Comparing Blended and Online Learners' Self-Efficacy, Self-Regulation, and Actual Learning in the Context of Educational Technology

Zhuo Zhang
Qian Xu
Adrie A. Koehler
Timothy Newby
Purdue University, USA

Abstract
In this quantitative comparative study, we explored the differences in technology integration self-efficacy, use of self-regulated learning strategies, and actual learning between preservice teachers enrolled in blended sections (n = 275) and online sections (n = 50) of the same introductory educational technology course. The results revealed that preservice teachers enrolled in the online format of the course reported a significantly higher level of using time management strategies, but a significantly lower level of employing help-seeking strategies compared to preservice teachers enrolled in the blended format of the course. However, no significant differences in technology integration self-efficacy and actual learning existed. Results offer insight for designing educational technology courses that align with the needs of both online and blended learners and preparing preservice teachers that likely will be responsible for facilitating blended and online learning with their own students.

Keywords: online and blended learning, educational technology, teacher education, self-regulation, self-efficacy

Zhang, Z., Xu, Q., Koehler, A.A., & Newby, T. (2023). Comparing blended and online learners' self-efficacy, self-regulation, and actual learning in the context of educational technology, *Online Learning, 27*(4), 295-314. DOI: https://doi.org/10.24059/olj.v27i4.4039

In contemporary educational environments, learning experiences are increasingly delivered in blended or online formats due to advancements in technology, availability of the internet, and flexibility for navigating disruptions to learning (Lowenthal et al., 2017; Rasheed et al., 2020). Online learning is defined as learning experienced through the internet without the need for the co-presence of instructors and students (Singh & Thurman, 2019), while blended learning is "the thoughtful integration of classroom face-to-face learning experiences with online learning experