfying online course, but a lack of appropriate levels of interpersonal interaction has a negative perceived impact on the learner. Faculty and students alike see value in interpersonal interaction, yet both are frustrated with the barriers to achieving sufficient levels of this type of interaction in online environments.

Point of Diminishing Returns

Although interpersonal interaction has generally been demonstrated to lead to better student outcomes, more interaction may not always be better. Castano-Munoz, Sancho-Vinuesa, and Duart (2013) found evidence of a point of diminishing returns on academic achievement as a result of interpersonal interaction that existed in the online environment but did not exist in the face-to-face environment. This may be due to students becoming overwhelmed with the interactions, whether written or otherwise, in the online environment. Picciano (2002) mentions an example where students must monitor comments in an online discussion, and states that the nature of these comments makes monitoring them more extensive than discussions in face-to-face settings, which may lead to information overload. Northrup, Lee, and Burgess (2002) support this idea by stating that there seems to be an ideal range of appropriate interaction with an upper and lower limit. In Northrup, Lee, and Burgess' (2002) study, some participants reported being frustrated with an overwhelming amount of interactive assignments within a weekly module. Downing, Lam, Kwong, Downing, and Chan (2007) recommend that interaction in online environments be sustained only as long as there is an educational benefit in doing so. Based on the results of their study, the group theorized that students may disengage from interaction once they have the information they need to complete tasks. These studies give some evidence that increasing interpersonal interaction beyond a saturation point may not only not add any benefit to students but may actually be detrimental to their educational experience.

What is Purposeful Interaction?

One technique for promoting engaging learning activities is to provide opportunities for students to interact with one another and with faculty purposefully. Garrison and Cleveland-Innes (2005) give support that the quality of interaction, not the quantity, is important to fostering deep learning, stating that high levels of interaction do not necessarily facilitate meaningful learning. According to Garrison and Cleveland-Innes, "There must be a qualitative dimension characterized by interaction that takes the form of purposeful and systematic discourse" (p. 135) and "simple interaction, absent of structure and leadership, is not enough. We need to have a qualitatively richer view of interaction" (p. 145).

There is little research specifically referring to purposeful interaction in online environments. In one instance, Abrami et al. (2011) mention purposeful interaction: "Guided, focused, and purposeful interaction goes beyond whether opportunities exist to consider especially why and how interaction occurs" (p. 88). This statement again speaks to the qualitative component of interaction over simply measuring the volume of interaction.

Unfortunately, not all instances of interpersonal interaction in any learning environment directly impact or facilitate intellectual growth. In a face-to-face setting, interactions can be off-topic, redundant, or even distracting for students. In a similar way, interactions in the online environment (e.g., an "I agree" response to a discussion post) may not always be purposeful, valuable, or contributory to student learning. Conversely, not all interactions that do not directly relate to course content or learning objectives are without purpose and/or student benefit. For example, a case where students form social bonds with faculty or their fellow students can be a purposeful interaction. Research has shown that social presence can be an important characteristic in learning (Gilbert & Moore, 1998; Richardson & Swan, 2003; Tu & McIsaac, 2002; Pacquette, 2016). Abrami et al. (2011) believe the next generation of online education should be designed to facilitate more purposeful interaction by promoting targeted, intentional, and engaging interactions. In order for online interaction to fulfill its objectives and advance the learning process, interaction opportunities should be designed in a way that allow students to interact with content, faculty, and other students in a manner that is not fake or forced but meaningful and purposeful.

Purposeful Interpersonal Interaction

Purposeful interpersonal interaction (PII) is any high quality, organic, and valid communication exchange between two or more participants of the learning process that directly relates to the achievement of established learning outcomes or to the building of social relationships. As shown in Section 2, a seemingly endless number of studies have attempted to look at interpersonal interaction from a quantity perspective. Fewer studies have examined the quality of interpersonal interaction in OL and even fewer studies have examined interaction through the lens of measuring the amount of quality interpersonal interaction, defined here as PII.

Quality Interaction

An important aspect of PII is quality. Berge (1999) argues that just because interaction opportunities may increase in quantity, this does not automatically lead to increased quality of interaction in the course. Clearly, not all interactions in online learning are created equal; interactions may have differing levels of value to learners. Although interactions in the online environment can be easily structured by utilizing the robust features of many of today's widely used learning management systems (LMS), it is vital that many of these interactions are purposeful. According to Woo & Reeves (2007), an interaction is viewed as meaningful when it has a direct influence on intellectual growth for the student.

Social and instructional interactions among students and between student and faculty are common elements of a face-to-face classroom (Picciano, 2002). According to Picciano (2002), "The ability to ask a question, to share an opinion with a fellow student, or to disagree with the point of view in a reading assignment are all fundamental learning activities" (p. 1). In the face-to-face classroom, many interactions among students and between students and faculty occur spontaneously and organically (Hirumi, 2002), and the interactions help advance the learning process. Face-to-face learning provides many opportunities for informal learning where an interaction is not planned, but class discussions, reflections, debates, or group projects lead to the

stimulation of learning. This process is allowed to happen organically, as faculty member may notice verbal and nonverbal cues from students and feel the need to elaborate on a topic, for example (Hirumi, 2002). In the online environment, this informal learning and the ability to adapt in real-time to fill the gap in understanding may be decreased if students are not given the opportunity and appropriate tools to interact with their peers and faculty. For that reason, quality instructional and social interaction opportunities in online environments need to be deliberately designed into the course (Berge 1999; Bernard et al., 2009; Hirumi, 2002; Northrup, Lee, & Burgess, 2002).

Robyler and Wiencke (2003) highlight the importance of structuring these opportunities, stating, "Highly interactive learning environments are rarely serendipitous; activities must be designed to encourage, support, and even require interaction" (p. 87). The success of online courses often directly relates to the quantity and quality of these interactions (Picciano, 2002). These types of interactions in the online environment must occur in a purposeful way if learning is to effectively occur. According to Martin, Parker, and Deale (2012), "Effectively designed courses should impact students in such a way that there is an increased and spontaneous use of opportunities for interaction within the course" (p. 231).

Three Components of PII

PII can be broken into three main categories: instructional interaction, social interaction, and support interaction, as displayed in Figure 1. The first two types of interaction that make up PII directly relate to two types of interaction theorized by Gilbert and Moore (1998) to categorize interaction. The two categories identified are content interaction and social interaction. Gilbert and Moore (1998) state that many skeptics of online learning are concerned mostly with a lack of ability to foster two categories of interaction that are routinely found in face-to-face instruction: social activity and instructional activity. Courses with high levels of quality interaction will have components of content and social interaction designed in them (Northrup, 2002). When referring to content interaction in this context, it is not meant to be confused with Moore's (1989) student-content interaction, but rather it refers to interpersonal interaction that focuses on the content (relevant topics) of the course. These two categories seem to mirror two important categories of interaction that Berge (1999) identifies as task/content interaction and social interaction, and two categories of interaction Gilbert and Moore (1998) describe as social instructional interactivity and social interactivity. As a component of PII, the term instructional interaction will be used in place of content interaction or task interaction to avoid confusion. The third and final category of PII deals with providing online learners with appropriate support. Therefore, the three types of PII are instructional interaction (PIII), purposeful social interaction (PSI), and supportive interaction (SI).

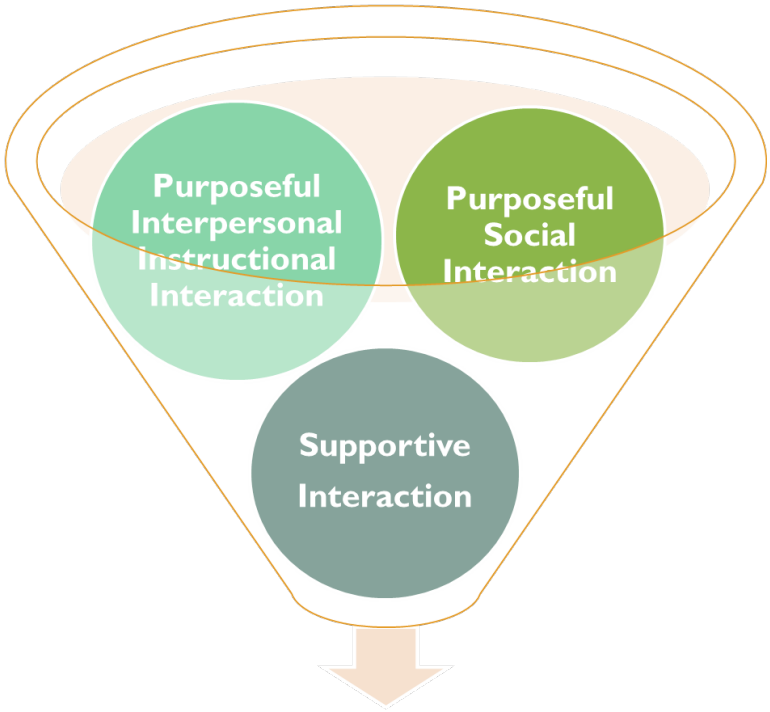

Figure 1. Three components of purposeful interpersonal interaction in online learning.

Purposeful Interpersonal Instructional Interaction (PIII)

A major part of all educational ventures are interactions directly associated with the instructional content of the course. Northrup (2002) states that "Content interaction is always directed at attaining the specific learning outcomes or goal of the instruction" (p. 220). In this sense, PIII is any interaction between participants in the learning process that directly relate to completing learning objectives. Although admittedly a very broad category at surface, this interaction category omits any instances of extraneous (nonpurposeful) interaction. Woo and Reeves (2008) explain that when students post to a discussion board simply to meet assignment requirements, it is not likely to lead to meaningful learning. This is an example of extraneous interaction that would not reflect a purposeful approach, especially in the event that the posting does not relate in any direct way to course objectives. A student posting an "I agree" or "me too" type of response in a discussion board would not be considered a PIII. Berge (1999) lists some examples of interpersonal interaction that faculty might employ:

- disseminating information not readily available from texts or workbooks in appropriately-sized pieces according to a teacher-determined structure;
- arousing or heightening student interest;
- reviewing previously learned skills and knowledge; and
- giving feedback and corrective guidance. (p. 7–8)

All of the items on Berge's list are consistent with PIII. These faculty interactions can be utilized as a strategy to increase instructor presence in online courses. Dennen, Darabi, and Smith (2007) state:

> Perceptions of instructor presence are based on learners' psychological reactions to an online instructor's actions in both public (whole class) and private correspondence. Further, presence is not only confined to the amount of instructor-learner interaction, but also to the content of those interactions. (p. 67)

Clearly, the items on Berge's list would all be interpersonal interaction occurrences that could be classified as leading to enhanced instructor presence in the online environment.

Timely feedback. The last item on Berge's list for instructional interactions, giving feedback and corrective guidance, has also been identified as an essential component of any learning environment (Berge, 1999; Hirumi, 2005; Lewis & Abdul-Hamid, 2006; Woo & Reeves, 2008). Students perceiving that they have access to faculty and receive timely, valuable feedback from faculty is essential to their educational experience (Croxton, 2014). According to Kranzow (2013), "When students receive feedback promptly, they can either have reassurance that they understand the content sufficiently, or conversely, students can request assistance to guide them in the right direction" (p. 132). Students are often frustrated when they do not receive timely feedback (Woo & Reeves, 2008), so it is essential for faculty to "close the loop" on student work in a timely manner by providing students with a grading rationale, confirmation, and corrective feedback. Dennen et al. (2007) found that learners find receiving timely feedback is more important than receiving extensive feedback.

Northrup (2002) also demonstrated that students rate regular feedback from faculty as important. Although feedback can occur in both nonverbal and verbal ways in the face-to-face environment, it is arguably even more important in the online environment as it can be imperative to student satisfaction and performance (Dennen et al., 2007; Northrup, Lee, & Burgess, 2002; Thurmond, Wambach, Connors, & Frey, 2002; Vrasidas & McIsaac, 1999). Two major types of feedback, corrective feedback and confirmatory feedback, are differentiated in the literature. Corrective feedback allows students to make improvements to their work as faculty stress key areas for improvement and confirmatory feedback allows students to gain approval from faculty that their work is correct (Hirumi, 2005). Studies have demonstrated that feedback can improve course satisfaction as well as academic performance in the online environment (Espasa & Meneses, 2009).

Feedback is also not limited to faculty, as other students can be a source of feedback as well. As stated previously, lack of feedback from faculty and from peers is a major perceived challenge for online students (Muuro et al., 2014). Tu and Corry (2003) state, "when students are allowed and encouraged to obtain support from peers, assignments become social exercises while maintaining original objectives. This may enhance assignment performance and will permit the addition of peer evaluation activities" (p. 55).

The timeliness of feedback is a vital characteristic of PII in the online environment. Faculty must ensure that learners are receiving prompt corrective and confirmatory feedback in order to allow them to progress through the learning process and achieve key course goals. Without feedback, students cannot identify their errors or gain understanding of what they are doing well, and in that regard, feedback is important for students to identify their weaknesses and recognize their strengths.

Collaborative learning. Today's modern LMS features enable learners to collaborate in the online environment in better ways than ever before. Group assignments and projects are common in many online courses, as online instructors recognize that collaborative learning is

important to cognitive development (Garrison et al., 2000). Graduate students especially can benefit from collaborative learning through the completion of authentic learning tasks and projects that will prepare them for similar assignments they will encounter in their professional lives.

In writing about the conceptual approach to collaboration, Krejins, Kirschner, and Jochems (2003) summarize the set of conditions that enhance collaboration:

- Positive interdependence: team members are linked to each other in such a way that each team member cannot succeed unless the others succeed and/or that each member's work benefits the others (and vice versa).
- Promotive interaction: individuals encourage and help each other's efforts so as to in order to reach the group's goals.
- Individual accountability: all group members are held accountable for doing their share of the work and for mastery of all of the material to be learned.
- Interpersonal and small-group skills: specific skills are needed when learners are learning within a group; students who have not been taught how to work effectively with others cannot be expected to do so must be developed.
- Group processing: the group determines which behaviors should continue or change for maximizing success based upon reflection of how the group has performed so far. (p. 339)

Kreijns, Kirschner, and Jochems (2003) state that ensuring these conditions exist for collaborative learning promotes the positive benefits of this type of learning while also reducing negative aspects of collaborative learning (e.g., social loafing, free-riders, and the "sucker" effect). In this respect, creating these conditions in collaborative learning can be viewed as PIII. The key to unlocking quality collaborative learning that enables students to achieve specific learning objectives in online environments while interacting as a group is social interaction (Kreijns, Kirschner, & Jochems, 2003); this is the bridge to the next category of purposeful interpersonal interaction.

Purposeful Social Interaction (PSI)

Purposeful social interaction (PSI) is the second main component of PII. According to Powell and Kaline (2009), "Vygotsky would say that social interaction and culturally organized activities are necessary in the classroom for proper psychological development" (p. 246). Although social interaction often may not deal directly with the instructional goals of the course, this sort of interaction can help shape the learning environment (Gilbert & Moore, 1998). Muilenburg and Berge (2005) found lack of social interaction as the most significant barrier to online learning perceived by students. Administrative/faculty issues was the second most reported barrier, which incorporates student-faculty interaction instances. Tu & McIsaac (2002) found that social presence positively impacts online interaction and recommend that faculty promote informal relationships to achieve greater interactivity in their courses. In a study conducted by Jung, Choi, Lim, and Leem (2002), the group receiving high levels of social interaction had higher levels of learning and greater participation than groups receiving only academic forms of interaction. Finally, in a study of 97 students enrolled in online courses, Richardson and Swan (2003) found that students reporting high levels of social presence also had high levels of perceived learning and satisfaction.

In light of this research, it is recognized that social interactions that are in some ways separate from the learning outcomes of the course are purposeful as well. Berge (1999) supports

this sentiment by stating, "Much of learning inevitability takes place within a social context, and the process includes the mutual construction of understanding" (p. 8).

An important consideration of PSI is the concept of social presence. Garrison et al. (2000) describe social presence as the ability of participants of the online environment to come across to others as real people and state that its primary importance is to indirectly facilitate the process of critical thinking and support cognitive presence. Garrison (2009) later updates this definition to include the ability of participants to "communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (p. 352). Social presence is defined by Tu and McIsaac (2002) as "the degree of feeling, perception, and reaction of being connected by CMC to another intellectual entity" (p. 140). These definitions demonstrate that social presence is understood as a perception that directly results from interpersonal interaction and has influence on the learning process.

Social presence among participants in the learning process is often viewed as a prerequisite that must be established in order for instructional interaction and purposeful learning to occur (Garrison et al., 2000; Garrison & Cleveland-Innes, 2005; Tu, 2000; Woods & Baker, 2004). This precondition allows learners to create relationships and recognize the course as a safe setting where purposeful interpersonal interaction can occur.

Social presence is not always measured by the amount of social interaction that takes place in the online environment or improved by additional social interaction. For example, in Tu's (2000) study, social presence decreased when a group member participated too much or dominated the conversation. In a different study, Tu and McIsaac (2002) found that social presence positively impacts interaction, yet a high amount of participation does not necessarily equal a high level of social presence.

Northrup (2002) distinguishes social interaction from content (instructional) interaction by stating, "Social interaction, on the other hand, provides opportunities for peers to connect in non-task specific conversation" (p. 220). A key difference between instructional and social interaction is that social interaction is more flexible and mutual than instructional interaction (Gilbert and Moore, 1998). Gilbert and Moore (1998) confirm that social interaction can improve instructional interaction: "Social interaction between students and teachers and between students and students can sometimes have little to do with instructional learning, but can still help to create a positive (or negative) learning environment…" (p. 30). Social interaction can have real, measurable impacts on student outcomes in the online environment. Quality and intensity of social interaction has been associated with increased academic achievement (Kozuh et al., 2015).

Tu and McIsaac (2002) elaborate on how social interaction relates to overall interpersonal interaction, stating, "By incorporating concepts such as building trust online, providing 'hand-holding' technical support, and promoting informal relationships, instructors can help provide greater interactivity within the online community of learners" (p. 147). The results of Swan's (2003) study of 97 students in online courses demonstrated that students who reported higher levels of social presence in their online course also reported higher levels of perceived learning and satisfaction with faculty than students who reported lower levels of social presence.

Social interaction must be designed into the beginning of courses, and when designed correctly, it can continue on its own without faculty stimulus (Northrup, 2002). Garrison (2009) states that social presence incrementally develops in the online environment and warns faculty not to overstress this interaction early in the course. An overabundance of social interaction early in a

course may become a source of frustration for students and some may be unwilling to build deep social relationships early on. For that reason, it is essential that faculty determine the appropriate level of social interaction (not too little and not too much) when beginning a course. Downing et al. (2007) identified a pattern of engagement for discussions in an online course that is characterized by a socially active phase (where promotion of social interactions by faculty is key to developing relationships), an instrumental phase (characterized by the assignments in the course), and then a gradual disengagement from the discussion, which may be similar to the process of social engagement and then disengagement that occurs in a face-to-face course.

Kreijns, Kirschner, and Jochems (2003) describe two pitfalls many faculty make pertaining to social interaction. The first is assuming social interaction will occur just because the online environment provides tools (LMS or external) for it to occur. Kreijns, Kirschner, and Jochems (2003) give an example: "Just putting a forum in a group and labeling it 'café' or 'lobby' does not increase interaction" (p. 347). The second pitfall is restricting social interaction among students to strictly task contexts without consideration to nontask, socioemotional interactions. Both academic and personal social interaction appear to be important to learning in the online environment. It is therefore essential that faculty facilitate social interaction opportunities that allow students to develop trust, a sense of belonging, and social relationships, especially early in an online course.

Immediacy. Immediacy in the online environment refers to "expressiveness, stimulation, and the conveying of feelings and emotions through online language" (Tu, 2000, p. 1665). Swan (2002) reports that one of the ways faculty and students attempt to develop social presence in an asynchronous online course where face-to-face interaction is limited or nonexistent is by deploying verbal immediacy behaviors (e.g., paralanguage, self-disclosure, greetings, agreement, etc.) through text-based communication. Response time and communication style were also found to be contributors to social presence (Tu, 2000).

Supportive Interaction (SI)

The third and final main component of PII is support, which is an important factor for any learning environment (Caliskan, 2009). Providing support in a variety of ways to students is something many faculty take for granted in the online environment because the face-to-face environment allows them to be far more agile and responsive to student issues. In the online environment, students are separated by time and distance from the faculty and other learners, so student issues have the potential to further isolate students and increase the transactional distance faculty seek to decrease. For this reason, it is essential that faculty provide supportive interactions to students, as well as find ways to facilitate support from various resources in the event that a student needs assistance.

Student-interface interaction conditions that instructors cannot expect all learners to have the ability to interact with content, faculty, and their peers effectively without first ensuring that they can interact with the LMS, which is an important component of support in the online environment (Hillman et al., 1994). Providing support for navigating the LMS, either through tutorials, university resources (e.g., instructional design teams or tutors), or by request is an essential part of the online teaching experience, as other interactions cannot be successful if the student cannot effectively navigate the LMS.

Students may also struggle in a variety of other areas. In an online writing class, it may be appropriate to supply students with supportive assistance for APA or MLA formatting. Various software tools, external websites, and social networking tools may need to be thoroughly explained

to some learners, while other may embrace them early on. Many times, these student issues differ drastically by course, so it is essential for faculty to be aware of areas of their courses that warrant additional supportive interaction in the online environment.

Results from Northrup's (2002) study reveal that support is an important consideration for successful outcomes in the online environment. Providing support mechanisms can help obstruct the possibility of learners becoming frustrated and feeling isolated in an online course. Although the number of potential student issues are vast, it is most important for faculty to be cognizant that they will occur and be agile and responsive in providing supportive interaction to those students.

PII Summary

Purposeful interpersonal interaction (PII) is made up of three components: purposeful interpersonal instructional interaction (PIII), purposeful social interaction (PSI), and supportive interaction (SI). These interactions together make up the interpersonal interactions found in the literature that have been identified as important to student outcomes. Many attempts to examine the quantity of interpersonal interaction in the online environment have been apparent in the literature. In this light, PII can be summarized as looking at interaction from a quality standpoint.

How Can We Measure PII?

The rubric for assessing interactive qualities of distance courses (RAIQDC) created by Robyler & Wienke (2003) in Appendix A focuses on the level of interaction perceived by participants in an online course. This instrument can be used to determine the amount of PII perceived by students in an online course. The RAIQDC has been demonstrated to be a valid, reliable instrument to measure interaction in distance courses (Robyler & Wiencke, 2003; 2004). Robyler and Wiencke (2003) revealed that the rubric had convergent and divergent validity and had consistency among different raters of the same course, as 95% of the student ratings were within four points of the total 25 points. The rubric was also reviewed and improved based on feedback from 42 distance educators to be clearer and more comprehensive (Robyler & Wiencke, 2004).

Robyler and Wiencke's (2004) study used the rubric alongside course evaluations in four classes that had no or limited face-to-face components across two universities. The researchers assessed the reliability and validity of the rubric in three different ways in the study. First, inter-rater reliability was determined to be good, with Cronbach's alpha levels of .88, .64, .93, and .95 for the four courses involved in Robyler and Wiencke's (2004) study. Interestingly, the course with the lowest Cronbach's alpha, Course Two at .64, was the course with the greatest F2F component (80% asynchronous online and 20% F2F). Second, concurrent validity was determined using Pearson's correlations between formal course evaluations and scores on the RAIQDC. For the four courses, the correlations were determined to be .630, .720, .643, and .475. Three of the four correlations were significant at the .01 level, while Course One was significant at the .05 level (Robyler & Wiencke, 2004). Third, correlations between specific rubric elements and course evaluation scores were conducted and revealed that each of the five rubric elements were correlated with course evaluation sub scores at the .01 significance level. The results of these two studies (Robyler & Wiencke, 2003; 2004) give evidence that the RAIQDC is a valid and reliable instrument to assess the interactivity of online courses. The rubric is an acceptable measure for student samples, as demonstrated by Restauri (2006).

The instrument is easy for students to complete. Using a Likert-type scale, respondents choose one of five possible levels (1–5) for each of five different elements corresponding to the interaction in their course. Each level of each element has a corresponding label and description, and the respondents choose the option they perceive as most closely reflecting their course. The labels are as follows: Low is 1 point, Minimum is 2 points, Moderate is 3 points, Above Average is 4 points, and High is 5 points. The points for all elements are then totaled and used to categorize each course into one of three groups. The three groups are as follows: low interactive qualities group (1–9 points), intermediate interactive qualities group (10–17 points), and high interactive qualities group (18–25 points). These groups were used as a way to categorize courses in the study.

The five elements that make up the different sections of the RAIQDC are used to assess various types of quality interaction in the online environment. Each element either directly incorporates components of PII or facilitates PII to occur. In order to justify the use of this rubric as a measurement of PII, each element is tied to the components of PII by stating the criteria for the highest score level in for each element and using concepts from the components of PII to support its legitimacy and importance to student outcomes in online courses.

Element 1: Social/Rapport-Building Designs for Interaction

High Level description—*In addition to providing for exchanges of personal information among students and encouraging student-student and instructor-student communication and social interaction, the instructor also interacts with students on a social/personal basis.*

This element relates to PSI through its focus on establishing social interaction and building social presence in an online course, especially early in the course. Social interaction and social presence have been identified as important precursors for meaningful learning to occur and have been demonstrated to positively impact perceived learning.

Element 2: Instructional Designs for Interaction

High Level description—*In addition to requiring students to communicate with the instructor, instructional activities require students to develop products by working together cooperatively (e.g., in pairs or in small groups) and share results and feedback with other groups in the class.*

This element relates directly to PIII, as it requires interpersonal interaction with regard to instructional activities. In addition, the description refers to collaborative learning, which has been identified as crucial to cognitive development. The description also references the importance of peer feedback, which is one of the aspects that is highlighted as a component of PIII. Lack of feedback from faculty and peers was one of the identified challenges of online students.

Element 3: Interactivity of Technology Resources

High Level description—*In addition to technologies used for two-way exchanges of text information, visual technologies such as two-way video or videoconferencing technologies allow synchronous voice and visual communications between instructor and students and among students.*

This element is likely the most subtle but it essentially deals with the communication tools made available to students in an online environment. This is an instance where the rubric is not assessing direct interpersonal interaction, but rather the facilitation of interpersonal interaction using LMS tools. Two-way exchanges of information refers to faculty and students being able to

communicate reciprocally either by text or by video (e.g., instant messaging, videoconferencing, etc.), whereas one-way exchanges of information refers only to instances where information can be presented by one party but not by the other (i.e., faculty posting a course announcement with no response area for students). These tools allow faculty to have a greater presence in the course as well as enable a deeper social presence for all participants. In addition, such tools may allow faculty to increase the immediacy in their courses. The use of videoconferencing using a synchronous tool (e.g., Zoom, Adobe Connect, or Skype for Business) can help to humanize online distance education. In essence, the use of interactive technology resources as communication tools allow faculty and learners to interact interpersonally in a deeper fashion, which can effectively decrease the level of transactional distance in the online environment.

Element 4: Evidence of Learner Engagement

High Level description—*By end of course, all or nearly all students (90%–100%) are both replying to and initiating messages, both when required and voluntarily; most messages are detailed, responsive to topics, and reflect efforts to communicate well.*

This element reflects interpersonal interaction as a result of effective course design as well as social presence. It has been identified that social interaction and the development of social presence are key to unlocking instructional interaction. Social presence is something that must be developed early in a course and, when developed appropriately, will continue throughout the course without faculty influence. This element reflects the literature well as it requires that at least 90% of students are actively engaging in messages (whether through the discussion board or other communication tools) by the end of the course. In addition, it relates to purposeful interaction because the messages are required and voluntary (not forced) and must be detailed (i.e., not a simple "I agree" or "good point" response). The element of learner engagement seeks to measure how well a course and faculty have established social presence and in turn create an environment conducive to PII for learners.

Element 5: Evidence of Instructor Engagement

High Level description—*Instructor responds to all student queries; responses are always prompt, i.e., within 24 hours; feedback always offers detailed analysis of student work and suggestions for improvement, along with additional hints and information to supplement learning.*

This item directly relates to two types of PII: support interaction and purposeful interpersonal instructional interaction. Responding to student issues and concerns is identified as an important part of the online teaching experience. Whether through issues with navigating the LMS or different e-learning tools, faculty should provide support to students in a variety of areas when needed. Timely feedback has been identified as an essential component to successful learning in the online environment and positively impacts student satisfaction and academic achievement. The literature demonstrated that students would rather receive prompt feedback than extensive feedback, and the 24-hour time frame reflects this. Offering detailed analysis of student work and suggestions for improvement can be both confirmatory and corrective feedback. This feedback serves to guide learners on a path to achieving the key instructional goals of the course.

Summary of RAIQDC as PII

The five elements of the RAIQDC relate directly and indirectly to the different components of PII. In principle, all five of these elements either directly influence or facilitate PII in online courses. In that regard, this instrument can be used to identify how much PII has occurred in any online course from the students' perspectives. This rubric can be utilized as a tool for instructors to improve their online course design and instruction by finding an appropriate level of interaction for their course.

Conclusion

Despite extensive studies surrounding the topic of interaction in online learning, faculty are often still relegated to an attempt at replicating their face-to-face course interactions in the online environment. Building a quality lens to view interpersonal interactions in online learning is possible through purposeful interpersonal interaction (PII). The three interaction types in PII—purposeful interpersonal instructional interaction, purposeful social interaction, and supportive interaction—have been associated with important student outcomes like perceived learning, satisfaction, and academic achievement. Robyler and Wiencke's (2003) rubric for assessing interactive qualities of distance courses (RAIQDC) includes many of the concepts identified as important to PII and has been established as a valid and reliable tool for assessing the amount of quality interpersonal interaction that occurs in an online course.

Instructors can utilize this rubric to improve their online course design and instruction. Furthermore, instructors and researchers can utilize other validated research instruments in conjunction with the RAIQDC to determine the association between level of PII and important student outcomes like satisfaction, perceived learning, academic achievement, and persistence. Studies of this type will allow further insight into the point of diminishing returns for interpersonal interaction in online learning. Future research in this area is warranted to examine the effect of supplementing PII and decreasing nonpurposeful interactions on important student outcomes.

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Appendix A: Rubric for Assessing Interactive Qualities of Distance Course

(Robyler & Wienke, 2003)

"Rubric for Assessing Interactive Qualities of Distance Courses"

Assessment of Lessons and Courses

Pick 5 Scored

RUBRIC DIRECTIONS: The rubric shown has five (5) separate elements that contribute to a course's level of interaction and interactivity. For each of these four elements, circle a description below it that applies best to your course. After reviewing all elements and circling the appropriate level, add up the points to determine the course's level of interactive qualities (e.g., low, moderate, or high)

Low interactive qualities	1-9 points
Moderate interactive qualities	10-17 points
High interactive qualities	18-25 points

Element 1. Social/Rapport-Building Designs for Interaction

Low	Minimum	Moderate	Above average	High	Score
The instructor does not encourage students to get to know one another on a personal basis. No activities require social interaction or are limited to brief introductions at the beginning of the course (1 pt)	In addition to brief introductions, the instructor requires one other exchange of personal information among students, e.g., written bio of personal background and experiences. (2 pts)	In addition to providing for exchanges of personal informatoin among students, the instructor provides at least one other in-class activity designed to increase communication and social raport among students. (3 pts)	In addition to providing for exchanges of personal informatoin among students and encouraging communication and social interaction, the instructor also interacts with students on a social/personal basis. (4 pts)	In addition to providing for exchanges of personal informatoin among students and encouraging student-student and instructor-student communication and social interaction, the instructor also interacts with students on a social/personal basis. (5 pts)	

Element 2. Instructional Designs for Interaction

Low	Minimum	Moderate	Above average	High	Score
Instructional activities do not require two-way interaction between instructor and students; they call for one-way delivery of information (e.g., instructor lectures, text delivery) and student products based on the information. (1 pt)	Instructional activities require students to communicate with the instructor on an individual basis only (e.g., asking/responding to instructor questions). (2 pts)	In addition to requiring students to communicate with the instructor, instructional activities require students to communicate with one another (e.g., discussions in pairs or in small groups). (3 pts)	In addition to requiring students to communicate with the instructor, instructional activities require students to develop products by working together cooperatively (e.g., in pairs or in small groups) and sharing feedback. (4 pts)	In addition to requiring students to communicate with the instructor, instructional activities require students to develop products by working together cooperatively (e.g., in pairs or in small groups) and share results and feedback with other groups in the class. (5 pts)	

"Rubric for Assessing Interactive Qualities of Distance Courses" (continued…)

Element 3. Interactivity of Technology Resources

Low	Minimum	Moderate	Above average	High	Score
Fax, web pages, or other technology resource allows one-way delivery of information (text and/or graphics). (1 pt)	E-mail, listserv, conference/bulletin board, or other technology resource allows two-way, asynchronous exchanges of information (text and graphics). (2 pts)	In addition to technologies used for two-way asynchronous exchanges of information, chat room or other technology allows synchronous exchanges of primarily written information. (3 pts)	In addition to technologies used for two-way synchronous and asynchronous exchanges of written information, additional technologies (e.g., teleconferencing) allow one-way visual and two-way voice communications between instructor and students. (4 pts)	In addition to technologies used for two-way exchanges of text information, visual technologies such as two-way video or videoconferencing technologies allow synchronous voice and visual communications between instructor and students and among students. (5 pts)	

Element 4. Evidence of Learner Engagement

Low	Minimum	Moderate	Above average	High	Score
By end of course, most students (50%-75%) are replying to messages from the instructor, but only when required; messages are short and sometimes unresponsive to topics. (1 pt)	By end of course, most students (50%-75%) are replying to messages from the instructor and other students, both when required and on a voluntary basis; replies are short but usually responsive to topics. (2 pts)	By end of course, all or nearly all students (90%-100%) are replying to messages from the instructor and other students, both when required and voluntarily; replies are detailed and responsive to topics. (3 pts)	By end of course, most students (50%-75%) are both replying to and intiating messages, both when required and voluntarily; most messages are detailed and responsive to topics, but may be wordy or rambling. (4 pts)	By end of course, all or nearly all students (90%-100%) are both replying to and intiating messages, both when required and voluntarily; most messages are detailed, responsive to topics, and reflect efforts to communicate well. (5 pts)	

Rubric for Assessing Interactive Qualities of Distance Courses Detail
HandsOn With Technology, 3e

Page 2

"Rubric for Assessing Interactive Qualities of Distance Courses" (continued...)

Element 5. Evidence of Instructor Engagement

Low	Minimum	Moderate	Above average	High	Score
Instructor responds only randomly to student queries; responses usually take more than 48 hours; feedback is brief and provides little analysis of student work or suggestions for improvement. (1 pt)	Instructor responds to most student queries; responses usually are within 48 hours; feedback sometimes offers some analysis of student work and suggestions for improvement. (2 pts)	Instructor responds to all student queries; responses usually are within 48 hours; feedback sometimes offers some analysis of student work and suggestions for improvement. (3 pts)	Instructor responds to all student queries; responses usually are prompy, i.e., within 24 hours; feedback always offers detailed analysis of student work and suggestions for improvement. (4 pts)	Instructor responds to all student queries; responses are always prompt, i.e., within 24 hours; feedback always offers detailed analysis of student work and suggestions for improvement, along with additional hints and information to supplement learning. (5 pts)	
Total each ___pts.	___pts.	___pts.	___pts.	___pts.	
Total overall ___pts.					

Source: Based on concepts in Roblyer, M. D. & Ekhaml, D. (2000). How interactive are YOUR distance courses? A rubric for assessing interaction in distance learning. *The Online Journal of Distance Learning Administration, 3*(2).

The Role of an Interactive Visual Learning Tool and its Personalizability in Online Learning: Flow Experience

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Abstract
The purpose of this study was to examine the effect of interactive online learning tools on college student learning using flow as the guiding perspective. Study 1 was conducted to test the effect of online interactivity manipulated by dynamic visual learning tools on student's flow experience, level of telepresence, actual performance on tests, and perceived values of such activities. Study 2 was designed to test the effect of personalizability of difficulty levels in the interactive online activity on students' learning experience. The results found that interactive online learning tools can facilitate student's active learning process by increasing attention, curiosity, and interest about the online activity and by reducing awareness of physical surroundings. In addition, the interactive activity significantly improved students' test scores. This study also found that personalized difficulty options available in the interactive online activity significantly increased students' perceived hedonic value (i.e., enjoyment) of and the level of satisfaction with the activity. The results emphasize the critical role of interactive visual learning tools in the online activities in improving students' flow experience and actual performance. Personalizability of task levels is also recommended in online learning activities to increase students' perceived hedonic value and satisfaction with such online activities.

Keywords: online learning, interactivity, visual learning tools, persoanalizability, flow, perceived value

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The Role of an Interactive Visual Learning Tool and its Personalizability in Online Learning: Flow Experience

Online-based learning has become an increasingly common mode of learning in higher education. According to a report by the Babson survey research group (Allen, Seaman, Poulin, & Straut, 2016), 28.4% of all enrolled students in higher education took at least one distance learning course in 2014. In the fall of 2016, more than 6.3 million U.S. students took at least one online class (Friedman, 2018). As of 2017, over 700 learning management system suppliers offer products to the growing eLearning market (Jasmini, 2017). Despite the increasing popularity of online learning, online courses in higher education still suffer from high dropout rates (Chen, 2018). Some found the reason to be the lack of interactivity and personalized experience in the context of online learning (Oria, 2017).

With the technology, the online learning environment provides an exciting opportunity to enhance learning experience of learners by offering interactive and personalizable content. As dominant online information is visual (Carroll & Kop, 2016), properly designing visual learning tools that allow interactive and personalized learning experience can be critical for successful online learning.

Previous research and literature provide support for the importance of interactivity and personalizability in online learning effectiveness. As emphasized by online educators (Moreillon, 2015), interactivity is a key feature of online education which helps attract and retain students in online classes. Interactive online tools provide opportunities for instructors to communicate better with students and enhance students' online learning experience. While the online tools are often adopted to compensate for the loss of face-to-face interaction in a traditional education setting (Sun & Hsu, 2013), well-designed online tools not only can transfer some face-to-face teaching techniques but also can increase individual students' engagement and motivation to learn. Computer-mediated interactions can elicit students' curiosity and hedonic motivation when the learning material is interactive and engaging (Oudeyer, Gottlieb, & Lopes, 2016). Kucuk and Richardson (2019) found that a well-designed online learning interface made learners cognitively and emotionally engaged in learning and increased their satisfaction as well.

The theory of flow provides the conceptual framework of why interactive visual learning tools help students engage and actively participate in the learning process (Csikszentmihaly, 1990). The flow theory suggests that interactive visual learning tools have a high potential to engage students in the learning process as students are likely to experience flow and the effect will be greater when the students' skill matches the task difficulty (Csikszentmihaly, Abuhamdeh, & Nakamura, 2005). Interactive online learning activity with personalizable options enable learners to be more focused and engaged as they can select the learning level that matches their skills (Pandey, 2017). Ou, Joyner, and Goel (2019) also emphasized the critical role of personalized online teaching materials in stimulating learners' interest and engaging them in learning.

While previous research investigated the role of interactivity and flow in learning, a few gaps in the literature call for further investigation. The scope of the online learning literature is mostly focused on the role of human-human interaction (e.g., learner-instructor and/or learner-learner), limiting our understanding of the human-computer interaction (i.e., learner-content/interface) effects on online learning. Considering the importance of interface in online learning, Wei, Peng, and Chou (2015) urged need for expanding the scope of interactivity from human-human interaction to human-computer interaction in an online learning environment. The

current study responds to this call and investigates human-computer interaction effects on online learning. Also, interactivity and flow effects on learning from previous literature have been inconsistent, particularly in the context of internet-based learning environment (Meyer & Jones, 2013). Such inconclusive findings may be due to the fact that the majority of studies adopted self-reported surveys of learning experience (e.g., Chou, Peng, Chang, 2010; Etemad-Sajadi, 2016; Wei et al., 2015) that are prone to response biases, such as social desirability, memory biases, and an inability to detect causal relationships. In addition, while personalization is hailed as a critically important element of online interface, few scholarly journal articles examined the effect of personalization on students' online learning. To fill the gap in the area of research, the current study aims to understand the causal impact of interactivity and personalization of online visual learning tools on student's learning through a series of experiments. This study focused on understanding two key factors linked to online visual learning tools: interactivity and the balance between skill level and task difficulty (i.e., interactivity with personalizable options). Two experimental studies were conducted to investigate each element. The purpose of Study 1 was to examine the effect of online interactivity on student learning process manifested as flow experience. The focus of Study 2 was to investigate whether students' learning experience is enhanced when students could match their skill level with the task difficulty through personalization options.

Review of Related Literature

Interactivity in Online Learning

Previous research (e.g., Cho & Kim, 2013; Park, 2011; Rodriguez-Ardura et al., 2016; Wei, Peng, & Chou, 2015) has emphasized interactivity as a critical success factor of online learning because it enhances students' learning experience and their performance. The concept of interactivity used and examined in online learning literature has been varied (Domagk, Schwartz, & Plass, 2010; Wei et al., 2015). Most common type of interactivity tested in previous online learning research was the effect of human-human interaction on student learning (e.g., Chen, Chang, Ouyang, & Zhou, 2018; Luo, Zhang, & Qi, 2017; Kent, Laslo, & Rafaeli, 2016; Yeh, Rega, Chen, 2019). Human-human interactivity in the e-learning literature reported significant effects of student-instructor communication (Cheng, 2013; Luo et al., 2017: Paechter, Maier, & Macher, 2010), student-student interaction (Chen et al., 2018; Cheng, 2013; Luo et al., 2017), and peer evaluation (Yeh et al., 2019) on student online learning experience. Researchers have also emphasized the critical role of human-computer interaction in the context of online learning environment (Chou, 2003; Low, Low, & Koo, 2003; Wei et al., 2015). Previous research on human-computer interactivity were likely to focus on learner-interface interactivity, attempting to understand effects of using various new learning management systems (e.g., Wei et al., 2015). A small number of studies investigated learner-content interactivity that addresses the question of learning-specific online contents such as individualized guides, activities, and instructions.

In this study, learner-content interactivity is of the focal interest and interactivity is defined as a characteristic of an online system that allows a user to modify elements and contents of the online environment in real time (Rodriguez-Ardura & Meseguer-Artola, 2016) and provides immediate responses to the user's input (Chang & Wang, 2008). Evans and Sabry (2003) conceptualized a three-way model of human-computer interactivity in computer-mediated learning environment: computer-initiation, learner-response, and computer-feedback. Accordingly, in the

e-learning environment, students interact with online activities as they respond to the learning activity (e.g., by clicking and moving images, by answering questions, etc.) and get immediate feedback from the activity (e.g., correct answers, tips, and guidance provided). Interactive online learning tools examined in the current study was developed to incorporate this three-way interactivity.

Telepresence

In the online environment, interactivity is a critical determinant of engagement (Karageorgakis, 2018) because high interactivity of a system allows the users to be fully present in the mediated environment. This feeling or perception of being present in a simulated or mediated environment is called telepresence (Li, Daugherty, & Biocca, 2002). Telepresence is described as a user's immersive experience in a mediated environment (Steuer, 1992) and sometimes also noted as immersion in the literature (e.g., Carrozzino & Bergamasco, 2010).

Previous research in the mediated environment found interactivity of an online system is an important predictor of telepresence (Esteban-Millat, Martinez-Lopez, Huertas-Garcia, Meseguer, & Rodriguez-Ardura, 2014; Li et al., 2002; Lim & Ayyagari, 2018; Skadberg & Kimmel, 2004). For example, in a study of online advertisement, participants felt stronger telepresence when the online advertisement was interactive (e.g., Fortin & Dholakia, 2005). Likely, interactive online features such as clickable images with hyperlinks were found to increase telepresence (Coyle, Mendelson, & Kim, 2008). Therefore, H1 was hypothesized.

H1: Students who used the interactive visual learning tools will report a higher level of telepresence than those who used the one with noninteractive visual learning tools.

Flow

Flow is a subjective experience of total immersion in the activity (Csikszentmihaly, 1990) and a momentary feeling of complete engagement (Meyer, Klingenberg, & Wilde, 2016). Flow is often characterized by simultaneous experience of several dimensions: attention focus (or concentration), positive emotions such as enjoyment, joy, and pleasure, sense of control, distorted sense of time, and reduced awareness of physical surroundings and self (e.g., Rossin, Ro, Klein, & Guo, 2009). Researchers in human-computer interaction emphasized the role of flow as an important antecedent of learning in an online environment because of the interactive nature of online operations (Hoffman & Novak, 2009).

Because interactivity increases telepresence, it is likely that high interactivity also increases the flow experience. Hoffman and Novak (2009), after a review of 12 empirical studies using flow theory, reported that interactivity has both direct and indirect effects on flow. Researchers reported empirical evidence of the positive effect of interactivity on flow experience in a web-based training program (Choi, Kim, & Kim, 2007), e-learning environment (Rodriguez-Ardura & Meseguer-Artola, 2016), and online university courses (Esteban-Millat et al., 2014; Guo, Xiao, van Toorn, Lai, & Seo, 2016). In online flow experience research, the majority of researchers understood flow as a multidimensional construct and measured these multiple constructs to capture flow (Hoffman & Novak, 2009). Similarly, in this study, the core elements of the experience of flow is operationalized as (a) control, (b) attention focus, (c) curiosity, and (d) intrinsic interest following the conceptualization of Huang (2003). Therefore, H2 was formulated.

H2: Students who used the interactive visual learning tools will experience a higher level of flow (control (H2a), attention focus (H2b), curiosity (H2c), and intrinsic interest (H2d)) than those who used the noninteractive visual learning tools.

Interactivity and Learning

Interactive tools can be effective in facilitating student learning. A range of literature provides evidence that interactivity increases learning measured as test scores, understanding of concepts, retention of information (Evans & Gibbons, 2007; Wang, Vaughn, & Liu, 2011), and perceived knowledge gain (Skadberg & Kimmel, 2004; Sun & Hsu, 2013).

Interactivity of a tool can positively influence learning for several reasons. Some noted that interactive instructional tools can encourage learners to self-motivate and direct their own learning, consequently increasing learning by actively constructing knowledge (Evans & Gibson, 2007; Reiter, Lakoff, Trueger, & Shah, 2013). Others reasoned interactive tools enhance learning because they allow users to control the learning process by engaging in the learning activity at their own pace and by skipping, reviewing, and repeating the content as needed (Wang et al., 2011). Others argued the interactions within the instructional tools help engage learners in the learning process and prolong their concentration on learning (Esteban-Millat et al., 2014; Kiili, 2005). Therefore, H3 was developed.

H3: Students who used the interactive visual learning tools will perform better on a test than those who used the one with the noninteractive visual learning tools.

Utilitarian and Hedonic Value

Online information tools can provide utilitarian/instrumental value (e.g., useful information to enhance performance efficiency) or hedonic/experiential value (e.g., enjoyment) (van der Heijden, 2004). Researchers emphasized comprehensively understanding both hedonic and utilitarian values (Babin, Darden, & Griffin, 1994). In the context of learning, utilitarian value refers to the degree to which a tool provides benefits to achieve learning. Hedonic value, on the other hand, is the degree to which a tool provides emotional and entertainment benefits. Previous research emphasized the effect of interactive learning environment on learners' perceived hedonic (e.g., pleasure) and utilitarian (e.g., usefulness) value about online learning (Liaw, 2008; Liaw & Huang, 2013). Wei et al. (2015) also found that students' perceptions of online learning are highly related to teacher's design of interactive learning activities. Cheng (2013a) who longitudinally examined the effect of interactivity features in the context of e-learning environment found that online interactive features (e.g., responsiveness, personalization, etc.) positively influenced learners' perceived usefulness and enjoyment of e-learning system. Similarly, when the students use an interactive visual learning tool, they are more likely to find the learning tool to be useful and fun because the tool not only effectively provides contents (i.e., utilitarian value) but also inherently possesses the ability to dynamically change in response to the user input. Therefore, H4 was formulated.

H4: Students who used the interactive visual learning tools will perceive a higher level of utilitarian (H4a) and hedonic value (H4b) than those who used the noninteractive visual learning tools.

Personalization: Skill-Challenge Level

Csikszentmihaly et al. (2005) identified three important preconditions for flow experience: clarity of the goal, clear and immediate feedback, and the skill-challenge balance. The interactive

visual learning tools can be designed to satisfy the first two conditions. The students are usually given a clear objective for learning (i.e., to accomplish the task and learn the materials) and the interactivity provides immediate and clear feedback on the student's input. However, the last condition is dependent on individual student's ability (e.g., prior knowledge). While learning activities are designed to offer a reasonable level of challenge for students, the balance can only be achieved when the students are properly prepared for the given task. According to the model of flow (Csikszentmihaly & Csikszentmihaly, 1988), when the challenge and skill do not match, the individuals will feel anxiety (low skill-high challenge), boredom (high skill-low challenge) or apathy (low skill-low challenge). In a meta-analysis study of antecedents of flow, Fong, Zaleski, and Leach (2015) found the skill-challenge balance to be a strong antecedent of flow among nine antecedents investigated. Therefore, in order to make students fully engage in online learning and experience flow, the skill-challenge balance should be achieved. Guo and colleagues (2016) empirically showed that the skill-challenge balance positively influenced flow that students experienced during online learning.

While previous studies relied on self-reported perception of skill/challenge balance by measuring either perceived skill/challenge level and comparing two scores to determine the balance (e.g., Fullagar, Knight, & Sovern, 2013) or measuring the perceived balance itself (e.g., Engeser & Rheinberg, 2008), the current study attempted to achieve the balance by providing varying degrees of task challenge options (i.e., personalization option). It is assumed that the individuals would find the balance between their skill level and the task challenge if they could choose from easy, medium, and hard difficulty level tasks. When multiple difficulty levels are offered, individuals can personalize the difficulty level to match their skill level. This way, many individuals with different levels of skill can find the balance and satisfy the precondition of flow, and therefore, are likely to experience flow. Hence, H5 was developed.

H5: Students in the personalizable difficulty condition will experience a higher level of flow (control (H5a), attention focus (H5b), curiosity (H5c), and intrinsic interest (H5d)) than students in the fixed difficulty condition.

Since personalized online learning activity empowers students to choose their own learning path that is right for their skill level, it helps students manage what they learn and better perform in the given task (Pandey, 2017). Skadberg and Kimmel (2004) found that website visitors learn contents better when the skill and challenge level was balanced. Wang et al. (2011) found that animated online interactivity that allows students to personalize the input levels to generate a different visual presentation significantly enhanced students' understanding of the contents covered in the online lecture. Personalized virtual learning environment was also found to significantly improve learners' performance in final exam (Xu & Wang, 2006). Accordingly, H6 was formulated.

H6: Students in the personalizable difficulty condition will perform better on a test than students in the fixed difficulty condition.

When the balance is achieved, learner performance and perceived hedonic and utilitarian value are expected to be also enhanced. Learners are likely to perceive an interactive tool as helpful in increasing their performance when there is personalization option. Hoffman and Novak (1996), in their seminal work, theorized the skill-challenge balance leads to positive subjective experience and exploratory mindset. These intrinsic motivations are directly connected to hedonic values. Empirical research supported the positive effect of skill-challenge balance on utilitarian and

hedonic values. Cordova and Lepper (1996) in their experimental research found that individually personalized computer activities significantly enhanced students' engagement in learning, perceived competence, and hedonic motivation. In the experimental research, Xu and Wang (2006) found that personalized online learning materials positively influenced students' perception of system usefulness and hedonic motivation. Guo and colleagues (2016) empirically showed that the skill-challenge balance indirectly influenced perceived utilitarian and hedonic value of an online course. Thus, H7 was developed.

H7: Students in the personalizable difficulty condition will perceive a higher level of (H7a) utilitarian (i.e., usefulness) and (H7b) hedonic value (i.e., enjoyment) than students in the fixed difficulty condition.

Personalizable learning tools are likely to increase learner satisfaction with the learning activity. When the learner can match the task difficulty with their skill level, they are able to reduce negative emotions such as anxiety or apathy and are encouraged to engage in learning. Such an experience is likely to create positive learning experience and increase satisfaction. Online learning research found that e-learning interface with various presentation types improved learner satisfaction (Liu, Liao, & Pratt, 2009). Özyurt and Özyurt (2015) content-analyzed 69 articles on individualized adaptive e-learning published between 2005 and 2014 and concluded that the most robust findings from the literature was the positive outcome of learner satisfaction, usability, and preferability. Out of 69, 18 studies investigated and reported significant effect of adaptive e-learning (i.e., personalized teaching tools based on students' learning style) on learner satisfaction. Therefore, it is also anticipated that the skill-challenge balance positively affects user satisfaction because the flow experience leads to a positive mood and an enhanced feeling of satisfaction (Hoffman & Novak, 1996). Therefore, H8 was formulated.

H8: Students in the personalizable difficulty condition will show a higher level of satisfaction than students in the fixed difficulty condition.

Study 1

The purpose of Study 1 was to test effects of interactivity on online learning. Study 1 is designed to test H1 through H4.

Method

Experimental stimuli development. To test the effect of interactivity on student online learning experience, a single factor, two-level (Interactivity: Yes/No), between-subjects experiment was designed. For the manipulation of interactivity, two versions of an online instructional website on color theory were developed: one with noninteractive visual contents and the other with an interactive visual learning tool that allows dynamic manipulation of visual contents. Both websites contained basic explanations for key concepts of color theory: hue, value, intensity, and color schemes. The noninteractive visual learning tool was one long webpage with written information about color theory and still images to illustrate the concepts without interactive features embedded. Thus, students scrolled down the webpage to read and learn the materials. The interactive visual learning tool was an embedded interactive flash object that presents the same content. Students could click tabs, buttons, and checkboxes to open or collapse the content and to interact with the educational contents. As students interact with the learning tool, the flash object

modifies its content in response to the user input. See Figure 1 for sample screen shots of the interactive visual learning tool used in Study 1.

Instrument development. Eight telepresence items, adapted from Kim and Biocca (1997), were measured using 5-point Likert scales. To measure students' flow experience during the learning activity, four constructs associated with flow were measured using 5-point Likert scales. Three items were used to measure each of four flow constructs: control, attention focus, curiosity, and intrinsic interest (Nel, van Niekerk, Berthon, & Davis, 1999). Utilitarian value, operationalized as perceived usefulness (Davis, Bagozzi, & Warshaw, 1992), was measured using four items (e.g., "The online activities like the color theory exercise would improve my learning productivity"). Hedonic value, operationalized as perceived enjoyment (Childers, Carr, Peck, & Carson, 2001), was measured using eight items (e.g., studying with the online activities would be fun for its own sake). Both measures used 5-point Likert scales. The inter-item reliability of measurements was checked by Cronbach's alpha and all showed good reliabilities (Cronbach's $\alpha > .70$). Multi-item measurements were averaged to get single scores.

Sample and procedure. Forty-five undergraduate students participated in the experiment for extra credits. This experiment was done in a lab setting to minimize the effect of other miscellaneous environmental factors (e.g., technology types, computer specification, internet speed, time spent, etc.) on dependent measures. In the computer lab, students were asked to learn the materials by exploring the assigned website for 10 minutes. Students were randomly assigned to either the interactive ($N = 24$) or the noninteractive site ($N = 21$). After the 10 minutes, students were given a survey questionnaire which included items measuring flow experience and telepresence while browsing the site, and utilitarian and hedonic values of using the online learning tool. Students were also asked to provide demographic information (age, ethnicity, year in college) and previous experience with online learning tools. Upon the completion of the activity, students completed a short quiz on color theory consisting of six questions. The quiz scores were used to measure actual student learning after the completion of the online activity.

Results

Description of participants. Participants' ($N = 45$) mean age was 20.73, with a range of 18 to 26. Hispanic American was the single largest group accounting for about 35.6% of participants. Other participants were Caucasian-American (28.9%), African-American (8.9%), Asian/Asian-American (17.8%), and other (6.7%). Most participants were sophomores (46.7%) and juniors (37.8%). The number of freshmen (4.4%) and seniors (8.9%) was small. The majority (80% of participants) claimed that they have previously used online learning tools, such as a study guide or other online activities in four classes or more.

Hypotheses testing. Multivariate analysis of variance (MANOVA) was used to test the effects of interactivity on various dependent measures. The results showed a significant multivariate main effect of interactive online activity on dependent measures (F [8, 36] = 5.426, $p < .0001$). Univariate analysis of variance (ANOVA) was also analyzed to test each hypothesis proposed in Study 1 as follows.

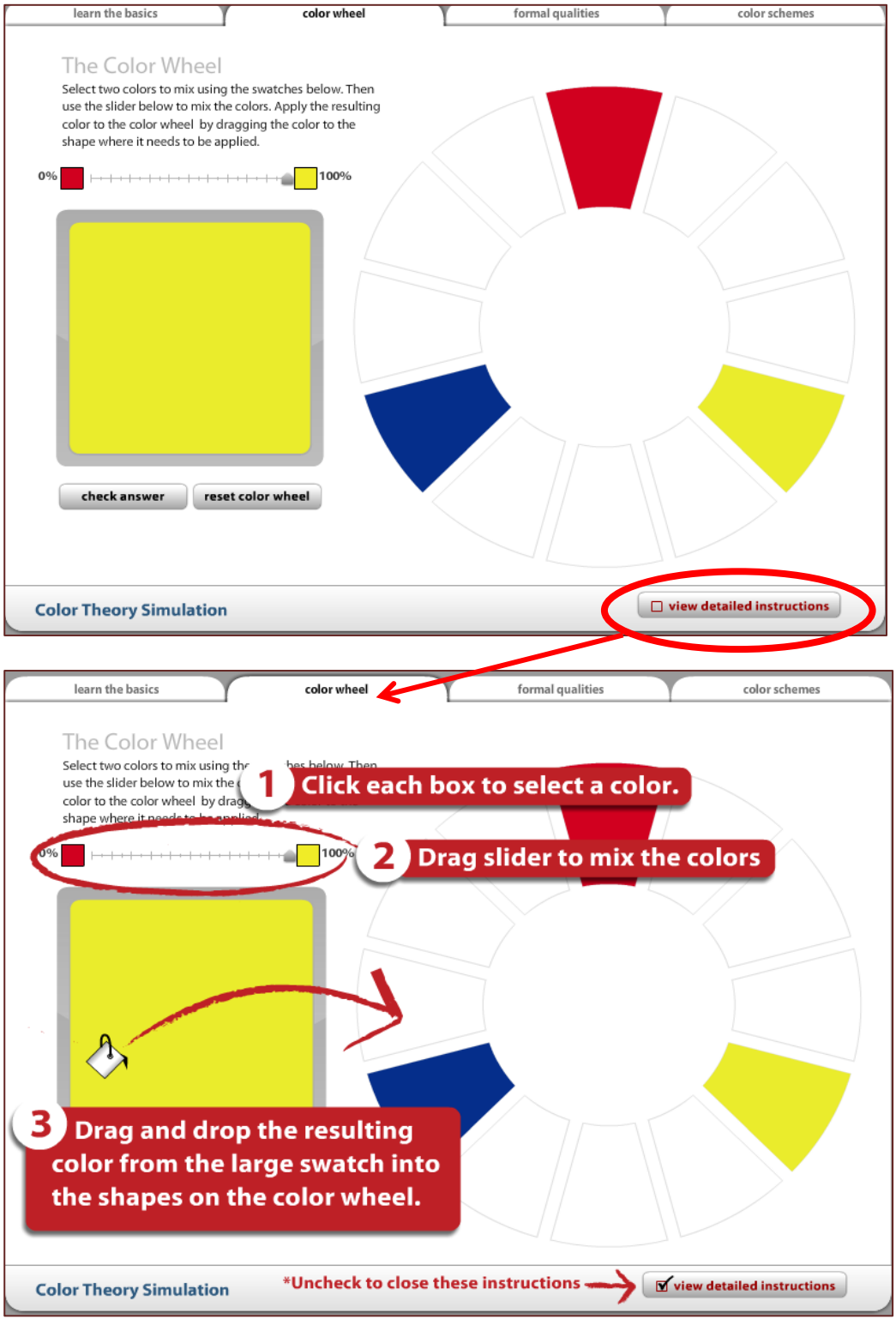


Figure 1. Sample screenshot of the interactive visual learning tool used in Study 1.

Hypothesis 1. ANOVA found a significant main effect of interactivity on telepresence (F [1, 43] = 15.729, $p < .0001$). Students in the interactive condition showed significantly higher mean scores for telepresence ($M = 2.99$, $SD = .983$) than those in the noninteractive condition ($M = 2.02$, $SD = .570$). The result indicates that interactive visual imageries used in the online activity contributed to telepresence. Thus, H1 was supported.

Hypothesis 2. ANOVA revealed a significant main effect of interactivity on attention focus (F [1, 43] = 10.608, $p < .001$), curiosity (F [1, 43] = 14.053, $p < .001$), and intrinsic interest (F [1, 43] = 26.969, $p < .0001$), supporting H2b, H2c, and H2d. Students in the interactive condition showed significantly higher mean scores than those in the noninteractive condition for attention focus (interactive: $M = 3.34$, $SD = .726$, noninteractive: $M = 2.60$, $SD = .807$), curiosity (interactive: $M = 3.88$, $SD = .679$, noninteractive: $M = 3.13$, $SD = .654$), and intrinsic interest (interactive: $M = 4.03$, $SD = .629$, noninteractive: $M = 3.05$, $SD = .635$). However, control did not show a significant difference between groups, rejecting H2a. Although the difference was not statistically significant, mean scores showed the direction consistent with our prediction (interactive: $M = 3.68$, $SD = .641$ vs. noninteractive: $M = 3.41$, $SD = .893$).

Hypothesis 3. A significant main effect of interactivity on student's actual performance in the test was also found (F [1, 43] = 35.110, $p < .0001$). An inspection of the cell means revealed that students in the interactive condition performed significantly better in the quiz (interactive: $M = 5.33$, $SD = 1.049$ vs. noninteractive: $M = 3.38$, $SD = 1.161$). Thus, H3 was supported. The results indicate that the interactive visual learning tool used for the online activity could enhance student learning.

Hypothesis 4. ANOVA revealed a significant main effect of interactivity on utilitarian (F [1, 43] = 18.161, $p < .0001$) and hedonic value (F [1, 43] = 7.334, $p < .01$). An inspection of the cell means revealed that students in the interactive condition perceived the online activity more useful and enjoyable (utilitarian: $M = 4.50$, $SD = .659$, hedonic: $M = 4.01$, $SD = .601$) than those in the noninteractive condition (utilitarian: $M = 3.68$, $SD = .628$, hedonic: $M = 3.51$, $SD = .619$). Thus, H4a and H4b were supported.

Study 2

The purpose of Study 2 was to test effects of skill and challenge balance on flow and learning. Study 2 is designed to test H5 through H8.

Method

Experimental stimuli development. To examine the effects of skill-challenge balance on flow experience, a single factor, 2-level (personalizable difficulty vs. fixed difficulty) between-subjects design was used. It is assumed that student skill level and task difficulty would be more likely to match when the students have an option to personalize the level of task difficulty. Therefore, two interactive visual learning tools, one with three personalizable difficulty levels and the other with a fixed difficulty level, were developed.

The learning tools had multiple tabs for providing concepts and theory explanation and for application activities. Both tools contained the identical theory information tab that provided written information on the basic color theory with proper visual examples and interactive features to assist understanding of the basic concepts. Both learning tools presented an interactive activity tab that was designed to help students understand various color relationships using Munsell color

chart. Students were able to drag and drop color chips in the correct order on a two-dimensional chart with the x-axis representing intensity or chroma and the y-axis representing value of a hue. The activity could be repeated for four different hues and students could select one hue at a time.

Two learning tools differed in the availability of difficulty selection options. For the tool with the personalizable option, students were able to choose a difficulty level out of three options (i.e., easy, medium, and hard) using a drop-down menu. The easy, medium, and hard levels (see Figure 2 for three difficulty levels) presented 8–15, 18–28, and 61–93 color swatches to be placed in the chart, respectively. The exact number of color swatches varied based on value and intensity of the selected hue. The activity with the fixed difficulty option presented the medium difficulty level only with 18–28 color swatches (see Figure 2 for the medium difficulty option).

Sample and procedure. One hundred and forty undergraduate students from four sections of the same course taught in two large universities participated in the experiment for extra credits. In a computer lab, students were randomly assigned to one of the experimental conditions (personalizable [$N = 72$] vs. fixed difficulty [$N = 68$]) and were asked to learn the materials and explore the online activity for 20 minutes. Students were directed to view the basic information tab first to learn about the color theory, and then to complete the interactive online activity through which students created a value/intensity color chart. Upon the completion of the activity, students were asked to complete a survey questionnaire online, which included items measuring four flow constructs, utilitarian and hedonic values of using such activities, and satisfaction. Students ($N = 50$) from one university also completed a short test to measure the effect of skill-challenge balance on learning. Test scores were used to examine students' actual performance after the activity. Students in the other university could not complete the test due to the limitation of course schedule. Demographic information (age, ethnicity, year in college) and four questions regarding previous experience with the online learning tools were also collected.

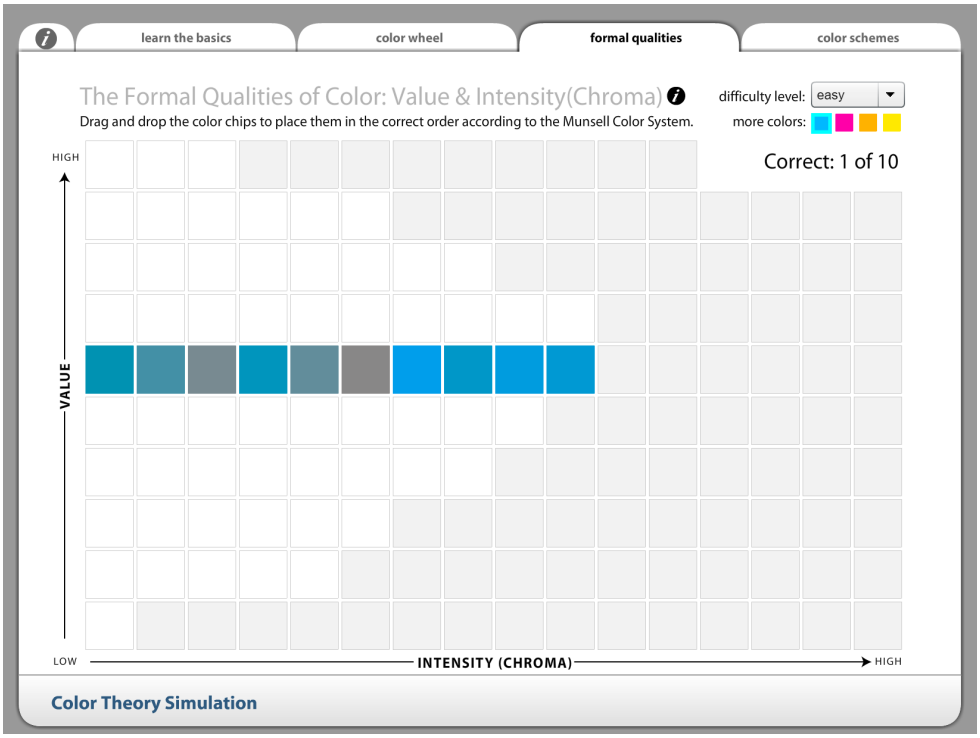
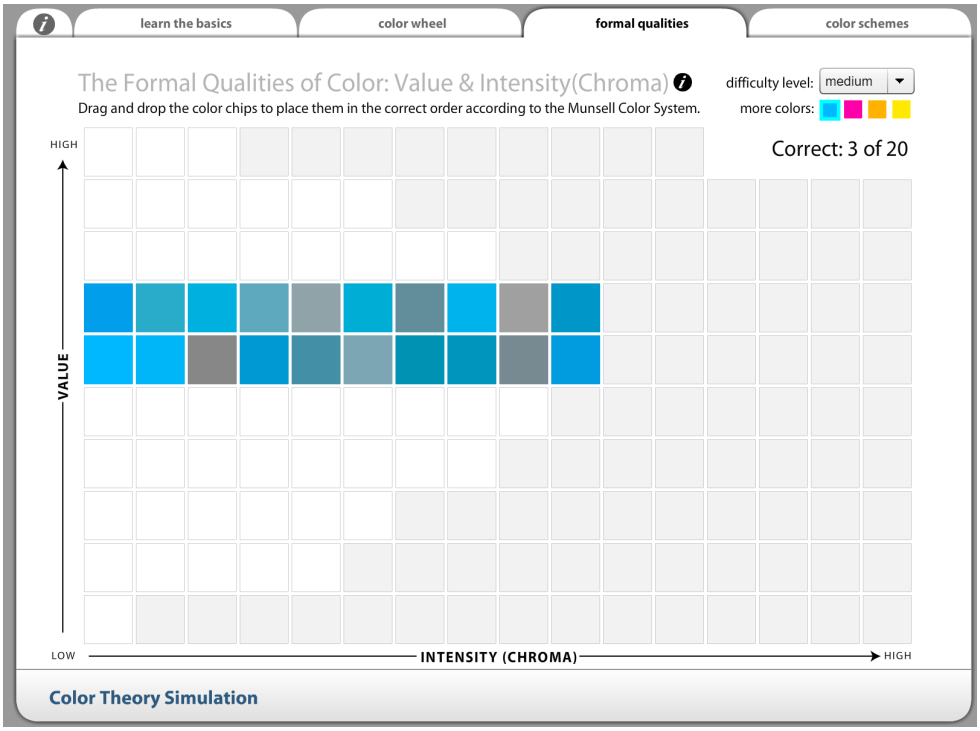


Figure 2a. Three difficulty levels manipulated in Study 2: Easy



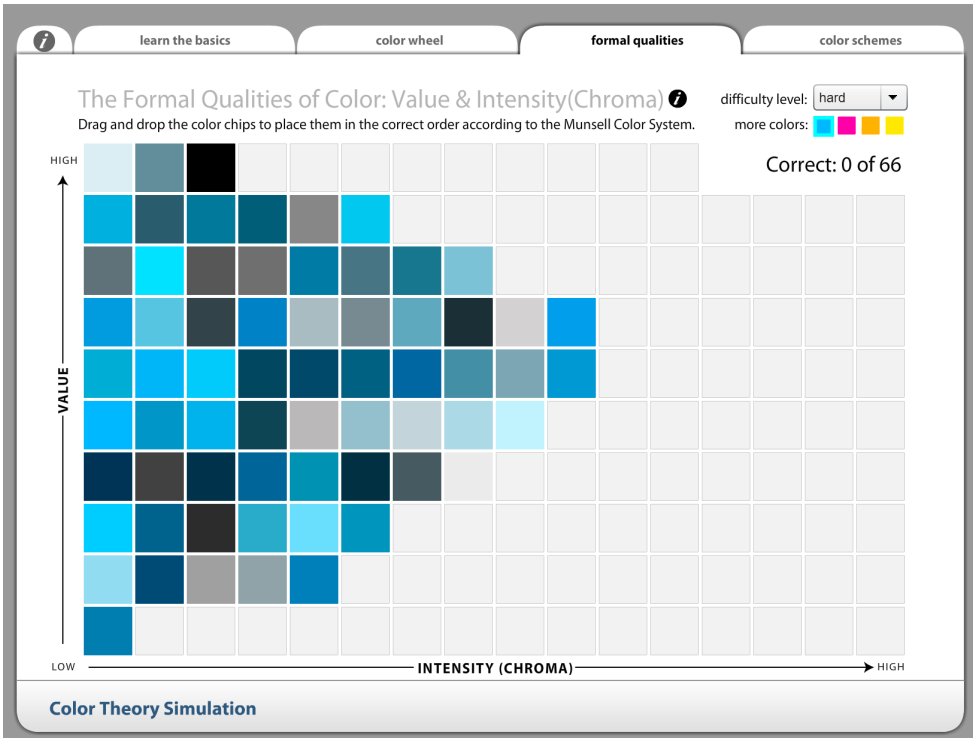


Figure 2b. Three difficulty levels manipulated in Study 2: Medium (top), Hard (bottom)

Instrument development. The same items used in Study 1 were used to measure flow experience and utilitarian/hedonic values. Three overall satisfaction items (e.g., Do you like the online activities like XXX?) were added to Study 2 and measured using 5-point Likert-type scale (Not at all to Very much). The inter-item reliability of measurements was checked by Cronbach's alpha and all showed good reliabilities (Cronbach's $\alpha > .702$). A multi-item measurement was averaged to get a single score to test hypotheses.

Results

Description of participants. The mean age of participants (N = 140) was 21.5, with a range of 18 to 39. Caucasian American was the single largest group accounting for about 68.6% of participants followed by Asian American (12.9%), Hispanic American (10.7%), African American (2.1%), and other (5.7%). Most participants were seniors (66.4%), with about equal numbers of juniors (15%) and sophomores (14.3%). Freshmen (4.3%) were small. The majority (over 70%) of participants had often used the online learning tools to obtain course information (e.g., lecture note, grades) and to use for the group discussion.

Hypotheses testing. Multivariate analysis of variance (MANOVA) was used to test the effects of personalizable difficulty level option on various dependent measures. The results showed a significant multivariate main effect of personalizable difficulty-level option on dependent measures (F [7, 125] = 2.292, $p < .05$).

Hypothesis 5. Univariate analysis of variance (ANOVA) revealed a significant main effect of personalizable difficulty level option in the interactive activity on curiosity (F [1, 131] = 4.823, $p < .05$) and intrinsic interest (F [1, 131] = 10.09, $p < .005$), supporting H5c and H5d. Students in the condition with three personalizable difficulty-level option showed significantly higher mean scores for curiosity (personalizable: M = 4.02, SD = .644 vs. fixed: M = 3.74, SD = .809) and intrinsic interest (personalizable: M = 4.13, SD = .624 vs. fixed: M = 3.75, SD = .766) than those in the fixed condition. However, control and attention focus did not show a significant difference between groups, rejecting H5a and H5b.

Hypothesis 6. The result of ANOVA revealed no significant difference between two groups in terms of actual test scores (F [1, 48] = 2.97, p = .09), rejecting H6. This result suggests that the availability of personalizable difficulty-level option in the interactive online activity did not influence students' actual performance on the test.

Hypothesis 7. ANOVA results showed a significant main effect of personalizable difficulty level option in the online activity on hedonic value (F [1, 131] = 6.048, $p < .05$) but not significant on utilitarian value (F [1, 131] = 3.272, p = .073). Cell means also revealed that students perceived the interactive online activity with the personalizable difficulty level option more enjoyable (M = 4.05, SD = .502) than the activity with the fixed option (M = 3.80, SD = .677). Thus, only H7b was supported.

Hypothesis 8. A significant main effect of personalizable difficulty level option on student's satisfaction toward the interactive online learning activity was also found (F [1, 131] = 4.839, $p < .05$). This indicates that students found the interactive online activity with personalizable difficulty level option more favorable than the one with the fixed option (personalizable: M = 4.42, SD = .574 vs. fixed: M = 4.15, SD = .819). Therefore, H8 was supported.

Table 1

Mean (M) and Standard Deviation (SD) Scores for Different Conditions in Study 1 and Study 2

	Study 1				**Study 2**			
	No Interactivity		**Interactivity**		**Fixed Difficulty Level**		**Three Difficulty Levels**	
Dependent Variables	M	SD	M	SD	M	SD	M	SD
Control	3.41	.893	3.68	.641	3.90	.682	3.89	.644
Attention Focus	2.60	.807	3.34	.726	3.33	.878	3.47	.707
Curiosity	3.13	.654	3.88	.679	3.74	.809	4.02	.644
Intrinsic Interest	3.05	.635	4.03	.629	3.75	.766	4.13	.624
Intrinsic Motivation	3.51	.619	4.01	.601	3.80	.677	4.05	.502
Extrinsic Motivation	3.68	.628	4.50	.659	4.21	.804	4.45	.734

Note. All items were measured using 5-point Likert scale.

Discussion and Conclusion

Contribution of the Study

The current study empirically investigated effects of the interactive visual learning tools on student learning experience and performance through two experiments. The findings of the study contribute to the literature of human-computer interaction in the context of online learning. Based on the theory of flow, the current study highlighted the potential of the interactive visual learning tools for teaching visual contents online. The study is also a response to a call for empirical testing of human-computer interaction effect on student online learning (Wei et al., 2015). Additionally, this study makes contribution to the literature of e-learning by testing two important characteristics of online learning tools, interactivity, and personalizable options for skill-challenge balance, that positively lead to flow experience, learner perception, and performance. It is noteworthy that this study provides evidence for causal effects of interactivity and personalization through controlled experiments while many studies inferred the effects through correlations between learner's self-reported perception and academic performances (e.g., Chou et al., 2010; Etemad-Sajadi, 2016; Wei et al., 2015).

Effect of Interactivity on Telepresence, Flow, and Learning

The purpose of Study 1 was to investigate the effect of the interactive visual learning tools on students' learning process. Similar to the prior research (Lim & Ayyagari, 2018) suggesting interactivity as a major antecedent of telepresence in the context of e-commerce setting, this study demonstrates the significant effect of interactivity on telepresence in the online learning environment. This result demonstrates the critical role of dynamic, real-time interactivity in improving students' learning by reducing awareness of physical surroundings.

Consistent with previous research (Esteban-Millat et al., 2014; Rodriguez-Ardura & Meseguer-Artola, 2016), the result of this study also supports that the interactive visual learning tools augmented students' flow experience in the context of an e-learning environment. The result reveals that students who used the interactive visual learning tools experienced a higher level of flow (attention focus, curiosity, intrinsic interest) than those who used the noninteractive one. This

implies that interactive visual learning tools can facilitate student's active learning process by increasing attention, curiosity, and interest about the online activity. Therefore, to enrich student learning experience in the online learning environment, it is of greatest importance to incorporate interactivity by means of dynamic visualization into online instructional materials. This can be more beneficial when students learn abstract concepts, particularly in the context of online learning environment where students easily lose their attention and interest on lecture materials.

This study also confirms that the interactive visual learning tools contribute to learning, which was evidenced by higher test scores for the interactive group than for the noninteractive group. Previously published studies have reported mixed findings related to effects of interactive learning tools on performance. Some found supporting evidence for positive effects of interactive learning tools (e.g., Sharp & Hamil, 2018) while others failed to confirm the effect (Wei et al., 2015). According to Wang et al. (2011), this inconsistency might be because levels or types of learning examined in previous studies were not consistent. Wang et al. (2011) found that animated interactivity is more effective for the intermediate level of learning (i.e., understanding concepts) than for the lowest (i.e., remembering) or highest level of learning (i.e., high level applying). Since the current study employed the interactive activity to help students understand the concept of color theory, the learning activities students were engaged in can be in the intermediate level of learning. Thus, our result corroborates Wang et al.'s (2011) findings. When developing an interactive online learning activity, online content developers or instructors are necessary to consider levels or types of learning students should achieve.

Effect of Personalized Interactivity on Flow and Satisfaction

Study 2 tested how the interactive online activity with personalization (i.e., three difficulty level options to achieve skill-challenge balance) influences students' learning experience. As expected, students experienced significantly higher level of curiosity and interest about the online activity when three difficulty-level options were available than when one fixed option was available. Once the balance between students' skill level and task challenge in the online activity is achieved, students tend to experience higher level of flow elicited by higher curiosity and interest about the online activity. This result is consistent with the previous research (Guo et al., 2016) that found the significant impact of perceived balance between challenge and skill level on flow experience in online learning.

However, inconsistent with the hypotheses, the influence of the skill-challenge balance on level of attention focus was not significant. The effect could have been minimal because both conditions presented very interactive tools with dynamic visualizations. When compared with the noninteractive group in Study 1, both personalizable and fixed difficulty groups in Study 2 experienced fairly high level of attention focus (see Table 1 for mean scores). It is possible that the availability of online interactivity has a stronger effect on level of attention focus than the availability of personalizable difficulty level options. In addition, Engeser and Rheinberg (2008) found that perceived importance of the task moderates effects of the skill-challenge balance on flow experience. Therefore, it is possible that when the students feel the task is important, the effects of the balance may be attenuated because their goal to achieve the end outcome predominantly determines their level of flow.

Although no significant difference was found in terms of test scores between two groups, students' overall satisfaction with the online activity was significantly higher for the group with personalizable difficulty-level option. This finding is in line with results of a previous study that

reported perceived balance of challenge and skill only affects satisfaction but not perceived learning of subject matter or actual performance (Rossin et al., 2009). Rossin et al. (2009) argued that this might be because of an intrinsic reward associated with tasks performed. As demonstrated earlier in the current study, personalized difficulty options induced higher curiosity and interest for students and influenced satisfaction. The results imply that the online task performed serves as its own intrinsic reward (i.e., satisfaction) at the moment of first use and therefore no need for an extrinsic reward (e.g., test score improvement) to continue adopting the task. Wei et al. (2015) claimed that once the task is adopted and used frequently, performance score will be improved as well.

Control in Online Learning

For both Study 1 and 2, effects of interactivity and skill-challenge balance on control were not supported. Although mean scores showed the direction consistent with our prediction, control was not statistically different between two experimental conditions in Study 1. Similarly, the mean scores of control for the personalizable difficulty group and the fixed difficulty group were statistically same. Control is a feeling that one is in control of their own action and the interactions at the moment (Koufaris, 2002) and is an important element of flow experience. However, it could be that the students in all conditions felt equally in control of their actions because the context of the experiment was online learning and they were left to explore the learning tools on their own. Regardless of their experimental conditions, whether they were using the interactive tool or not, or working on the activity with the personalizable difficulty levels or not, the students were given the time, space, and the computer to play with the learning tool. Therefore, in the context of online learning, control may be not as important as some other dimensions of flow. Consistent with this logic, Fong et al. (2015), after analyzing 46 studies specifically investigating the relationships between skill-challenge balance and flow, concluded that the skill-challenge balance effects on flow is weakest in work or education contexts (vs. leisure or personal contexts). Fong et al. (2015) also noted the skill-challenge balance seemed to be more important for older populations (i.e., aged 30 and over). This implies that personalization effects on feeling of control may be stronger for older people. Because our study sample is a younger group of students in their early 20s, the effects could have been attenuated.

Hedonic and Utilitarian Values

Consistent with previous research (Cheng, 2013a), the result of Study 1 supported that students exposed to the interactive visual learning tools perceived the online activity more useful (utilitarian value) and enjoyable (hedonic value) than those exposed to noninteractive visual learning tools. The result confirms the critical role of human-computer interactivity in enhancing students' hedonic and utilitarian motivation to use online learning tools. It is important for online instructional designers to utilize interactive online contents that are more useful and enjoyable, which will cultivate learners' involvement in learning.

As demonstrated in Study 2, students perceived higher level of hedonic value about the online activity when they were able to balance the task-challenge level with their own skill level. Students tend to enjoy the online learning activity more when they have personalizable options to choose the challenge level than when they have no option. This result supports Cordova and Lepper (1996) who found the significant impact of personalization and choice on students' perceived hedonic value (i.e., enjoyment) in the process of learning. Both Studies 1 and 2 demonstrate that interactivity and personalizability play important roles in motivating students hedonically.

Although no statistically significant difference was found in terms of perceived utilitarian value, as revealed in the cell mean comparisons (see Table 1), students were likely to perceive the online activity with personalizable options more useful than the one with the fixed option. More importantly, both conditions showed high usefulness mean scores, indicating that students tend to perceive the interactive online activity, whether it was personalizable or not, highly useful and valuable for their learning productivity. Similarly, Wang et al. (2011) found that three levels of animated interactivity (i.e., low to high interactivity) did not change students' perceived usefulness of the activity used. More importantly, students in all three interactivity treatment groups in Studies 1 and 2 showed higher perception scores than the control group (i.e., no interactivity group in Study 1). Therefore, it is possible that the availability of dynamic visual interactivity contributes more to students' perceived utilitarian value than that of personalization options (or higher level of interactivity). Results from two experiments suggest that online interactivity is a major determinant of both hedonic and utilitarian values and achieving a skill-challenge balance with personalizable options is also considered important for perceived hedonic value. This implies that as long as dynamic interactivity exists in the online learning context, students would perceive such activities as useful and enjoyable for e-learning process. However, for engagement and intrinsic motivation, hedonic value can be particularly important. Therefore, online course designers are advised to offer appropriate task challenge options based on learners' inherent skill level to enhance their interest in online learning process.

Limitations and Future Studies

Although this study contributes to the understanding of students' learning process established by flow experience in the context of online learning environment by employing real online activities in two experimental studies and by measuring actual test scores upon the completion of each activity, there are a few limitations to be addressed. To minimize effects of other confounding factors (e.g., internet access/speed, computer specification and types, etc.) on dependent measures, both studies were done in the lab setting with limited time given to students. Therefore, interpretation and generalizability of the findings should be done with caution. It is possible that results of this study would be slightly different from the current study when various personal and situational factors (e.g., computer or mobile devices used, internet speed, time spent on activity, other environmental factors, etc.) are introduced. Thus, replications of the current study in various settings such as an online experiment in the future are necessary to understand combined effects of various factors. Also, the current study used two versions of a single content learning object to test the interactivity and personalization effects. Conducting studies with similar online learning materials will be meaningful to test the robustness of the effects across multiple interactive learning tools. In future studies, it is also important to examine how personal differences in learning styles affect students' performance and responses to this type of interactive online learning activity, particularly with customizable options, because not everyone learns in the same way.

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Using Structured Pair Activities in a Distributed Online Breakout Room

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Abstract
With the increasing availability of synchronous video-based breakout rooms within online courses, a growing need exists to understand how to best leverage this technology for enhanced online education. To help address this challenge, this paper reports on a case study that explored student activity within online video-based breakout rooms via a Structured Paired Activity (SPA) methodology. SPA, which is adapted from the concept of Paired Programming, defines a general way to structure roles and activities for the participants within the breakout room. Initial qualitative results suggest that the use of SPA in online breakout rooms increases student engagement and process effectiveness. These results are potentially applicable to a broad range of web-based synchronous online courses.

Keywords: online education, synchronous distance learning, breakout rooms

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Using Structured Pair Activities in a Distributed Online Breakout Room

With the continued growth of online education (Allen & Seaman, 2013), and the increasing ability for instructors to use video conferencing tools to share computer screens and documents, a growing need exists to understand how to best leverage these technologies in order to enhance online education. One method of learning often available within this type of web-based learning environment is a breakout room, a form of peer collaborative learning where students synchronously work together in small groups. A breakout session is an active learning technique designed to engage a small group in solution of a problem outside of the larger class meeting (Lougheed et al., 2012). Breakout sessions have been a staple of face-to-face class sessions, and more recently have been employed in both asynchronous and synchronous online courses (e.g., Chandler, 2016; Martin and Parker, 2014).

Collaborative learning benefits when using breakout sessions have been demonstrated in many studies. These benefits include deeper learning, better grades, longer retention of information, greater communication and teamwork skills, and a better understanding of the professional environment in which students will work (Oakley et al., 2004). But Oakley and her colleagues caution that these benefits are not automatic. Kuhn (2015) warns that "cognitive collaboration with peers does not always yield identifiable benefits, and whether it does or not appears to depend on who is learning what and under what conditions" (p. 46.) Others have

observed that students often have difficulties coordinating their interactions and achieving the benefits of peer collaborative learning when left to their own devices (Hesse, Garsoffky, & Hron, 1997; cited by Weinberger, 2011). Hence, to achieve the benefits of peer collaborative learning, instructors must create an effective classroom structure for teamwork. This challenge, of how to design synchronous video-based breakout room student interaction, is especially acute since, in this type of breakout room environment, the instructor may not able to actively monitor all the breakout rooms at the same time. In the face-to-face classroom, an instructor can more easily observe, at least at a high level, all the team interactions at once.

To address the challenge of how to effectively use such rooms, this paper explores one approach to structuring the activities in online breakout rooms. Specifically, it reports on a case study observing two semesters of an introductory data science course that used a structured methodology within its virtual breakout rooms. This approach, described as a Structured Paired Activity (SPA) methodology, is loosely based on Pair Programming (PP), in which two programmers work together at one keyboard. SPA can be considered a form of a collaborative script designed to provide learners with a specific socio-cognitive structure that maps their roles and interactions (Weinberger, 2011), and thereby overcomes some of the difficulties observed in unscripted peer collaboration.

This case study was done within a data science course. Data science integrates concepts across a range of fields, including computer science, information systems, software engineering, and statistics. It combines basic computer coding with iterative problem-based discussions to understand the goals of the effort, the knowledge needed to reach the goals, and the best approach to solving the problem at hand. For these reasons, a data science course is an appropriate domain to evaluate the use of this more structured process. While this case study was done within a data science course, an additional goal of this research was to understand the potential applicability of SPA in breakout rooms to other domains.

The case study compared team behavior when using SPA to behavior when students were left to their own devices on how to work in virtual breakout rooms. It also explored how graduate data science students perceived the utility of using SPA in breakout rooms. Specifically, this research focused on the following questions:

RQ1: How does student team behavior change when using SPA, compared with unscripted collaboration?

RQ2: Do students perceive SPA as being a useful structuring mechanism within virtual breakout rooms?

This paper begins by describing previous research related to breakout rooms. Then a description of SPA as well as an explanation of the methodology used in the case study is discussed. This is followed by a review of the findings from the case study. Finally, a concluding discussion includes possible next steps and limitations.

Review of Related Literature

This section first reviews the general topic of distributed synchronous group learning, which has been in existence for almost twenty years. Next, research with respect to the use of video-based breakout rooms is discussed. This is followed by a review of pair programming and more importantly, distributed pair programming.

Emerging and Scripted Role Assignments in Distributed Synchronous Collaborative Learning

There has been significant research on the use of distributed synchronous group learning, much of it occurring when basic synchronous computer mediated communication technology was first realized, approximately fifteen years ago. While there were many technical challenges, such as network bandwidth limitations, these research efforts typically focused on how an instructor should interact with a class during a synchronous online session. Of course, much of that computer mediated communication was hindered by the lack of audio and video capabilities (Wang, 2004). Despite these technology challenges, there was still a research focus on distance-based group collaboration. Generally, case studies (e.g., Chen, Ko, Kinshuk & Lin, 2005), found that online synchronous live instruction could be valuable to students. However, when examining synchronous collaboration in a chat environment, Pfister & Mühlpfordt (2002) noted that "lack of coordination and coherence among contributions is a typical problem" and found that establishing scripts within the chat environment helped provide some structure and improved student learning.

As the technology improved, it was noted that students, while skilled at watching videos, still lacked the knowledge of how to collaborate in a formal synchronous learning environment (Cole, 2009). Perhaps even more important, Warden, Stanworth, Ren & Warden (2013) culminated nine years of research evaluating synchronous learning environments and found that issues were typically not due to technology, but rather, from human behavior, and observed that "while students are familiar with virtual worlds and video meetings, they are inexperienced as virtual learners." Since scripts were shown to improve synchronous collaboration in the chat environment, scripts may also be a useful approach to help students overcome their inexperience as online collaborative learners using other synchronous technologies. Weinberger (2011) suggests that scripts can help learners engage in activities that are related to knowledge construction, reduce process losses in complex collaborative learning arrangements by taking over coordination tasks not inherently related to learning, and can make learners aware of the different responsibilities within the group and thereby facilitate beneficial motivational states and self-regulation.

One scripting approach that has shown promise is the use of scripted role assignments. Within this context, roles are defined as stated functions and/or responsibilities that guide students' behavior and group interaction, and scripted role assignments specify and externalize the roles expected from learners during collaboration (Strijbos and Weinberger, 2010). In a study of undergraduate students in an asynchronous environment, Olesova et al. (2016) found that scripted roles were an effective strategy to improve both learning processes and outcomes. They randomly assigned students in online discussions into one of three roles (*starter*, *skeptic*, *wrapper)* or no role at all. Role assignments were rotated. They found that students demonstrated a higher level of cognitive presence when assigned a role than they did with no role assignment. In an earlier study of an asynchronous learning environment, Aviv et al. (2003) found that knowledge construction and critical thinking reached their highest level when the learning network was more highly structured. Other researchers (e.g., Schellens et al., 2005; DeWever et al., 2010) have found that different roles have different impacts on knowledge construction, with the summarizer role in online discussions having the most positive effect. Research on scripted role assignment has also suggested the importance of rotating assigned roles (O'Donnell and Dansereau, 1992.)

There has been much discussion concerning the strengths and weaknesses of using scripts to structure collaborative interaction in the computer supported collaborative learning (CSCL) community. Kollar et al. (2006) and Weinberger (2011) have pointed out that the preexisting,

internal collaboration scripts may be in conflict with whatever scripted role assignments an instructor might design. These internal, or emerging, scripts are evident and may be observed when a collaborative activity is unscripted and allowed to proceed as the participants desire. Weinberger (2011) cites three potential risks inherent in overscripting collaborative interactions. First, overly constraining scripts can dampen student motivation (Rummel, Spada, & Hauser, 2009). Second, externally provided scripts may also interfere with existing, well-functioning internal collaboration scripts (Kollar, Fischer, & Slotta, 2007). Finally, externally provided scripts, may by their very nature, interfere with self-regulated, playful, and exploratory thinking (Dillenbourg, 2002.) Thus, it is important to observe and understand both scripted and emergent role assignments when exploring role effects in distributed synchronous online breakout rooms.

Use of Breakout Rooms in Online Learning

Breakout rooms are increasingly used within online learning environments. For example, Martin and Parker (2014) found that 25% of the surveyed online educators used breakout rooms. In general, the use of breakout rooms encourages "learner-learner interaction," which as noted by Moore (1993), is a valuable resource for learning. Chandler (2016) found that breakout rooms are useful for facilitating collaborative learning and interaction. Chandler noted that breakout rooms provide distance-learning students with the opportunity for peer-to-peer contact, which can be invaluable in building relationships and confidence. Some have argued that the effectiveness of active learning techniques such as breakout rooms lies as much in the enhancement of engagement as in the ability to generate in-depth exploration of the topic (Redish, Saul, & Steinberg, 1997). Some educators have even begun to research the incorporation of "escape-room" narrative and gamification to provide experiential structure to the use of breakout rooms. They claim two benefits of adopting the escape room strategy: a clear problem-based structure for students, combined with a higher level of engagement.

However, there has been minimal research exploring the pedagogical aspects of breakout groups in face-to-face or online classrooms. Lougheed et al. (2012) reported that research about the use of breakout groups in postsecondary education is sparse. They also reported that most of the published literature pertaining to the use of breakout groups describes the feedback generated during the breakout sessions rather than specific pedagogical elements of the breakout groups themselves. This dearth of published information highlights the need for research related to factors that affect their use in this context.

There has also been little research into online interaction during synchronous breakout sessions (Brown, Schroeder, & Eaton, 2016). Two papers briefly discuss online breakout rooms, but without any explicit focus on the viability of breakout rooms or the process to be used in the breakout room. In one paper, Martin and Parker (2014) noted that using breakout rooms could enhance interaction and build a sense of community. However, there was no examination on use or the effectiveness of breakout rooms. Ellingson and Notbohm (2012) also discussed the use of breakout rooms, but focused on the technical details, such as how to setup a breakout room. They described breakout rooms as an "appealing feature," but did not discuss any guidelines on how to use the breakout rooms, nor did they report on any observations of use of breakout rooms.

There are also some indications that breakout rooms do not always magically create engagement and higher levels of learning. Blackstone and Oldmixon (2016) found that students in a breakout from a lecture class were not more satisfied and did not succeed at higher levels compared to their peers in a lecture-only class. Lougheed et al (2012) found that higher-GPA

students had a significantly less favorable response to the use of breakout groups than did their lower-GPA colleagues. In these studies, researchers speculated that possible reasons for these findings were that students may not have been clear about what they were supposed to gain from the breakout group sessions, or that some (e.g., high-GPA students) may have found that the structure of the sessions did not meet their needs.

These concerns are consistent with Kuhn's (2015) critique, who argues that results of collaborative learning are often precarious, and it therefore should not be considered a "silver bullet." Kuhn argues that without careful design attention to the nature of the task or problem, and specification of the learning goals expected, the outcome of any collaborative learning intervention is likely to be unpredictable. Thus, what little research exists on the subject of synchronous distributed breakout rooms suggests that much more attention needs to be paid to the pedagogical structures and scripts used to prepare students to use them.

Distributed Pair Programming

Pair Programming (PP) is an agile software development technique that is part of Extreme Programming (XP). When using PP, two developers work together, side-by-side, at one keyboard. One person, "the driver," types at the keyboard. The other person, "the observer," reviews each line as it is typed, checking for errors and thinking about the overall design (McDowell et al., 2002). Distributed Pair Programming (DPP) is pair programming with the two programmers working at a distance via online tools (Hanks, 2005). Pair programming is thought to provide several benefits, including fewer errors in the code, enhanced ability to share best practices, faster team learning, and social support that improves morale.

Research in DPP within an educational context has typically reported on the use of DPP when the students have been able to build a relationship within a face-to-face context. Early research with respect to DPP, such as Stotts et al. (2003), used students within a face-to-face class to compare the results of DPP and PP. Even though the technology used was not as advanced as what is possible today, in those early experiments, DPP was shown to have a positive impact on outcomes, similar to PP. In more recent research, Tsompanoudi et al. (2016) implemented a system that supports the application of DPP within an interactive development environment (IDE), and found that the use of collaboration scripts, defined to implement DPP, yields improved results, such as improved student learning. Like many of the earlier studies, their experiment was for a face-to-face class that used DPP, not for a distributed team using DPP. In fact, in a review of DPP research, Estácio (2015) notes that while there have been 34 articles discussing DPP, these papers have primarily covered tools to support DPP, or reported on experiments where a face-to-face class uses DPP (e.g., Stotts, 2003; Tsompanoudi et al., 2016), and that "few studies explore DPP as a pedagogical tool and how DPP could be integrated with the trend of online courses."

Overall researchers have not often explored DPP when the students were not taking a colocated, face-to-face class. This distinction is important, since colocation enables students to establish a connection in a face-to-face context and then use online tools to do DPP. This gap in the research has also been noted by Edwards et al. (2010), who called for more comprehensive and intensive investigation into the power of pair programming when used within purely online courses.

Motivation for the Study

Gaps in the literature reviewed above provide three dimensions of motivation for this study. First, scripted collaboration role assignments have primarily been studied in asynchronous environments. This prior research suggests that there are potential benefits and risks that should be also be explored in synchronous environments, especially in the comparison of scripted versus naturally emerging role behavior. Thus, this study observes role behavior in both emergent and scripted situations. Second, while technology advances have made the use of distributed online breakout rooms more common, research on the pedagogical structures supporting their use has been sparse. Finally, while the use of the Distributed Pair Programming concept provides a potential model for breakout room role assignment, there has been little research exploring its use in purely online courses. Thus, this study explores the impact of using a Structured Pair Activity (SPA) methodology for scripted role assignment on students' collaborative behavior in distributed online breakout rooms.

Methods

Pair programming concepts were used to develop the SPA scripts, which structured student collaboration in breakout rooms during an online data science course.

The impact of using SPA within breakout rooms was explored via a case study. Merriam (1988) indicated that a case study should have a bounded system that can be identified as the focus of the investigation. This study examines the process of using SPA within synchronous online breakout room sessions, where students have access to video conferencing, chat, and the sharing of files.

Case Study Context and Setting

SPA was evaluated within two one-semester sections of an online graduate-level introduction to data science course. In addition to the class's asynchronous activities, the course also met in a synchronous online session weekly at a specific day and time. For part of each synchronous session, students worked in two-person teams using breakout rooms. Over the two semesters, 26 graduate information system students participated in the study. Students were randomly assigned into teams of two people for work in the breakout rooms. Twelve students (six teams) were in the first semester's class and 14 students (seven teams) were in the second semester's class. The same breakout teams were used across the entire semester. The students had a wide variety of educational and career backgrounds. Twenty-five percent of the participants were female. The students were geographically distributed across multiple time zones, with students participating from North America, Europe, and the Middle East. Eighty percent of the students had a STEM-focused undergraduate degree. Finally, 92% of the students had full-time jobs. The instructor, a coauthor of this research, was the same for each of the two semesters and had previously taught the data science course many times.

Each week, over an eight-week period, there was a different breakout-room assignment. Five of the assignments were programming assignments. In them, students were required to use the R programming language, a popular data science tool that is used in both industry and academia. For these assignments, the student teams were expected to do R programming, using typical data science techniques such as machine learning algorithms and geographic information analysis. For two of the assignments, the work focused on a more qualitative task that required

students to document the result of the team's discussion. The final assignment was the creation of a client presentation visualizing the results of the data analyses and documenting the outcomes that would likely be actionable by their client. The sequence of these breakout assignments is shown in Table 2. The synchronous sessions were 90 minutes long and typically the students were in breakout rooms for 40 to 50 minutes. The technology used for the synchronous sessions was similar to that described by Martin & Parker (2014) and included video conferencing, chat, screen-sharing, and the sharing of documents. Each virtual breakout room was equipped with similar tools.

Over the two-semester period, 104 breakout sessions were monitored. In each semester, the first four breakout sessions used a baseline condition where the instructor provided the assignment to be done in the breakout room but provided little guidance with respect to how the students should collaborate. These sessions provided an opportunity to observe naturally-occurring, or emergent, role behavior. Three of these four breakout sessions focused on coding tasks. For the following four breakout sessions, two of which were primarily coding tasks, the students used SPA. Thus, these sessions provided an opportunity to observe the impact of scripted role assignments.

Structured Pair Activity

For the first four sessions, the process used within the breakout room was left to the students. There was no specific process defined for them to use. Based on industry best practices (McKinnie, 2018), as well as the lack of identified research addressing how to use breakout rooms, this baseline condition, with unscripted role assignments, appears to be a common practice for many instructors that use breakout rooms. SPA was then used to provide a structure of scripted role assignments for the following four weeks.

Before the first use of SPA, the SPA process was explained to students via discussions and a documented presentation. Specifically, SPA role assignments were described to the students in terms of the following key concepts:

- Within each breakout room, there was one *driver* (the person that had control of the shared screen and was typing within a shared document). The second student was the active *observer* that, via the shared screen, saw what was being written by the driver (R programming code or other documents such as a PowerPoint presentation). These roles were explained to the students.
- *Drivers* were instructed with the following scripted role assignment:

  When you're the driver:

  Agree with your partner on one tiny goal at a time, something you can complete within a few minutes.
  State the problem in words.
  Talk to your partner!
  Ensure that you both know what you are working on right now.
  Complete the current tiny task (e.g., coding goal, presentation text, etc.) as quickly as you can.
  Ignore larger issues (but note them out loud).
  Trust the observer to be your safety net.

- *Observers* were instructed with the following scripted role assignment:

  When you're the observer:
  Read what the driver is writing as he or she writes it; evaluate it for accuracy.
  Your job is to review and think how it fits into the larger picture.
  Pay total attention, aiming to let nothing get by you.
  Think about possible issues and ways to simplify.
  Bring up issues directly related to the tiny task
  Wait until the current tiny goal is done to bring up larger issues and ideas for design improvement.
  Don't dictate—driver should be actively thinking about how to achieve the current tiny task, not just typing.
  Exploit the fact that you don't need to focus on the details.

- All students were encouraged to be actively engaged with each other, to share their thoughts and ideas, and to ask questions.
- Students were instructed to frequently rotate roles between *driver* and *observer*, with a goal of rotating every fifteen minutes.

Evaluating the Impact of SPA

To evaluate the impact of SPA, the research adapted Hackman's team effectiveness model (1987). This model, shown in Figure 1, states that to evaluate the effectiveness of a team process, one should observe task process and output, the team's continued desire to work together and the satisfaction of individual team members.

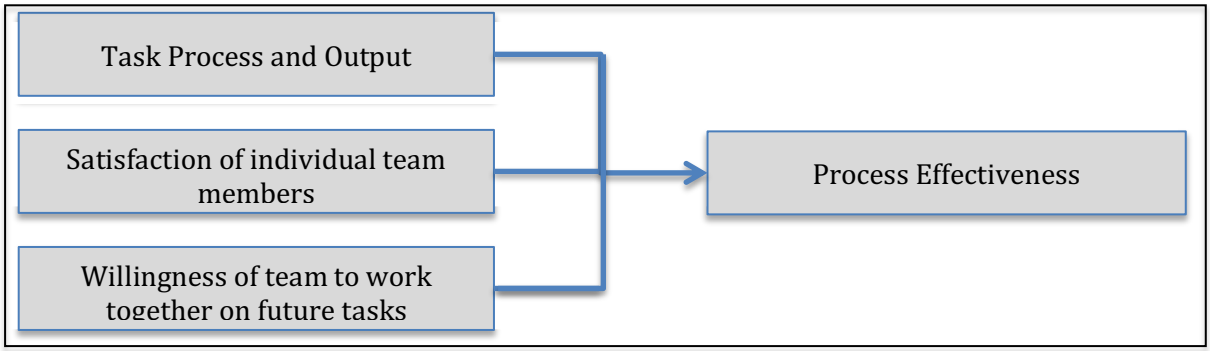

Figure 1. Evaluating the effectiveness of a process (adapted from Hackman, 1987).

To evaluate the model shown in Figure 1, multiple data sources were used, which is consistent with Eisenhardt (1989). First, since an instructor was able to easily move between the breakout rooms unobtrusively, systematic instructor observations provided insight into how the teams were working together, the group dynamics within each team, and the ways the scripted role assignments affected team behavior (answering RQ1). Students were informed that the instructor would periodically observe their interactions. During each breakout session, the instructor systematically moved through each of the different breakout rooms, observed the student teams in each breakout room, and documented those observations. Each room was observed for 3–5 minutes at a time and each room was visited 2–3 times per class session.

The observations of student behavior patterns of were focused through a set of specific questions: who is leading the conversation? Are students equally participating in the dialog? Does the team appear to be productive and effectively working toward completion of the task? Are there indications of expert-novice conditions (or experience gaps)? In sessions where SPA was used, the instructor added an additional question: are students rotating roles? These systematic observations provided a qualitative view of task process and output for each team.

Student satisfaction with SPA (RQ2) was explored through a three-item *student satisfaction scale,* which had a reliability, or internal consistency, of 0.94 (based on Cronbach's alpha). The scale consisted of the following three items:

I want to use SPA for future small group assignments.

SPA was useful for our work.

I am satisfied when using SPA.

The survey also included an open-ended question:

What were the strengths and weaknesses of the SPA breakout room process?

The survey was given to students at the end of each semester as part of a voluntary course evaluation process. Response rate was 69%. Consistent with IRB review guidelines, student survey participation was voluntary and students were informed that survey results could be used, in an anonymous fashion, as part of an ongoing pedagogical research project.

Finally, an indicator of students' willingness to work together on future tasks (RQ2) was obtained when students had the opportunity to reform teams for a subsequent project. Table 1 maps the data sources to the key measures defined in our model to evaluate the effectiveness of SPA.

Table 1

Measuring Team Effectiveness

Key Measures	**How Measured**
Task process and output	Instructor Observations
Satisfaction of individual team members	Student Survey
Willingness of team to work together on future tasks	Selection of (new) project team members

Results

Task Output and Team Process

An assessment of the effects of SPA on team process was made based on a systematic, week-by-week observation of the student teams, as described above. The weekly observations before the introduction of SPA are summarized in Table 2. Initial analysis determined that there were similar results in both semesters in the sense that there were codeveloper teams and one-person-dominant teams at the outset, and the one-person dominant teams modified their behavior

similarly after the introduction of SPA. As a result, results from the two semesters have been combined into a single presentation.

Table 2

Weekly Observations of Team Process Prior to the Introduction of SPA

Week	Assignment	Observations
1	Discussion of a real-world situation and how it could use data science	• Pairs were mostly polite with each other. • All teams began discussions of "How should we proceed?" • 7 teams seemed to have a more talkative person, who appeared to lead or dominate the discussion.
2	R Coding	• The teams exhibited three distinct patterns of role behavior: • **7 Teams: One-Person-Dominant.** One person**,** seemingly the most experienced, was the dominant person and did all the coding (this week was a coding assignment). In most of these teams, the other person was quiet and relatively uninvolved. • **4 Teams: Codevelopers.** Both team-members contributed equally, cutting and pasting code to each other via the chat function. Neither dominated the interaction. They appeared to have clear emergent role expectations, or internal collaboration scripts, that were compatible. • **2 Teams: Looking-For-Guidance.** These two teams were continuously asking the instructor what to do next. Neither person was dominant, but they did not appear to have a functional emerging collaboration script.
3	R Coding	• The two teams that had previously asked for help migrated to the One-Person Dominant strategy. This left: • **9 One-Person-Dominant teams:** In most of these teams, the non-dominant person continued to be relatively uninvolved, trying to understand what the more experienced partner was doing. • **4 Codeveloper Teams**: These teams continued to work effectively. Their internal collaboration scripts were active and functional.
4	R Coding	• The same pattern continued as in week 3. Roles had become normalized into the two basic emergent role scripts: One-Person-Dominant (9) and Codeveloper (4). • The less-experienced person in One-Person-Dominant teams remained relatively uninvolved, and there was a growing gap in their level of knowledge, since the "doers" were learning more while doing. Thus, this emergent script was not producing the desired learning outcomes for these individuals.

Observations on the Unscripted Sessions.

Across both semesters, in the first week, it was observed that the student's use of the breakout room was often a bit awkward. For example, students did not know each other well and did not want to "step on the other person's toes." Since this was the first week of the course, this could be explained due to the fact that the students did not know each other well, and hence, had to develop a social connection, especially since they were only connected via computer mediated communication. Unfortunately, during the following three unscripted sessions, only four teams were perceived to work effectively (the co-developer teams). The dynamics between the students during these unscripted weeks appears to have been driven by a number of factors, such as how outgoing the people were and how much knowledge each person had with respect to the assignment. Hence, often times, the more outgoing and/or knowledgeable person dominated the two-person discussion.

The weekly observations after the introduction of SPA are summarized in Table 3. From these weekly observations, four key themes emerged that suggests that task process improved, which are discussed in the rest of this section.

Table 3

Weekly Observations of Team Process After to the Introduction of SPA

Week	Assignment	Observations
5	Discussion of a real-world situation and how it could use data science	• There was some initial confusion on the roles and how to "rotate" who was "driving". • The instructor clarified questions and encouraged teams to swap who was driving and who was observing. • Switching roles was technologically challenging due to the limitations of the platform.
6	R Coding	• Most teams started to get the hang of SPA. They figured out workarounds to more easily switch who was driving (e.g., using Google Drive or emailing files). • Teams started to become more productive and got into a rhythm of doing work. • In seven of the nine original **One-Person-Dominant** teams (often due to an experience imbalance,) the less experienced person clearly was more engaged and doing more. The amount of discussion was greater this week compared to last week. • Two of the original **One-Person-Dominant** teams were still unable to swap driver/observer roles, and in these teams, the observer remained fairly uninvolved. One of these teams made no effort to switch roles. • Some observers expanded their role to do outside research (e.g. they looked for solutions to problems in websites like Google or Stack Overflow). The two original **Codeveloper** teams in the first semester were the leaders in this role expansion. They modified their previous co-equal collaboration scripts to include observer research while the driver was doing the writing/coding (this became an "active researcher/observer" role).

Week	Assignment	Observations
7	R Coding	• At this point, there were only two **One-Person-Dominant** teams remaining. Eleven were classified as **Codeveloper** teams. • The active researcher / observer role spread further in week 7, with more observers becoming proactive in searching for answers using external resources. • As teams become more comfortable, the teams seemed to be better at decomposing work into smaller tasks (short bursts of work). This was perhaps due to the need to switch roles and their improving experience in being able to switch roles. • Students still did not switch roles as frequently as the SPA instructions called for (every 15 minutes). Actual switching time was approximately 25 minutes. • One team was still unable to switch roles.
8	Creation of a presentation with visualization of findings	• Similar to week 7, teams were fairly predictable in how they were interacting. • Student-to-student engagement and dialogue continued to increase. • By the end of this week, only one team was still struggling to swap driver/observer. The observer on that team remained uninvolved.

Observations on the Sessions with SPA Scripted Role Assignments.

Improved team coordination and focus when using SPA. The dynamics within the breakout rooms changed when students were introduced to SPA. The nondominant person in the One-Person-Dominant teams started to be more productive. For example, it was noted that these teams, when using SPA, "would quickly determine who was the driver, and what was their short-term goal." SPA seemed to provide two key advantages. First, it provided a framework where being a leader was divided between two roles: doing the writing (the driver) and doing the brainstorming (the observer). This was helpful for the originally One-Person-Dominant teams (the definition and switching of the roles helped to balance the dominance). Thus, SPA provided a framework for the observer to be more active and for both students to have well-defined roles. In general, it was observed that there was more two-way dialog (due to the active nature of the observer) under SPA as compared to the baseline condition.

Expanded observer responsibilities. During the first semester, the instructor observed that in both of the initial codeveloper teams, the person in the SPA observer role often started to work on tasks beyond what was suggested for the observer. Specifically, the students who were observers would sometimes start to actively look for solutions (via websites such as Stack Overflow or a specific data science website). These students then shared their insight with their driver so that the driver could leverage that insight. The questions addressed by the observer when doing the searching ranged from specific coding details (such as the parameters of a specific R function) to much more conceptual open-ended questions (such as how one might handle missing data). Since it was believed that this type of active research improved the team effectiveness, the description of the observer was expanded to include this type of activity in the second semester. This addition did not change the basic pattern of unscripted versus scripted role behavior in the second semester. In the first semester, there were two original codeveloper teams and four original one-person-dominant teams by week three. In the second semester there were two original

codeveloper teams and five original one-person-dominant teams by week three. In both semesters, all but one of the One-Person-Dominant teams evolved to become Codeveloper teams.

Role-switching difficulty. Even though the frequency of role rotation increased under SPA, the teams did not rotate between driver and observer at the frequency suggested. Specifically, the SPA instructions suggested that students rotate every fifteen minutes. However, most teams rotated at a rate of approximately once every twenty-five minutes (i.e., one rotation within the breakout session). This decrease in role-switching was at least partly due to the technology being used, in that switching roles was not seamless. For example, files needed to be explicitly "uploaded and then downloaded" from one student to the other student.

Increased student engagement. An unexpected observation was that, later in the course, there was a perceived increase in student engagement (i.e., questions to the instructor, dialog between students) compared to the first half of the course and to other course sections that were offered in previous semesters (course sections that used unscripted breakout rooms but did not use SPA). This might have been due to the observed bonding that occurred within the SPA-breakout sessions, where the social sharing of information was much greater than what occurred when using a more traditional breakout room process. In other words, using a more well-defined breakout room process might have improved team bonding due to the structure of alternating who was is "in charge" (i.e., the person typing at the keyboard).

Team Member Satisfaction

To explore student satisfaction, the three-item *student satisfaction scale,* described above was used. The voluntary survey was administered at the end of each term and the response rate was 69%. The average student response for this scale was 4.4, suggesting that students were relatively satisfied with SPA.

The open-ended qualitative feedback, within the same survey, was analyzed to more deeply explore the drivers of student satisfaction when using SPA. Three key themes emerged that seemed to drive their satisfaction. These themes are described below:

Improved learning. Students thought that their learning improved when using SPA. This improved learning was driven by better insight shared between the partners. For example, one student stated "I got to learn more by working with my partner in this way."

Improved coordination & collaboration. Since a key goal of SPA is to improve coordination between the two students, it was not surprising that several students noted that they thought that SPA improved coordination, which often led to a feeling of improved collaboration. For example, "it helped me coordinate with my partner" and "it allowed us to collaborate much easier" were statements that exemplified how the students perceived their improved collaboration when using SPA. However, one student did note a disadvantage to using SPA, in that "some people are hard to keep on track, or are very rigid in needing control." Note that this last feeling could have been instilled during the first four sessions. In any event, this personality trait might suggest that additional initial discussion with respect to working in a team is required prior to the use of breakout rooms.

Improved productivity. Students also focused on their perceived improved productivity. For example, one student noted that "we were most productive during class time when we used SPA versus on our own when we did not." This productivity was also aided by the fact that students thought it was easy to work with their partner, perhaps due to the structured dialog with using SPA.

For example, one student simply noted that SPA "Made it easy to work with someone else remote" and another stated "It was an easy way to work with my partner."

Willingness to Work Together on Future Projects

In terms of the students' willingness to work together on future projects, after the four SPA breakout sessions, the students had to form a project team to work on an end-of-the semester project. Students were given the opportunity to stay in their current "breakout team" or select different team members (with or without the help of the instructor). Ninety-two percent of the students wanted to continue working with their breakout team member, and the others did not strongly object to staying with their current breakout team. While this could have been driven by students being comfortable with the status quo and not wanting to risk working with a "bad" partner, it nevertheless does show that the students were at least not frustrated with the current partner. Hence, there was a clear favorable response with respect to the students' desire to continue to work together on future projects.

Discussion

This paper defined a process, Structured Paired Activity (SPA), for use within breakout rooms of an online course. A case study was performed to explore the effects of using SPA within a breakout room. Systematic observations suggested that SPA was a useful way to provide structure within breakout rooms and positively modified student behavior (thus addressing the first research question). In addition, students also thought that SPA was a useful way to provide structure (addressing the second research question). Furthermore, based on the fact that (1) task output was thought to improve, (2) team members were very satisfied while using SPA, and (3) the students wanted to continue working with their teammate, our model of process effectiveness suggests that SPA was an effective intervention. One additional finding was that the use of breakout rooms seems to have enabled learning via a social and constructive process. This connectedness was evident via increased student-to-student interaction during class as well as increased student-to-student communication outside of class.

Prior to the introduction of SPA, there was clearly a mismatch between the internal collaboration scripts possessed by nine of the thirteen teams and the requirements of the virtual breakout rooms. Since there was no instruction on how to use the breakout rooms, it is not surprising that these teams experienced a momentary lack of support (underscripting) as described by Dillenbourg (2002). Because of the scarcity of research on breakout rooms (virtual or face-to-face) described by Lougheed et al. (2012), it is difficult to know how often students are provided with little or no structure to guide collaboration in real breakout-room environments. But personal experience suggests that such underscripting may not be uncommon. The introduction of SPA alleviated this underscripting in all but two of the teams. The results support the idea that at least some of the problems previously observed in breakout rooms (e.g., lack of success and satisfaction (Blackstone and Oldmixon, 2016;) dissatisfaction in higher-GPA students (Lougheed et al., 2012)) can be attributed to lack of structure and underscripting.

It is also interesting to consider the four codeveloper teams that began the course with seemingly effective internal collaboration scripts. Some research has suggested that external scripts may interfere with previously effective internal collaboration scripts (Weinberger, 2011; Kollar, Fischer, & Slotta, 2007). In this case, however, these student teams not only adopted the

SPA script, but also positively modified it by expanding and enriching the SPA observer role. The concerns expressed by Dillenbourg (2002), that externally provided scripts, may by their very nature interfere with self-regulated, playful, and exploratory thinking, were not evident in this exploration of SPA. Thus, the SPA script seems robust and flexible enough to avoid both overscripting and underscripting.

Ideally, the provision of an external collaboration script is intended to achieve several different outcomes. First, the goal is to regulate learning activities and provide complementary process knowledge that leads to more effective team performance (Weinberger, 2011). SPA appears to have achieved this goal. Collaboration scripts also hope to increase both individual and shared domain knowledge. While this appears to be the case in this study, the qualitative design provides no direct evidence. Future studies of SPA should develop explicit measures of individual and team learning to study the learning effects of SPA. Designs such as those used by Kuhn (2015) would be beneficial. This is especially germane since this study revealed expert-novice experience gaps in a number of the teams. Such gaps may be common in many types of courses. Finally, instructor-provided collaboration scripts are intended to help students learn how to collaborate more effectively in the future; that is, the ultimate goal is that students will gradually transition from external to internal collaboration scripts. This study indicated that students found SPA to be useful. Future research should investigate how much of the SPA collaboration script is internalized.

While there were over one hundred breakout sessions observed, there were only two classes in this case study, and each had a low number of students in the course. Hence, one limitation is the small sample size, in terms of the number of students and number of courses in the study. Another limitation of this study's design was, as mentioned above, the lack of a direct measure of learning. In addition, SPA was compared to a straightforward no-script alternative. While this alternative may reflect reality in a number of classrooms, a possible next step could be to explore the value of using the SPA process versus breakout rooms with different structuring methodologies.

While data science was an interesting class to evaluate SPA (since the assignments ranged from open-ended discussions to more structured programming tasks), it would be interesting if other types of courses evaluated SPA. For example, more discussion-focused courses could be explored to better understand the strengths and weaknesses of SPA in other contexts. Kuhn's (2015) probing discussion of the types of skills best suited to collaborative learning (e.g., argumentation skills, inquiry skills) can be useful in guiding this future expanded research. In our study, inquiry skills were clearly needed, as students labored to develop new ways of approaching problems in data analytics. Research in other domains would help us to understand if some tasks are better suited for using this methodology (or, in general, if some tasks are better suited for breakout rooms).

In summary, this case study suggests that when students use the scripted SPA role assignments in a video-enabled web-based breakout room, student process, productivity, motivation and connectedness to other students improve. While additional research on how to best structure student interaction in breakout rooms is required, this research indicates that the practice of just sending students into a breakout room without much structure is not ideal.

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The Validity and Instructional Value of a Rubric for Evaluating Online Course Quality: An Empirical Study

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Abstract
This study investigates the validity and instructional value of a rubric developed to evaluate the quality of online courses offered at a midsized public university. This rubric is adapted from an online course quality rubric widely used in higher education, the Quality Matters rubric. We first examine the reliability and preliminary construct validity of the rubric using quality ratings for 202 online courses and eliminate 12 problematic items. We then examine the instructional value of the rubric by investigating causal relationships between: (a) course quality scores, (b) online interactions between students, instructors, and content, and (c) student course performance (course passing rates). A path analysis model, using data from 121 online courses enrolling 5,240 students, show that only rubric items related to *learner engagement and interaction* have a significant and positive effect on online interactions, while only student-content interaction significantly and positively influence course passing rates.

Keywords: online course quality, rubric, online interactions, rubric reliability, rubric validity, quality matters rubric

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The Validity and Instructional Value of a Rubric for Evaluating Online Course Quality: An Empirical Study

The number of college students taking online courses has increased dramatically over the past decade, with almost 31% of U.S. undergraduate students (about 5.2 million) having taken at least one course online as of the 2016 fall semester (McFarland et al., 2018). With this rapid growth in the number of online courses, evaluating their quality has taken on a new urgency. While many approaches have been developed to evaluate online course quality for example, surveys, checklists, observations, peer reviews, and expert reviews—one common way is through *quality rubrics* (Custard & Sumner, 2005; Jaggars & Xu, 2016; Roblyer & Wiencke, 2003; Yuan & Recker, 2019). With a quality rubric, a course can be rated along several constituent quality dimensions—for example, the Quality Matters (QM) rubric (Quality Matters, 2018) consists of eight dimensions,

such as learning objectives, instructional materials, learner support, accessibility, and usability, etc. Each of these dimensions may, in turn, be composed of one or more specific quality indicators (Custard & Sumner, 2005). In addition, for each indicator, rubrics often use rating scales and may be accompanied by a scoring guide.

While quality rubrics are commonly used in many higher education institutions, few rubrics have been empirically tested in terms of their reliability or validity (Yuan & Recker, 2015). Moreover, an often-ignored aspect of course quality is its influence on online interactions and student outcomes; in other words, the *instructional value* of the rubric. A key assumption is that a well-designed course following a proven instructional design theory will enhance student learning and engagement and thereby lead to improved outcomes (Reigeluth, 1999). Thus, a course that scores high on quality should result in better student outcomes than one receiving a low score. However, this relationship has seldom been examined in the literature (Jaggars & Xu, 2016).

The purpose of this article is twofold. The first is to test the validity of a rubric developed to evaluate the quality of online courses offered at a midsized public university. This rubric, called the AS rubric, was adapted from the QM rubric. The QM rubric is one of the most widely used rubrics in higher education and its design is informed by online learning research (Quality Matters, 2018). In particular, using the course quality scores from 202 online courses, we examined the preliminary construct validity of the AS rubric.

The second purpose is to examine the implicit logic linking online course quality to online interactions and student course performance. We investigated the causal relationships between course quality scores, online interactions between students, instructors, and content, and student performance as measured by their course passing rates. We characterized student and instructor online interactions in a subset of these online courses (the number of courses = 121; the number of students = 5,240) using the clickstream data automatically captured by the learning management system (LMS) for these courses. Finally, we examined the extent that the course quality measures, mediated by student and instructor interactions, influenced passing rates. The specific research questions guiding this research are:

1. To what extent is the AS online course quality rubric valid in measuring quality along a number of course quality dimensions? Which specific indicators are reliable (internal consistency reliability of the rubric) and valid (construct validity of the rubric)?
2. How do the course quality measures, when mediated by student and instructor online interactions, influence course passing rates?

Figure 1 articulates the logic underpinning this study: an online course that rates highly on quality along several key dimensions will positively influence the online interactions of its students and instructors and how they interact with content, which will ultimately lead to improved course performance. Figure 1 also illustrates how these three constructs are operationalized in our study.

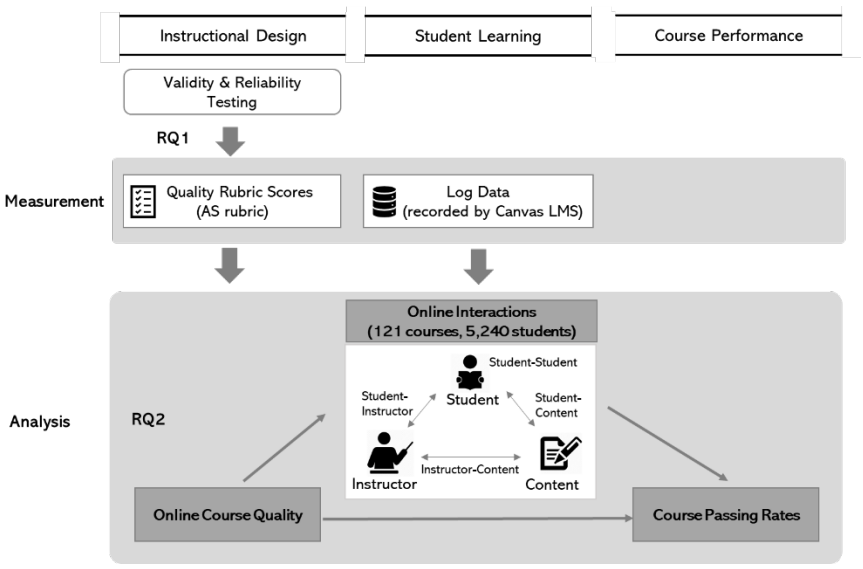

Figure 1. The study's logic linking instructional design to student course performance with measures for each component.

Review of Literature

In this section, we review the literature related to these three constructs shown in Figure 1. We first review the growing literature surrounding the use of course quality rubrics in higher education. We also specifically review the few studies that examine the relationship between online course quality scores and student learning outcomes. Finally, we describe a framework for characterizing and classifying interactions in online courses.

Course Quality Rubrics

We conducted a search of course quality rubrics in ERIC and Google Scholar with the following keywords: *online course*, *quality*, *rubric*, and *evaluation*. We also found rubrics from reviewing references of existing rubrics and getting recommendations from colleagues. These strategies yielded 31 rubrics. Ten course quality rubrics were ultimately selected based on the following criteria: they (a) were used for evaluating the quality of online courses; (b) consisted of more than two dimensions, with accompanying definitions of the dimensions; and (c) were used in higher education settings. Building on the approach used in a prior review of the quality rubric literature (Yuan & Recker, 2015), we examined online course quality rubrics used by higher education institutions in terms of three aspects: (a) *development process,* (b) *quality dimensions,* and (c) *and results of reliability and validity testing.*

First, in terms of the development process, most of the rubrics were adapted from other existing rubrics, rather than based on online learning theories or models (see Table 1). Regarding revisions to the rubrics, eight rubrics noted that they went through several rounds of revisions.

Table 1

Development Process, Reliability, and Validity of the Ten Rubrics Reviewed

No	Rubric	Development process	Reliability & Validity (publicly reported)
1	Checklist for Evaluating Online Courses (Southern Regional Education Board, 2006)	• Developed based on Southern Regional Education Board's standards for quality online courses	• Not reported
2	Quality Standards Inventory (Egerton & Posey, 2007)	• Developed based on the principles of active learning and effective teaching	• Not reported
3	Online Course Design Rubric (New Mexico State University, 2011)	• Developed based on QM • Noted that "the rubrics are updated regularly."	• Not reported
4	Online Course Best Practices Checklist (Palomar College, 2012)	• Informed by a few existing rubrics (e.g., Blackboard, QM) • Revised several times	• Reported that "a pilot test of the checklist was conducted" but specific results were not reported.
5	Quality Learning and Teaching Instrument (California State University 2015)	• Informed by existing rubrics and models (e.g., QM, Community of Inquiry model) • Revised several times	• Not reported
6	Online Educational Initiative Course Design Rubric (California Community College, 2016)	• First version developed in 2014 by the OEI Development work group • Revised based on feedback from instructors and reviewers	• Not reported
7	Exemplary Course Program Rubric (Blackboard Inc., 2017)	• First developed in 2000 • Reviewed and updated annually by Blackboard experts	• Not reported
8	Rubric for Evaluating Online Courses (University of North Dakota, 2017)	• Developed based on a few existing rubrics (e.g., Blackboard) • Revised several times	• Not reported
9	Quality Online Course Initiative Rubric (Illinois Center College, 2017)	• Informed by existing rubrics • Brainstormed dimensions first and then chucked into categories • Revised several times	• Not reported
10	Quality Matters (QM): Course Design Rubric Standards (2018)	• Informed by a few research articles, and revised based on users' inputs • Revised for a few versions	• Improvement process reported (Shattuck et al., 2014) • Measured "rater agreement."

Second, with regard to quality dimensions, although each rubric used slightly different terms, our review found five common dimensions for measuring online course quality across the rubrics. These were: (a) course design and introduction, (b) learning objectives and assessment, (c) interaction and collaboration, (d) learning resources and support, and (e) course technology and accessibility. However, the rubrics also showed differences in their evaluation focus. For instance, Rubric #10 (Quality Matters, 2018) consisted of 42 weighted items with almost 30% of the weight

addressing "learning objectives and assessment" and only 11% of the weight focused on "interaction and collaboration." In contrast, Rubric #6 (California Community College, 2016) emphasized "course technology and accessibility" with 48% of the total items related to these issues.

Finally, rubrics require sufficient levels of *reliability* and *validity* (Roblyer & Wiencke, 2003). Despite the importance of establishing reliability and validity of rubrics, none of the reviewed rubrics publicly reported the results of reliability or construct validity tests. Only two rubrics (Rubric #4 and #10 in Table 1) noted that they underwent empirical testing, such as a measurement of rater agreement, but details were not reported. This lack of reliability or validity testing calls into question the rubrics' overall suitability for rigorously evaluating online course quality (Yuan & Recker, 2015).

To summarize, the ten rubrics reviewed in this study show similarities in the dimensions addressed and the rating scales used, but they differed in their focus for evaluation. These differences seem reasonable, as all higher education institutions have different needs, interests, and criteria for evaluating online courses (Britto, Ford, & Wise, 2013). However, from a research perspective, key questions remain: which dimensions are more important in evaluating the quality of an online course? Which dimensions better predict student performance?

Course Quality and Student Learning Outcomes

Our literature review suggests that rubrics for measuring course quality have been validated mostly in terms of the opinions and perceptions of faculty and students, rather than in terms of construct validity or relationships to learning outcomes (Hixon, Barczyk, Ralston-Berg, & Buckenmeyer, 2016). Empirical studies (Jaggars & Xu, 2016; Lee, 2014; Liu et al., 2010; Sun et al., 2008; Swan et al., 2012) have found that a course with high quality scores measured by rubrics resulted in higher student learning outcomes in terms of course performance or satisfaction than one receiving low quality scores. However, studies also showed that not all scores on dimensions of the rubrics significantly predicted learning outcomes (Jaggars & Xu, 2016; Lee, 2014; Sun et al., 2008). For instance, Jaggars & Xu (2016) explored the relationship between rubric scores from 23 online courses and student final grades at two community colleges in the U.S. Results revealed that among the four rubric dimensions, only the "interpersonal interaction" dimension had a statistically significant and positive impact on student final grades. Thus, while well-organized courses or well-described learning objectives might be desirable, these quality aspects may not lead to better learning outcomes per se.

Characterizing Interactions in Online Learning

Interactions among learners, instructors, and content are integral components of online education (Bernard et al., 2009). A widely used framework for examining interactions in online education is Moore's (1989) *interaction framework*. This framework classifies interactions into three types: Student-Instructor, Student-Student, and Student-Content.

Later, Anderson and Garrison (1998) expanded Moore's framework by differentiating between Student-Content and Instructor-Content interaction. These four types of interactions are defined by Anderson (2008) as Student-Instructor (SI), Student-Student (SS), Student-Content (SC), and Instructor-Content (IC). SI interaction refers to communication between learners and experts, which includes instructor feedback, support, and encouragement to learners. SS interaction is defined as communication between one learner and other learners, including

collaborative or cooperative settings. SC interaction includes student activities such as reading course materials, watching lecture videos, and completing assignments. IC interaction refers to instructors creating, monitoring, or modifying content or learning activities.

Many empirical studies have examined how the strength of interactions is associated with student learning outcomes, such as their performance or satisfaction (Borokhovski et al., 2012; Choi, Lee, Hong, Lee, Recker, & Walker, 2016; Hoey, 2017; Ke, 2013; Kuo et al., 2013; Murray et al., 2012; Sher, 2009). However, the effects of each interaction type on learning outcomes have not been found to be equal. Our review found that studies yielded different results depending on the outcome variable studied.

First, studies that used measures of student course performance as dependent variables indicated that the effects of SC or SS interaction were larger than the effect of SI interaction on student performance. For instance, Bernard et al. (2009) reviewed 74 empirical studies to examine the effects of three types of interaction (SS, SI, SC) strength on student performance. The results of a meta-analysis revealed that the effects of SS and SC interactions were significantly larger than the effect of SI interaction on performance. Similarly, in other studies, SS or SC interactions (Ke, 2013), SS interaction (Borokhovski et al., 2012; Choi et al., 2016), or SC interaction (Murray et al., 2012) had significant and positive influences on student performance.

Second, studies that used student affective outcomes as dependent variables tended to show somewhat different results. For instance, in the meta-analysis by Bernard et al. (2009), the effect of SS interaction was significantly larger than the effects of SC or SI interactions on student attitudes. However, a study by Kuo et al. (2013) produced opposite results, finding that SC and SI interactions were significant predictors of student satisfaction, while SS interaction was not. To summarize, our review found that the effects of each interaction type differed depending on the dependent variable used in the study and the characteristics of interactions analyzed.

Methods

Course Quality Rubric

This study used course quality rating scores collected through a rubric used at a midsized public university in the U.S. The rubric was developed collaboratively by instructional designers at an Academic Support (AS) unit in order to support instructional designers in better designing online courses as well as ensuring online course quality at this university. The AS rubric was adapted from the well-established and reliable QM rubric and consists of nine dimensions (course organization, course introduction and syllabus, learning objectives, assessments and activities, resources and materials, interaction and learner engagement, accessibility, course technology, and learner support) and 51 items to measure online course quality.

However, we identified several problems with these predefined dimensions. First, the number of items measuring each quality dimension, which influences the coefficients of internal consistency and reliability (Drost, 2011), varied widely across the dimensions (from 3 to 12 items). Second, some items did not adequately reflect their dimension, which raises content validity issue. For instance, one item in the "course instruction and syllabus" dimension, "provides clear expectations for student response, engagement, and participation," also aligned to the "interaction and learner engagement" dimension. For these reasons, we decided to ignore the predefined

dimensions and generate new ones using the results of an exploratory factor analysis, described below.

Research Context and Participants

To measure the preliminary construct validity of the AS rubric (RQ1), we used course quality scores collected from the ratings of 202 online courses offered at this university from 2012 to 2016. Among the 2,797 courses offered during this period, the instructional designers randomly selected 202 courses and evaluated their course quality using the AS rubric. The courses included both undergraduate (173 courses, 85.6% of the sample) and graduate level courses (29 courses, 14.4% of the sample) from various academic disciplines. Each course was rated by one instructional designer in the AS unit at the beginning of the semester. The items were rated on a two-point scale (Yes = 1, No = 0). Note that no responses were coded as null.

To measure the level of online interactions in each course (RQ2), we categorized instructor and student clickstream data automatically collected by the university's LMS into the four types of interactions as defined by the framework described above (see Table 2). Of the original sample of 202 courses, 81 lacked LMS interaction data or student final grades and were excluded from further analysis. The remaining 121 courses enrolled a total of 5,240 students. All measures were converted to Z-scores before computing the average level of interaction. We also measured student course performance in terms of passing rates. This was computed by dividing the number of students who successfully passed the courses (receiving grades of A, B, C, or D) by the number of students enrolled in each course. Among these students, 169 students (3%) received a grade of W (Withdrawal), indicating that the students dropped the course after the first three weeks of the semester.

Table 2

Summary of LMS Variables Used to Measure the Four Types of Interaction

Online Interactions	LMS Variables		Measures
Instructor-Content (IC)	ic_atta	# of attachments posted by an instructor	$\frac{ic_{atta}+ic_{disc}+ic_{wiki}+ic_{quiz}+ic_{assi}}{5}$
	ic_disc	# of discussion topics posted by an instructor	
	ic_wiki	# of wiki topics posted by an instructor	
	ic_quiz	# of quizzes posted by an instructor	
	ic_assi	# of assignments posted by an instructor	
Student-Content (SC)	sc_atta	Avg. # of attachments viewed by a student	$\frac{sc_{atta}+sc_{disc}+sc_{wiki}+sc_{quiz}+sc_{assi}}{5}$
	sc_disc	Avg. # of discussions viewed by a student	
	sc_wiki	Avg. # of wiki topics viewed by a student	
	sc_quiz	Avg. ratio of quizzes completed by a student	
	sc_assi	Avg. ratio of assignments completed by a student	
Student-Student (SS)	ss_disc	Avg. # of discussion messages (initial messages and replies) posted by a student	- *ss_disc*
Student-Instructor (SI)	si_disc	# of discussion messages (initial messages and replies) posted by an instructor	- *si_disc*

Note. The course is the unit of analysis. All interaction measures were converted to Z-scores.

Data Analysis

Before examining the validity of the rubric (RQ1), the internal consistency reliability of the AS rubric was measured using Kuder-Richardson formula-20 (KR-20) with two-point measurement data. Specifically, we used a stepwise procedure to find unreliable items and to maximize scale reliability (Raubenheimer, 2004). In the stepwise procedure, the least reliable item is removed, as indicated by the expected increase in KR-20 coefficient for the subscale. Then, the next least reliable item is removed, and the analysis is repeated until the removal of items does not lead to an increase in reliability.

To examine the preliminary construct validity of the rubric, we conducted an exploratory factor analysis (EFA) as we had little theoretical or empirical basis for the rubric's design. Since our data are dichotomous, we computed *tetrachoric correlation coefficients* and then conducted an EFA using these coefficients. For the extraction factor rotation methods, we chose unweighted least-squares (ULS) extraction with Promax rotation, the recommended method for the analysis of tetrachoric correlation coefficients (Han et al., 2001).

For RQ2, we conducted a path analysis to investigate the relationships between online course quality scores, online interactions, and passing rates. The path model tested three hypotheses: (a) the online course quality scores influence all variables (the four types of interactions) and passing rates; (b) the four types of interactions influence passing rates, and; (c) the online interactions mediate the influence of online course quality scores on passing rates. R Studio with the *psych* and *lavaan* packages was used for all analyses.

Results

Research Question 1: Reliability and the Preliminary Construct Validity of the AS Rubric

The first research question examined the reliability and the validity of the AS quality rubric using its quality dimensions and items. To answer this question, we conducted an internal consistency reliability analysis and an EFA. The initial KR-20 coefficient for 51 items was .82. Next, the stepwise procedure was performed to maximize reliability. As a result, eight items were eliminated (16% of the total) (see Table 3), and the KR-20 coefficient for 43 items increased to .87. As summarized in Table 3, four of the eliminated items (item #39, #40, #41, #42) were related to the "accessibility" dimension. The other four eliminated items (item #28, #30, #31, #47) related to course technology issues

Table 3
The Items Eliminated from the Reliability Test and the EFA

	Item no.	Descriptions
Items removed from the reliability test	item40	Scanned PDF documents are made screen readable with OCR technology.
	item41	Images used for learning have a visual description.
	item39	Audio is captioned or transcribed.
	item47	Course provides sufficient instructions for students on use of tools and media.
	item31	No unreasonable software requirements.
	item42	Images have an alt tag.
	item30	Resources & materials can be accessed with multiple operating systems.
	item28	Resources & materials are easily accessed and used.

Items removed from the EFA	item11	Provides clear expectations for instructor response and engagement.
	item08	Evaluation methods and assessment activities are clearly outlined.
	item29	Purpose of each element is explained
	item32	Learner engagement and interaction activities promote achievement of learning objectives.

Next, we conducted an EFA using the remaining 43 items to examine the preliminary construct validity of the rubric. The results of Bartlett's test of sphericity ($\chi^2[903] = 16200.13$, $p < .05$) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (KMO = .70) indicated that our data were suitable for performing a factor analysis (Yong & Pearce, 2013). Forty-three items were analyzed using an ULS extraction method with Promax rotation. For the convergent validity, we used cut-off loadings of 0.4. Next, to determine the number of factors to retain for rotation, we checked eigenvalues (Kaiser's rule) and performed a parallel analysis. The results indicated that the nine-factor solution had the cleanest structure (i.e., fewest cross-loadings and no factors with fewer than three items).

Table 4 shows the results of factor loadings for the 43 items. The nine-factor solution explained 73% of the total variance. Among the 43 items, another four items were eliminated because one cross-loaded onto two factors, and the other three did not have primary factor loadings of .4 or above. These four items tended to have imprecise descriptions or criteria to evaluate course quality, perhaps making use by raters difficult (see Table 3).

Table 4

Results of Factor Loadings for AS Rubric Items (43 items)

Items	1	2	3	4	5	6	7	8	9
Eigenvalues	5.99	4.08	3.70	4.03	3.09	3.01	2.51	2.59	2.44
% of variance	0.14	0.09	0.09	0.09	0.07	0.07	0.06	0.06	0.06
Cumulative %	0.14	0.23	0.32	0.41	0.49	0.56	0.61	0.67	0.73
item19	0.59	-0.13	-0.25	-0.20	0.26	-0.03	0.09	0.12	0.37
item22	0.42	0.13	0.21	0.08	0.22	0.16	-0.28	-0.04	0.29
item23	0.87	-0.15	0.15	-0.12	0.01	0.20	0.07	0.12	-0.43
item24	0.44	-0.09	-0.02	0.19	0.06	0.34	-0.17	0.24	-0.18
item25	0.58	0.32	-0.09	-0.23	0.15	0.00	0.29	-0.05	0.14
item26	0.68	0.18	-0.12	0.28	-0.17	-0.02	0.12	-0.13	0.16
item27	0.83	-0.01	0.11	0.16	-0.25	0.09	0.01	-0.01	0.03
item43	0.64	-0.15	0.09	0.20	0.20	0.06	-0.05	0.33	-0.10
item44	0.82	0.31	-0.14	0.07	-0.03	-0.01	-0.03	-0.30	-0.03
item48	0.51	0.13	0.09	-0.09	-0.12	-0.16	0.06	0.28	-0.01
item01	0.02	0.89	-0.22	-0.04	-0.01	-0.01	-0.06	-0.01	0.11
item02	0.08	0.71	0.06	-0.08	-0.13	0.16	-0.14	0.11	0.04
item03	0.17	0.84	0.14	0.10	-0.21	0.16	-0.22	-0.07	-0.09
item04	0.12	0.62	0.18	0.20	0.10	-0.01	0.03	-0.06	-0.02
item49	0.12	-0.03	0.78	-0.13	0.00	0.10	0.10	0.02	0.00
item50	-0.03	0.06	1.02	0.04	0.00	0.04	-0.05	-0.13	-0.07
item51	-0.08	0.06	0.98	0.06	0.02	0.01	-0.05	-0.12	0.00
item13	0.18	0.10	0.03	0.76	0.09	-0.06	0.38	-0.04	-0.13
item14	-0.06	0.30	0.20	0.55	0.22	0.07	-0.05	0.12	-0.08
item34	0.03	-0.05	0.16	0.73	0.21	-0.13	0.09	-0.37	0.18
item35	0.06	-0.15	-0.18	0.74	-0.22	0.35	0.24	-0.12	0.30
item36	0.39	0.03	-0.18	0.54	0.07	0.14	0.01	-0.06	0.03
item37	-0.01	0.14	-0.26	0.47	0.08	0.03	-0.11	0.27	0.07

Items	1	2	3	4	5	6	7	8	9
item16	-0.15	0.00	0.00	0.24	0.98	0.10	0.04	-0.11	-0.30
item17	-0.08	-0.10	-0.03	0.11	0.81	-0.19	-0.01	-0.05	0.13
item18	0.16	-0.17	0.03	-0.03	0.78	-0.06	0.06	0.13	0.11
item05	-0.05	0.26	0.12	0.03	-0.20	0.59	0.12	0.00	-0.07
item06	0.17	0.10	-0.02	0.02	0.08	0.76	0.07	0.08	-0.13
item12	0.12	-0.44	0.33	-0.07	-0.15	0.46	0.39	0.03	0.21
item33	0.26	-0.03	0.19	0.27	-0.02	0.44	-0.09	0.09	0.21
item07	-0.35	0.25	0.08	-0.04	0.26	0.11	0.41	0.28	0.19
item09	0.17	0.06	0.15	-0.11	0.10	0.34	0.49	-0.09	0.09
item10	0.09	-0.34	-0.08	0.40	-0.04	0.03	0.99	-0.01	0.08
item38	-0.24	0.02	0.02	0.05	0.00	0.33	0.00	0.42	0.39
item45	0.08	0.17	-0.28	-0.25	-0.11	0.22	0.08	0.96	0.11
item46	0.40	-0.19	0.17	-0.03	0.10	-0.19	-0.08	0.66	0.10
item15	-0.23	0.32	0.14	0.00	0.23	0.37	-0.12	-0.14	0.54
item20	-0.02	0.13	0.32	0.14	-0.28	-0.37	-0.09	0.18	0.44
item21	0.08	-0.10	-0.13	0.16	-0.06	-0.16	0.28	0.17	0.67
item11*	-0.24	0.29	0.01	0.46	-0.08	0.21	0.43	0.13	-0.09
item08**	0.08	0.11	0.34	0.00	0.13	-0.49	0.36	0.07	0.09
item29**	0.39	0.35	-0.13	0.02	0.10	-0.03	0.06	0.19	-0.01
item32**	0.24	0.23	-0.24	0.37	-0.01	0.06	-0.07	0.17	0.24

Note. Factor loadings < .4 are suppressed. * Item cross-loaded onto multiple factors. ** Items without primary factor loadings of .4 or above.

Finally, Table 5 summarizes the nine factors, their labels, and their 39 items based on the EFA. Factor 1 accounted for the highest amount of the total variance (14%) among the nine factors. Ten items displayed meaningful loadings (greater than .40) for this factor and all the items related to student activities or course content. This factor was labeled "Learning Activities & Materials."

Table 5

Summary of New Factors and Their Items Based on the EFA

EFA constructs and labels		Items from AS rubric
Factor 1 (Learning Activities & Materials)	item19	Assessments and activities are consistent with the course objectives and resources.
	item22	Activities provide students with opportunities to receive feedback early and frequently, specifically in preparation for high stakes assessments.
	item23	Course includes assessments and activities that are problem-centered or application-oriented in nature.
	item24	Students are encouraged to integrate new concepts into regular practice and understanding through demonstration, reflection, creation, or similar activities.
	item25	Resources & materials support learning objectives.
	item26	Resources & materials are sufficient for students to learn the subject.
	item27	Resources, materials, and instructor interactions activate students' prior learning and experiences while introducing new concepts.
	item43	Tools and media support the learning objectives.
	item44	Tools and media are appropriately chosen and appropriately varied to enhance student interactivity with course content.
	item48	Course provides additional tutorials/resources as needed to accomplish objectives.

EFA constructs and labels	Items from AS rubric	
Factor 2 (Course Introduction & Design)	item01	Upon first entering the course, students can easily find the course syllabus and introductory materials.
	item02	The progression of course content and activities is easy to find, clearly outlined, and appropriately segmented into units or modules.
	item03	Course appears visually clean, consistent, and appealing on the home page and throughout.
	item04	A course introduction orients student to the course environment and suggests the relevance of course materials and activities to students and/or program goals.
Factor 3 (Learner Support)	item49	Course provides technical support services link/description.
	item50	Course provides academic support services link/description.
	item51	Course provides student support link/description.
Factor 4 (Learner Engagement & Interaction)	item13	Provides clear expectations for student response, engagement, and participation.
	item14	Provides clear expectations for student etiquette in participation.
	item34	A means for making course announcements is clearly available and used regularly to encourage student completion and participation and to connect course content with current events and research.
	item35	Course design fosters interaction with other students.
	item36	Course design fosters interaction with content.
	item37	Appropriate synchronous or asynchronous means are provided for students to ask questions and receive answers from the instructor and/or students.
Factor 5 (Learning Objectives)	item16	Objectives are clearly stated.
	item17	Objectives are measurable.
	item18	Objectives are consistent with the course material/assessments/assignments.
Factor 6 (Course Facilitation)	item05	Course has an instructor introduction.
	item06	Students have an opportunity to introduce themselves.
	item12*	Course fees, if any, are explained.
	item33	Course design fosters interaction with instructors.
Factor 7 (Course Information)	item07	The course grading policy is clearly stated.
	item09	Course technology requirements are addressed up front, if applicable.
	item10	Textbook information and other materials requirements are provided.
Factor 8 (Course Technology)	item38	Course has a statement directing students with ADA-documented disability to the DRC for reasonable accommodations as needed.
	item45	Tools and media are as easy to use as is reasonably possible.
	item46	Tools and media are sufficiently compatible with web and other applicable standards.
Factor 9 (Course Management)	item15	Syllabus addresses course-appropriate policies, including academic honesty, harassment, withdrawal and I-grades, and the student grievance process.
	item20	Appropriate pacing mechanisms (due dates, reminders, follow-ups) are used to ensure timely student completion and regular engagement.
	item21	Specific descriptive criteria are provided for the evaluation of student's work and participation, ideally in the form of a rubric.

Note. * Item does not fit well in category

Factors 2, 3, and 4 each explained 9% of the total variance. The four items loading onto Factor 2 related to aesthetic dimensions of the course or its introductory materials. This factor was labeled "Course Introduction & Design." The three items loading onto Factor 3 dealt with whether academic or technical support links/descriptions are provided in the courses (labeled "Learner Support"). Six items displayed significant loadings for Factor 4 related to interaction, student participation, and engagement in courses (labeled "Learner Engagement & Interaction").

Factors 5 and 6 each explained 7% of the variance. Factor 5 consisted of three items and was labeled "Learning Objectives." Four items displayed meaningful loadings for Factor 6. Three items (item5, item6, item33) dealt with facilitating the courses (labeled "Course Facilitation"). However, one item (item12: "Course fees, if any, are explained") did not seem to measure the same construct as other items, which implies that revisions to the rubric are needed.

Factors 7, 8, and 9 each explained 6% of the total variance. The three items loaded onto Factor 7 dealt with course policy or requirements (labeled "Course Information"). Factor 8 consisted of three items related to course technology issues (labeled "Course Technology"). The three items showing meaningful loadings for Factor 9 dealt with course management issues such as syllabus, pacing mechanism, and evaluation of student work (labeled "Course Management").

Research Question 2: Instructional Value of the Rubric

The second research question investigated how course quality measures, when mediated by student and instructor online interactions, influenced course passing rates. We used a path analysis to model the influence of course quality scores on the four types of online interactions and passing rates. Table 6 summarizes the descriptive statistics for course quality rubric scores, online interactions, and passing rates. For course quality scores, we computed average rubric scores for the nine factors identified by the EFA.

Table 6

*Descriptive Statistics of all Variables Included in the Path Model (*N *= 121 courses, 5,240 students)*

	Variables	*M*	*SD*	Min.	Max.
Course quality scores (rubric scores)	Factor 1: Learning Activities & Materials	0.92	0.16	0.10	1.00
	Factor 2: Course Introduction & Design	0.87	0.26	0.00	1.00
	Factor 3: Learner Support	0.87	0.30	0.00	1.00
	Factor 4: Learner Engagement & Interaction	0.76	0.30	0.00	1.00
	Factor 5: Learning Objectives	0.88	0.27	0.00	1.00
	Factor 6: Course Facilitation	0.83	0.25	0.00	1.00
	Factor 7: Course Information	0.95	0.17	0.00	1.00
	Factor 8: Course Technology	0.93	0.17	0.00	1.00
	Factor 9: Course Management	0.80	0.26	0.00	1.00
Online interactions (recorded by LMS)	Instructor-Content interaction*	0.00	0.67	-0.95	3.37
	Student-Content interaction*	0.00	0.58	-1.22	2.44
	Student-Student interaction*	0.00	0.99	-0.63	4.97
	Student-Instructor interaction*	0.00	0.99	-0.73	4.86
Course passing rate (ratio)		0.90	0.12	0.45	1.00

Note. The course quality scores are binary. *All interaction measures were converted to Z-scores.

First, we performed a path analysis using the initial model, with the direct effect of the course quality scores on course passing rates represented as path c, the direct effect of online interactions on course passing rates represented as path b, and the indirect effect of course quality scores on course passing rates represented as path a (see Figure 2). The model was statistically significant ($\chi^2[6] = 89.34$; $p < .05$), but it did not have a satisfactory model fit (Comparative Fit Index [CFI] = .37, recommended to be greater than .90) and included nonsignificant paths.

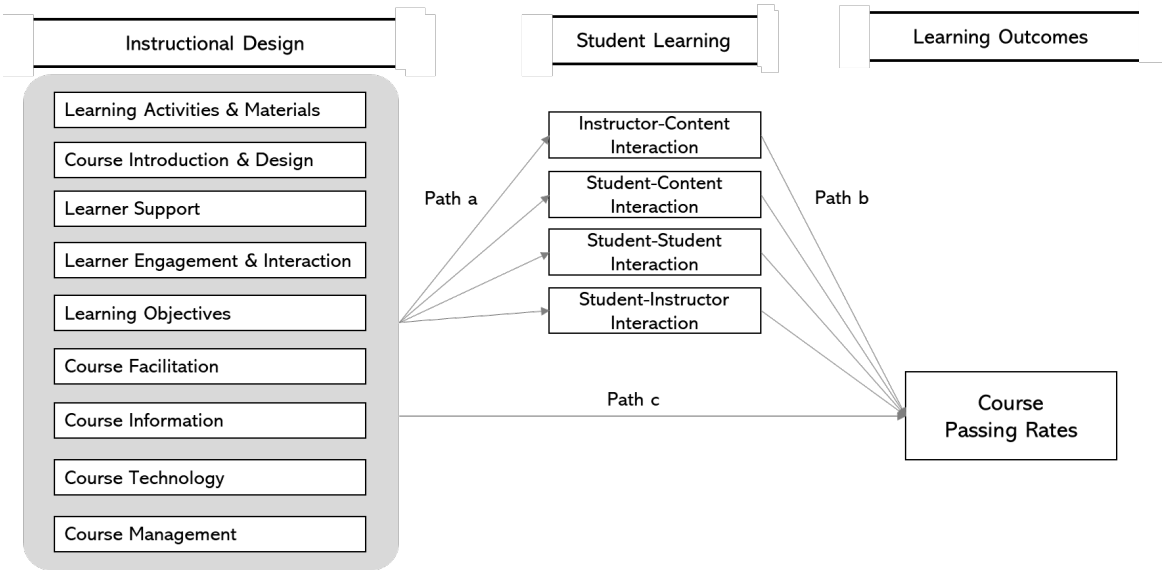

Figure 2. Path diagram for the initial model of the relationships among the course quality scores, online interactions, and course passing rates. (Note: Path a is from each of the nine factors to the interaction variables.)

We therefore dropped the nonsignificant paths and reconducted the path analysis, which showed good model fit ($\chi^2[6] = 14.26$; $p < .05$, CFI = .91, RMSEA = .11). Figure 3 shows the results with the standardized regression coefficients. In the revised model, all path coefficients were significant at the .05 level except for one path (Course Facilitation - Passing rate, $\beta = .155$, $p > .05$).

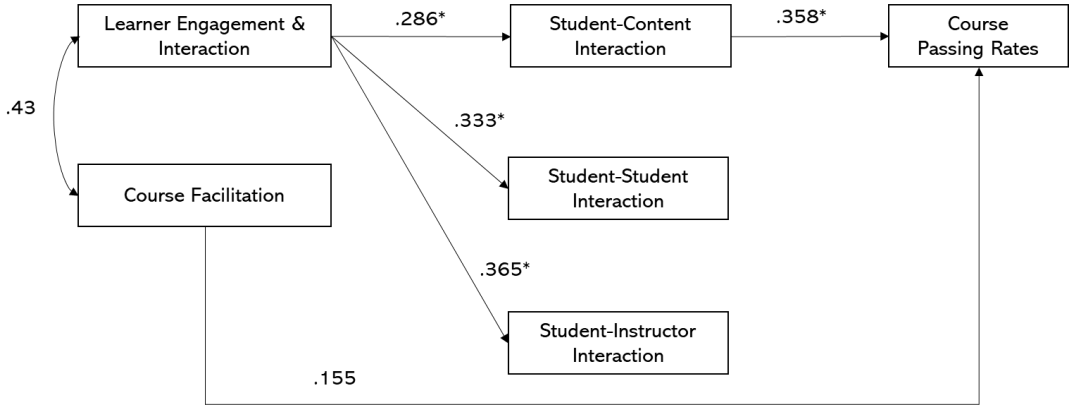

Figure 3. Path diagram for the final model.

Regarding the causal relationships between online course quality scores and online interactions, "learner engagement & interaction" scores had significant influences on Student-Content ($\beta = .286$, $p < .05$), Student-Student ($\beta = .333$, $p < .05$), and Student-Instructor interactions ($\beta = .365$, $p < .05$). Finally, Student-Content interaction had a significant direct effect on passing rate ($\beta = .358$, $p < .05$). The R-squared value indicates that approximately 16.3% of the variance in passing rate is explained by this model.

Discussion

This study examined the preliminary construct validity and instructional value of an online course quality rubric, the AS rubric. Instructional value was investigated in terms of the relationships between course quality, as measured by the AS rubric scores, online interactions between students, instructors, and content as automatically captured by the Canvas LMS, and student course passing rates.

For RQ1, the internal consistency reliability test for the AS quality rubric revealed eight unreliable items. Four were related to course accessibility, while the other four were related to course technology or course materials and resources. In addition, we found that some of the removed items did not use precise terms or clear guidelines in terms of evaluating course quality. For instance, the item "no unreasonable software requirements" did not define "unreasonable." Similarly, in the case of the item "course provides sufficient instructions for students on use of tools and media," the criteria for "sufficient" can be subjectively interpreted. Internal consistency reliability can be improved by using precise terms, clear guidelines, and making instructions as explicit as possible (Cohen et al., 2007). The EFA revealed four additional problematic items that either loaded on multiple factors or did not significantly load on any factor. The EFA identified nine factors, explaining 73% of the total variance. Among these nine factors, "learning activities & materials" explained the highest amount of total variance in course quality.

For RQ2, we modeled the causal relationships between the online course quality scores, the four types of online interactions captured by the LMS, and passing rates using a path analysis. First, results show that only rubric scores related to the "learner engagement and interaction" construct had a positive and significant effect on online interactions. The quality scores of "learner engagement and interaction" had the largest effect on SI interaction, followed by SS and SC interactions. Thus, online courses that are designed to encourage student participation and interaction with other students appear to not only have a higher level of SS interaction but also a higher level of SC and SI interactions. The quality measures for the other dimensions did not have a significant impact on any of the types of online interactions. While these dimensions address course features that are certainly desirable aspects to include in course design, they may not contribute to enhanced online interactions per se.

Second, in terms of the associations between the four types of interactions and passing rates, only SC interaction had a significant and positive effect on passing rates. This aligns with previous findings that SC interaction positively influenced performance (Bernard et al., 2009; Ke, 2013; Murray et al., 2012). We also note that SS interaction did not have a significant effect on passing rates. One reason for this result might be contextual differences as this study included courses from various academic disciplines. Indeed, one study (Ke, 2013) found that there were significant differences between disciplines in terms of the amount and type of online interactions.

Lastly, in terms of the relationship between the course quality scores and passing rates, the scores for one construct, "course facilitation," had positive and significant influences on passing rates in the initial model, but not in the final model. However, scores on the "learner engagement and interaction" construct had a positive and significant effect on SC interaction, which, in turn, significantly and positively influenced passing rates. Thus, the results imply that course design elements related to "learner engagement and interaction" are an important aspect of course quality, indirectly contributing to course performance. Another study (Jaggars & Xu, 2016) reported a similar result in that the "interpersonal interaction" dimension of a quality rubric had a significant and positive impact on student final grades, while other dimensions of the rubric did not. In addition, while the final path model explained only 16.3% of the variability in passing rates, it is important to note that many other factors, in particular, student-related factors (e.g., academic background, relevant experiences), also influence successful course completion (Lee & Choi, 2011).

Limitations and Future Research

Several limitations to this research are important to note. In terms of the AS rubric, although the quality of over 200 online courses was measured, all came from a single university with its own institutional culture. Also, the rubric was only applied by one rater thus making it impossible to determine another important form of reliability, inter-rater reliability. Finally, the rubric used a binary score while a Likert scale may have increased the usability of the rubric (Yuan & Recker, 2015). In addition, our data were also drawn from various academic disciplines. As previously mentioned, one study (Ke, 2013) found significant disciplinary differences in online interaction patterns. Therefore, future research should consider the quality of online interactions using a disciplinary lens. Future work should also consider how results from this study inform rubric design to improve validity and instructional value. Finally, future work should examine the influence of course design and interaction variables on other important kinds of student learning outcomes (e.g., satisfaction, perseverance).

Conclusions

While the AS rubric was based on the widely used and reliable QM rubric, almost one-fourth of the rubric items were identified as problematic. This concerning result has implications for other quality rubrics used in higher education institutions because: (a) most of the rubrics reviewed in the literature were adapted from existing rubrics, rather than based on empirical testing or online learning models and (b) none of the rubrics reported results from reliability or validity tests. In particular, a lack of construct validity may result in misinterpretations of a construct, as well as raise doubts about the suitability and credibility of the measurement tool (Cohen et al., 2007; Yuan & Recker, 2015). Thus, more empirical studies are needed to establish the reliability and validity of existing course quality rubrics.

From a practical perspective, this study has several implications. During the course design stage, instructors and course designers could consider adding different strategies to promote students' engagement and interactions, for example by using games and simulations, providing hands-on activities, and building an online course community using social networks. During the course review process, course designers could consider providing rubric definitions and guidelines, especially for items that are more subjective. They could also consider revising items related to course accessibility and technology use to make them easier to apply.

At the university level, although different higher education institutions might have different needs and criteria for evaluating online courses, a quality rubric plays an important role in identifying and addressing elements deemed important to instructional design (e.g., accessibility, course objectives). It is important to consider to what extent these elements serve to influence (or not) subsequent online interactions and learning outcomes. Many factors, stakeholders, and decisions influence the design of online courses and these results are revealing in terms of identifying those that seem to have a greater impact on students and providing guides for instructors and instructional designers on their course design process.

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A Dramaturgical Examination of Online University Student Practices in a Second Year Psychology Class

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Abstract
This study employs dramaturgical analysis, the study of social interaction in terms of theatrical performance, in examining online student interactions. Region-specific activity—front stage (the course LMS) versus backstage (Facebook)—was examined to determine where students spend their time doing class-related tasks. The context for this case study is a second-year online psychology class at an Australian university. Data were collected concerning students' course-related activities in the two venues. Over a 12-week semester, 126 students were observed in the LMS. Twenty-one students completed fortnightly questionnaires about where they spent their time and with whom. At the end of the semester, 14 students participated in online interviews. Findings suggest that the audience in each setting, as well as the timing of communication and duration within each setting, appear to have contributed to shaping students' learning experiences. Awareness of these contributing factors may aid online teachers in understanding students' learning preferences, and the roles of social networking tools in supporting learning collaborations.

Keywords: online learning, online teaching, student experience, Facebook, Goffman

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A Dramaturgical Examination of Online University Student Practices in a Second Year Psychology Class

Dramaturgical sociology views human interactions determined by time, setting, and audience (Goffman, 1959). Goffman's approach advocates that one must not analyze the cause of human interactions, but instead examine contexts in which those interactions occur. Goffman (1959) uses theatrical metaphors, specifically the stage: front stage (where the actors perform for an audience) and backstage (where the actors prepare for the performance). This study considers the learning management system (LMS) as the front stage and Facebook as the backstage and examines how and why online students use backstage online settings, such as Facebook, instead of front stage settings, such as the LMS, to support their university learning. A second-year online psychology class was selected as the case due to its large class size and the fact that students were familiar with online learning and social media. Online observations, questionnaires, and interviews were employed to understand students' front stage and backstage learning experiences.

Facebook and social learning in the university context

Facebook is a popular social networking tool among university students. Junco (2014), for example, found that university students spend over an hour a day using Facebook for university purposes. The three main ways to express presence on Facebook are through individual profiles, pages, and groups. A Facebook profile is a personal account where an individual can connect with friends, see other friends' posts, share their own thoughts, and share photos or links to internet sites. Facebook pages, on the other hand, are for official individuals (like Taylor Swift) or businesses to share stories and connect with people. In the university context, a university might have an official page and students would "like" the page. Then updates from the page would appear on individual users' Facebook feeds. Universities have successfully used official Facebook pages to integrate new students into academia before course registration (Lin, Hou, Wang, & Chang, 2013). There are also Facebook groups, which are settings for a small group or community to converse and share information. In one study, students reported being members of five or six university-related Facebook groups. These included groups for primary school alumni, political affiliations, hobbies, sharing opinions on current topics, having academic conversations, and sharing learning materials (Bosch, 2009). Groups can be publicly available, for anyone to join, or privately available where those who join must be approved by an administrator.

The affordances to communicate synchronously through Facebook messaging, asynchronously through wall posts, as well as commenting on and sharing information, are features that make Facebook ideal for social learning. While the blurring of lines between social networking and university learning has been criticized by some students (Donlan, 2014) and teachers (Prescott, Wilson, & Becket, 2013), others believe the inherently social nature of such sites supports learning. Indeed, studies surveying students found that they feel Facebook has the potential to promote collaborative and cooperative learning (Arouri, 2015; Bicen & Cavus, 2011; Roblyer, McDaniel, Webb, Herman, & Witty, 2010). Social learning theories see learning as generated through the observation of others and through direct experiences with others – two modes that Facebook tools afford. In their theory of situated learning, for example, Lave & Wenger (1991) refer to this phenomenon as legitimate peripheral participation (LPP). LPP is the process of observing others before direct social interaction with others. By observing others, students can learn about behaviors and their consequences as well as reap the benefits of any information shared while observing others' social interactions. Once a learner moves beyond LPP they can chose to take a more visible role in the group, however this is not a requirement of continual learning.

Lave & Wenger (1991) suggest that situated learning occurs when a group is made up of novices and experts, or newcomers and old-timers. The mixed abilities create opportunities for more experienced members to share their knowledge. An expert or old-timer can also be referred to as a more knowledgeable other (Vygotsky, 1978; Wenger, 1998). When students are surrounded by peers of various knowledgeability, they are afforded opportunities to go beyond the content that was scaffolded for them in the design of the curriculum. This is advantageous for students whose needs may not be being otherwise met. As one study suggested, learning backstage on Facebook was the result of a student's inability to find information and not understand content, assessments, or course administration (Cuesta, Eklund, Rydin, & Witt, 2016). This suggests that information seeking performed by a novice and information sharing performed by an expert or more knowledgeable other occurred. In several studies students reported that Facebook posts that asked questions that grew into discussions were beneficial to their learning (DiVall & Kirwin, 2012), particularly when the responses came from a 'more knowledgeable other,' such as the teacher

(Rambe, 2012) —again illustrating how cohorts of mixed abilities can support learning. In addition, one study found that Facebook posts about *not understanding* were balanced with responses of *understanding* by a 20:18 ratio (English & Duncan-Howell, 2008). This suggests that more knowledgeable others were present and willing to share their experiences and knowledge.

While expert presence may be viewed positively, it can also be disruptive. Rambe (2012) found that students abstained from answering classmates' Facebook posts related to content and waited for a teacher to respond. In this instance, students viewed the content-related posts as the teacher's domain (Rambe, 2012). Similarly, in Facebook groups with both postgraduates and undergraduates present, the postgraduates posted the most and the undergraduates posted the least (Ru-Chu, 2013). When experts, such as a teacher or older student, are present on the Facebook page, the students might defer to the expert and self-identify areas where they should not answer, even if they can. There was, however, one exception to this. (Bowman & Akcaoglu, 2014) found that "super-users" responded to classmates regardless of whether they knew the answer. With the exception of "super-users," students may be aware that more knowledgeable others are present and defer to them.

Students can also use situated learning to learn how to be a university student while learning course content. Learning to be a student involves knowledge-seeking or knowledge-sharing as regards course management, academic codes, and course requirements, particularly those related to assessments (Bowman & Akcaoglu, 2014; Cuesta et al., 2016). Learning content, on the other hand, involves seeking or sharing an understanding of content specific to a particular class. Learning-content posts, for example, can include links from class materials to current events (Bosch, 2009; Staines & Lauchs, 2013), political thought (Hyde-Clarke, 2013), as well as work experiences (English & Duncan-Howell, 2008). Overall Facebook posts about learning-to-be-a-student consistently outnumbered Facebook posts about learning the knowledge of a content area and, even when students' used Facebook independent from their class, they continued to seek and share information related more to assessments than the content knowledge (Selwyn, 2009). Nonetheless, as these studies demonstrate, few studies explore why students migrate towards online social spaces beyond the course. The studies only viewed students in one context, the Facebook context. Similarly, in studies of education it is common for researchers to only explore the formal education setting (Livingstone & Sefton-Green, 2016). The intent of this paper, however, is to explore student interactions in both settings. To achieve this, I employ Goffman's (1959) region-based behavior as the theoretical lens. The next section describes this approach and how it was applied across the two contexts.

Theoretical Approach: Goffman's (1959) region behavior

In dramaturgical sociology, region behavior occurs in any place defined by cultural perception. Borrowed from theater, Goffman (1959) metaphorically employs two regions of social behavior, the front stage and the backstage, as a means of analyzing social behaviors. In the front stage, an actor is putting on a performance and is conscious of being observed by others. In the backstage, an actor is afforded privacy from those in the front stage. The backstage is a place for preparation for front stage performance and a place to seek reprieve. In Goffman's 1959 study of the Shetland Hotel, he identified the dining room and parlor as the front stage. This was the space where guests and hotel staff interacted with each other. In this space, both employees and guests behaved according to British middle-class norms. But in the backstage, the kitchen, the employees behaved according to Shetland Islander norms. This meant that acceptable food, attire, and behavior in the backstage was different to that of the front stage. For example, it was acceptable

to wear a hat, hang socks over the stove to dry, spit in a cup, and keep moldy soup in the backstage. However, in the front stage, staff maintained a polished appearance and the presence of mold was unacceptable.

Goffman's (1959) overall observation was that an employee's front stage (in the restaurant) and backstage (in the kitchen) was parts of the whole individual separated by a kitchen door. Technology, the door, played an important role in situating behavior within the spaces of the hotel. Behaviors the hotel managers did not want the hotel customers seeing remained hidden behind the door in the backstage. One of the main parameters of Goffman's body of work is co-presence of participants. In recent times, however, technology has come to simulate a co-presence between people. In online studies, however, not studies of university students, Goffman's region behaviors have been applied to produce a fuller account of how internet users engage across the backstage and front stage spaces (Bullingham & Vasconcelos, 2013; Hogan, 2010; Pearson, 2009; Ross, 2007; Trammell & Keshelashvili, 2005). Bullingham & Vasconcelos (2013) argue that blogs and avatars are online environments, which could be the front stage to an offline backstage.

If the LMS is identified as the front stage, then all other environments that a student uses to prepare for their performance there combine to form the students' backstage learning environment. A front stage is typically marked by the decorum of those present, not the space. In the Shetland Hotel example, the front stage was marked by middle-class norms and the backstage Shetland Islander norms. However, the backstage kitchen was not totally hidden from the front stage dining area. The door, which separated the stages, could be propped open at times by waitstaff who were carrying heavy trays. This permitted customers the opportunity to glimpse into the kitchen. It did not suddenly turn the kitchen into a momentary front stage. By comparison, Ross (2007) studied London cabbies-in-training who used public online message boards as a backstage to their front stage in-person cabbie training. The backstage was an online community for learners, created by learners, with an occasional outsider passing through. The online backstage afforded cabbies a space to feel connected by using informal language, share resources that made learning possible, as well as anonymity that made critiquing actors from the front stage (examiners, customers, colleagues) possible.

In the context of the current study, for students taking formal online courses the LMS, the frontstage, is considered the central locus of learning. It provides space and tools where students and teachers can store and access learning materials, to communicate on discussion boards, and to submit assignments. As in the case of the Shetland Hotel where the door mediated the roles actors played between the dining room and the hotel kitchen, the LMS mediates the role of students and their interactions. Questions and statements posted to a front stage discussion board can be viewed by everyone in the course. If this public action induces feelings of stage fright, this may discourage further posting. That does not mean the question ceased to exist or went unasked. It could indeed get asked in a backstage venue. Facebook is often used a backstage where university students can interact out of view from teachers and staff, and essentially learn how to be university students (Selwyn, 2009).

For the purpose of this study, the front stage is defined as the space where an online student gives a performance—the LMS. Actions in the LMS front stage space can be "seen" by the university, whether through the online discussion board or through student activity logs. The backstage is the space where an online student prepares for a performance. This study examines what students do beyond the LMS and how social media spaces preferred by students afford social learning and enrich the student experience.

Methods

This research employs a constructivist paradigm in that it examines participants' lived experiences (Waller, Farquharson, & Dempsey, 2016). Researchers applying this paradigm accept that reality is socially constructed from the participants' point of view. Meaning is not taken for granted and interpretations of actions are based on how those we study define the situation (Denzin, 1989). While the findings are thus limited to the cohort studied, findings and their interpretations can nonetheless inform theory, research, and practice (Stake, 1995).

Data were collected through observations, fortnightly questionnaires, and interviews. In the first week of the course, the teacher announced that I would be observing for research purposes and encouraged students to participate in the research. Over a 12-week semester I observed 126 students in the front stage LMS. Of the 126 students, 21 students opted to complete fortnightly questionnaires that prompted the students to report where they spent their time completing class-related-tasks in the backstage, and with whom. At the end of the semester, 14 students chose to participate in an online interview. All data collection procedures were conducted in accordance with the university human ethics guidelines of the university. In the three sections that follow, I include a brief description of each approach.

Observations

Being enrolled in the LMS as an observer enabled me to take in the scene of the research setting – specifically the participants' front stage. I knew what students were being asked to do and when, including reading the weekly learning materials, activities, and assessments. I observed students' responses to the weekly activities and conversations that occurred in the discussion boards. If the teacher sent a group email, I also received the email. My observations of the front stage contributed to my understanding of the data generated from the backstage in the Facebook context.

Questionnaires

Fortnightly questionnaires were used to collect data about students' content-related tasks and study habits over the twelve-week semester. Each fortnight students were asked to recall where they went to seek and share information related to the course, who they interacted with, and for how long they did each of these actions in the front stage and backstage.

Interviews

Interviews gave participants the opportunity to give voice to their front stage and backstage data. Interviews were transcribed, uploaded to NVivo and coded by applying Braun & Clarke's (2006) guidelines for thematic analysis. To assure trustworthiness I participated in member checks and triangulation between the three data types (see Stake, 1995). The students who participated in the questionnaire and interview were a mix of part-time and full-time enrolments and ranged in age from 21 to 73 years old. They were also from a variety of locations around Australia, including major cities like Melbourne and remote areas like far north Queensland.

Setting: A second year university psychology class

This research was conducted in an online second year psychology class at an Australian university, which offers both face-to-face and online degrees. This course was part of a fully online bachelor's degree in psychology. The online students are awarded the same qualifications as the on-campus students. The class was delivered using the Blackboard Learning Management System

(Blackboard), which afforded students and teachers two main functions: access to course content and communication. The course content function allowed students to access learning materials such as articles, assignments, and videos. These learning materials were organized into twelve weekly learning modules. Each week covered one theoretical approach to counselling, which included a video of a patient receiving counselling and a discussion board activity. The communication function allowed for both asynchronous and synchronous communication between teachers and students. The class also used a live conferencing tool called Collaborate to host one-hour weekly tutorials.

Participation in discussion board forums was not graded; however, the syllabus stated that students were expected to contribute to the discussion board forums on a regular basis. Three total contact hours were prescribed for the course, which included two hours per week completing the learning materials, and one hour per week participating in a synchronous Collaborate tutorial (or watching the recording of those who participated). One unit coordinator and four tutors taught the class. The teaching team was responsible for monitoring the discussion board forums, marking students' assessments, and running the weekly Collaborate sessions.

Results

Consistent patterns in the students' participation emerged in the front stage observation data. In order to illustrate this, I characterized the students into four front stage typologies: performers, extras, cameos, and stagehands. The typologies not only describe the participation patterns, but also extend Goffman's (1959) theater terminology (front stage, backstage, actors, props, setting). Table 1 describes the performance patterns observed in the front stage.

Table 1

Description of Front Stage Roles

Front stage role	Description of the front stage performance patterns
Performer	Posted weekly, or more, to front stage discussion boards
Extras	Occasionally posted to the front stage discussion board, participation was consistent at the start and tapered off
Cameos	Made brief appearances in the front stage discussion board. This was typically to introduce themselves or ask one question about one assessment
Stagehands	Never posted to the front stage discussion board

Table 2

The Breakdown of Students in the Psychology Class and Total Participants in the Fortnightly Questionnaires and Interviews

Level of participation	Total students enrolled in the class	Total participants in fortnightly questionnaires	Total participants in interviews
Stagehand	44	7	3
Cameo	45	6	4
Extra	23	4	3
Performer	13	4	4
Total students	**126**	**21**	**14**

Source**:** Front stage observation data

Table 2 shows the breakdown of performers, extras, cameos, and stagehands in the psychology class. A variety of participation levels were present in the study. In addition, participants who completed questionnaires and interviews were well represented across the participation levels. Out of the 126 students, a total of 44 were stagehands and therefore never posted to the discussion board, and only 13 were performers. Most students rarely, if ever, posted to the discussion board in the front stage.

Interestingly, Table 2 illustrates how those students who had the highest representation in the study, the stagehands, had the lowest representation in the front stage discussion board. This participation pattern could be used to support the suggestion that a student's front stage data, such as posting to the discussion board or hours spent logged into the front stage, may not be an indicator of engagement in the online class. This was further supported by Table 3, which compares the average hours students spent in the front stage compared to the time students reported using to complete class-related tasks in the backstage.

Table 3

Average Hours that 21 Participants Performed Class-related Tasks over 12 Weeks

Level of participation (the cast)	Average hours online in the front stage	Average hours backstage online	Total Average online hours
Stagehands	10	27	**74**
Cameos	9	17	**63**
Extras	28	59	**142**
Performers	75	34	**145**
Total	**122**	**137**	**424**

Source**:** LMS data and questionnaire data

Backstage online Facebook groups and friends

As shown in Table 3, stagehands, cameos, and extras spent almost twice the amount of time in the entire online backstage (not just Facebook) when compared with the front stage. Although the times reported in Table 3 are not a measure of learning or engagement with the class, it does help to identify contexts where students might prefer to learn or engage within an online class. Responses to fortnightly questionnaires indicate that students were engaged in backstage online spaces such as the university library, Google Scholar, and YouTube; however, interviews reveal that the most popular space that stagehands, cameos, and extras used for learning in the online backstage was Facebook. The Facebook groups and the purpose students described are summarized in Table 4 below.

Table 4

Facebook Groups and Descriptions

Facebook Groups	**Purpose**
Social Science Majors (Closed)	A student group for all majors in the social science faculty at this university only. For learning content and learning to be a student.
Psychology Majors Only (Closed)	A student group for psychology majors that enrolled at this university in the same year. For learning content and learning to be a student.
Individual study groups related to specific class (Closed)	A small student group organized to study together for a specific class or complete tasks together
Social Facebook groups unrelated to the university (Public)	A public support group for any tertiary student at any institution for example: UNI Coffee Shop. For learning to be a student.
Content Facebook groups or groups unrelated to the university (Public)	A public Facebook group for people interested in learning about content of their choice for example: The Glasser Institute. For learning content.
Facebook friends from this university	Some students made one-to-one friendships and shared study and social or personal information like family photos. For learning to be a student, learning content, and social.

Source**:** Interview data

In dramaturgical sociology, elements of human interaction depend on audience, time, and setting (Goffman, 1959). These factors also shape social learning experiences in online courses. Explicated illustrations of each follow.

Audience size and attributes in the front stage and backstage

Most students reported being members of both the Social Science Majors and Psychology Majors groups. The Social Science Majors group was the largest of the groups, with over 600 members, and the Psychology Majors group had over 130 members. The discussion board in the LMS also had 126 members, but only 13 of those students were performers. Table 5 lists the characteristics from the interview data that students used to describe each audience. The most notable difference between the front stage and backstage audiences was the presence of teachers in the front stage and the presence of peers with a variety of experience levels in the online backstage.

Table 5

Students' Descriptions of the Front Stage and Backstage Audiences

Front stage discussion board audience	Backstage online Facebook audience
• Teachers who only log in at certain times of day • Teachers who give harsh feedback or request students to relocate discussion board posts • Teachers/university staff who have vetted learning materials • Teachers/peers who may not respond or respond too late to questions or completion of tasks • Peers and teachers who write using formal language and big words • Peers in this class only (12 weeks' time) • Peers who make off-topic posts making the discussion board unwieldy	• Peers from the same class (near peers) • Peers who have completed this class (experts) • Peers who are now friends (two years' time) • Peers who have vetted resources for learning • Peers from various class but on the same academic calendar • Peers who have around the clock access and easily accessible notifications about posts

Source**:** Interview data

Discussion

There is a marked difference between the ways online students present themselves front stage in the LMS and backstage in Facebook. Through the lens of Lave and Wenger's (1998) social learning theory, which suggests that learning occurs across space and time in multiple contexts, and Goffman's (1956) approach of region behavior, we see that students with low front stage participation were active and engaged in the backstage. Discussion of these practices is organized into four sections: (a) time and social learning experiences; (b) students' perceptions of tutors; (c) speed; and (d) a sense of belonging.

Time and social learning experiences

For some students, time may be an important factor that supports or impedes learning. Overall, students reported spending more time in the online backstage than they spent in the front stage. The exception to this finding was the Performer cohort, who perpetually logged into the front stage for fear of missing out on information that could be important. This group also acted as first-responders, being the first to respond to questions or tasks, as well as the first to offer encouragement to classmates. In studies of Facebook usage, Bowman (2014) referred to these students as super-users because they respond to students even when they don't know the answer. This was the also the case in the front stage discussion board. Super-users responded to almost every post by a student or teacher. Ingrid, for example, was a super-user who posted fifteen times more than the average student, which made her responsible for 15% of the 1,430 posts in the front stage:

> This [front stage] is my friendly place, where I feel part of something, not all alone at my desk, looking out at the horrible gray walls of the house next door. I think I have gained as much from various discussion boards as from all my other reading…

Ingrid uses "friendly" to describe her feelings of connectedness and sense of belonging in her studies. Ingrid did not have a Facebook account because she felt that the discussion board was enough to support her learning experience in the class. Like Ingrid, most of the performers were not on Facebook because they felt that their sense of belonging was fulfilled by their active presence in the front stage.

While students like Ingrid may be inherently social, other students may need more time to develop social ties that support their learning experience. In which case, time may be an important aspect between the front stage and backstage that impacts a social learning experience. The timing of communication, such as whether communication occurs synchronously or asynchronously, affords distinct behaviors (Hogan 2010). And in this case, the length of time in a space may have even impacted whether communication occurred at all. The online class ran for twelve weeks but some students were in the university Facebook groups for as long as two years or more. The ephemeral nature of the online class may afford students the time needed to negotiate their role in each space. In the front stage, a stagehand remained constant for the twelve weeks, whereas a cameo or extra tapered off around week 3. Table 6 shows how participation in the front stage significantly dropped off between weeks one and four. This decrease in participation suggests that learning may have shifted to a backstage.

Table 6

Participation Rate by Week

Weeks in the front stage	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Total students posting in the front stage per week	37	23	23	14	12	11	9	6	6	6	4	1

Source**:** Front stage observation data

In the large backstage Facebook groups most of the students described changing their participation trajectories in Facebook from stagehand to performer. Kara recalled being invited to the Social Science Facebook group during her first semester via a front stage discussion board post. She joined the Facebook group and, at first, only observed. As an observer in the Facebook group, Kara became acquainted with members from the Social Science Majors group because their names frequently appeared in her everyday Facebook feed. After six months of observing she began posting to the community because she felt more connected there than she did in the discussion board:

> I didn't really interact much at first. It is probably more after 6 months as the same names keep cropping up. We post a bit of everything [related to psychology] and sometimes just letting off steam over marks.

The process that Kara describes is a typical first step in social learning. Lave & Wenger (1991) suggests that all learning begins with legitimate peripheral participation before learners feel confident enough to participate as a newcomer, near peer, or expert. Despite being at the university and in the Facebook group for the same number of years, Kara was a stagehand in the front stage but described herself as an extra, if not a performer, in the online backstage. This, though, took her six months to achieve. This suggests that the length of a course may not be sufficient for some learners to establish a sense of trust, belonging, and the ability to negotiate their roles and interactions with others—all features which Wenger (1998) argues are conditions for social learning. This was the case for some extras, Briana and Julia, who describe how over time they made Facebook friends from their online university class who helped to support their social learning in the backstage:

> Fortunately I have established online relationships with people throughout this degree and they aren't necessarily in my current unit but may have completed and are often happy to discuss things via Facebook through inbox and also through Facebook on the main group for [Social Science Majors and Psychology Majors Only]. (Briana, Extra)

> I became friends with two ladies [from a previous class]. One's in Townsville and Cairns. We'd brainstorm forever…We message through Facebook. Actually one day I talked [to the one friend] for three and a half hours. So that works better than the discussion board in my personal situation. (Julia, Extra)

As a result of participating in Facebook groups, most of the students reported making Facebook friends who supported their learning experience. Bosch (2009) found that it was common for university students to be members of multiple university-related Facebook groups. One stagehand was simultaneously a member of the Social Science Majors group, the Psychology Majors Only group, a Facebook group for every class she enrolled in (past and present), and a Facebook group unrelated to the university about positive mental health counselling (the topic of the class). In addition to these groups, she has Facebook friends whom she met over the last three years of her university study. Most of the students interviewed were in more than one Facebook group, which may have increased their chances for finding relationships where they felt a sense of belonging, trust, and negotiation. Facebook provided multiple contexts for students to apply their learning, related to the psychology class, with others over time.

Students' perceptions of tutors in the front stage

Audience and time clearly shape social interactions. In the case of course tutors, some students described feedback as too slow, too harsh and sometimes disruptive to conversations that could have contributed to a student's understanding (see Table 5.). Stagehands, and to some extent extras and cameos, self-segregated themselves confirming Goffman's observation that front stage control is often one measure for audience segregation. Through segregating oneself from the front stage, actors can escape or buffer themselves from those aspects of a setting they find unpleasant (Goffman, 1959). This is a useful way to explain students' absence in the front stage. It might also explain sudden decreases in front stage participation. Kathy, an extra, was the leader for a small Facebook group of students who were unhappy about the class. Kathy described tutor feedback on assessments as "harsh." She also reported tutors asking her to move discussion board posts from one discussion board forum to another. This happened to various students in the class on six occasions. In each instance the conversation that had been interrupted ended and the student did not post to the discussion board again. Kathy describes this disruption:

> Kathy (Extra): I went on the discussion board and asked about ethics. About an experience I wanted to know about a psychiatrist…and one of the tutors was awesome about it and was telling me the procedure, but then another tutor said, "Ah, this shouldn't be on this discussion board, it should be just on the other discussion board. Did you want to move this conversation there?"
>
> Interviewer: Was that the end of the conversation?
>
> Kathy (Extra): Yep, I was talking to the other tutor, and she was like, talking about the ethics of it, and it was fine, but then the other tutor just like totally cut us off…I…I [also] put it on there [the discussion board] is there anyone in the Gold Coast who wants to study and meet up and…and then um, the tutor was just like "Oh, can you put this on the other…another discussion board" or something… I was like "Oh, okay". I just…I didn't post it to the other one. I just thought…well, I gave up.
>
> Interviewer: Did any of your classmates respond to you about meeting up?
>
> Kathy (Extra): No.

Kathy eventually stopped posting in the front stage altogether. By week 4, her discussion board participation ceased but her backstage Facebook participation increased. Goffman (1959) suggests that actors who go backstage are afforded opportunities to derogate the audience and that

the discussion in the backstage can often turn towards problems of staging. Interestingly, students explained how these backstage conversations eventually evolved into learning opportunities. In Kathy's case, she found a group of students from the Psychology Majors Only Facebook group that were upset about technology problems and class assessment feedback. Initially, these students bonded over their negative experiences in the front stage. Subsequently they created an individual Facebook group for the psychology class. In this group, they worked through weekly activities together and studied for the final exam together. Kathy preferred this space instead of the discussion board:

> Um, just I liked talking on Facebook more than the discussion board. I was able to learn from my classmates in that way. Yes, um, we completed the tasks [from the front stage] they [my classmates] also sent videos out on Facebook, like examples, like YouTube videos of different counselling methods.

Kathy's experience studying in a Facebook group was not uncommon. A total of four small separate study groups (containing 2–5 students) were reported during interviews and two more Facebook study groups were referenced by students in discussion board posts. While perceptions of their tutor may not be the only reason for their segregation into the backstage it does highlight the impact of teaching presence in online courses. As studies of Facebook show, students can seek and find information from those who make them feel more comfortable.

Students' perceptions of speed

In addition to self-segregating for the purposes of having small study groups, students also preferred Facebook based on their perception of the speed of responses to posts. Overall, speed of responses was reported as faster in the backstage Facebook groups. During interviews students echoed repeatedly that information was faster in the backstage online.

> My first step was [the] Discussion Board and I had to wait because responses are slow. Facebook was the second step. [But I preferred] the Facebook group because the responses were quicker and also more personal. (Briana, Extra)

There are several reasons why the backstage audience was perceived to be faster than the front stage audience. In the front stage, conversations may have been "slow" for reasons found by Rambe (2012): if students view certain posts as a teacher's domain this could slow down the responses in the front stage. However, if teachers are not present, like in the backstage Facebook groups of this study, then the behavior in the setting changes or in this instance the communication was "quicker":

> …there are quite a few really good YouTube channels that have ex professors and teachers and they are really good they explain things without treating the audience like a brainless dolt. Usually videos from Facebook were always good because another classmate already used it……that is one of the great things about the Facebook groups the sharing of links to extra material that sometimes help understand a class or concept [from that week]… (Kara, Stagehand)

Resources in the backstage, such as videos, were vetted by more experienced students who had already completed the class and understood what it was like to be a student in that class. This supported students taking control of their learning experience in terms of time and access.

Students' perceptions of belonging

Belonging emerged as a theme absent from prior research on Facebook in the university context. In the data, students reported and described a sense of belonging in the backstage that was not present in the front stage. Students in the backstage developed a "less formal" and more "comfortable" setting:

> Facebook was good actually, because you could post bits and pieces and whatever. It felt less formal than the discussion board. Even though we were probably talking about the same thing, but to me personally, it felt less structured. Less academic, is probably the word I am looking for. (Julia, Extra)

> I am not comfortable posting on DB. I think there is the fear of making an idiot of myself but that is only part of it. I do feel disconnected there, I have posted things and waited days for a response and sometimes no response. (Kara, Stagehand)

Students benefited from having a space for observing and a separate space for sharing. Multiple contexts help to facilitate social learning through both observation and direct experiences (Lave & Wenger, 1991; Wenger, 1998).

No backstage online Facebook presence

Three students reported not having a backstage online presence on Facebook. The reasons cited were not having a Facebook account, not knowing about the university or class Facebook pages, or not considering themselves social people. One cameo who did not consider herself a social person described herself: "I am not really a joiner though, like in general, I don't join groups." This student preferred to discuss her learning experience with her face-to-face co-workers and clients. Meanwhile, another cameo was a shift-worker. She could only study during the hours when her classmates were most likely sleeping, therefore both her front stage presence and backstage presence were minimal. These caveats remind us that not all students are social learners or live in circumstances that afford online social learning experiences. Similarly, it is unreasonable to expect that all students want an online Facebook presence to support their learning experience. As illustrated in the example above, some learners support their social learning experience through offline relationships and this could be another backstage worth exploring (see for example Gilmore, 2014; Gilmore, 2017; Livingstone & Sefton-Green, 2016).

Conclusion

By using the theatre metaphor, I was able to capture the specific ways university students' online learning practices differ across settings, time, and audience. This analytical approach revealed useful insights in explaining why students are absent from a class's discussion board and what they alternatively do to learn course content. Absence from the front stage may not be an absence from learning; rather, the act of being absent affords actors the control to escape, or buffer oneself, from deterministic demands (Goffman, 1959). Some students avoided the front stage discussion board because the audience was too slow, too harsh, and too formal. The backstage online audience solved these problems of the front stage, which made this a more attractive location. Students may need spaces where control and content are student-driven. The challenge for teachers and universities is to develop curriculum with the backstage in mind.

This study employed a dramaturgical approach to examine how online students perform class-related tasks in spaces other than those designed and monitored by the university. Such an approach allows for careful investigation and analysis of how setting, time, and audience impact online students' learning experience. While not every student used Facebook for university purposes, a closer examination of the backstage online in this psychology class reveals how Facebook facilitates some students' social learning experiences, a finding that can apply to various forms of social media and collaborative technologies outside of an LMS.

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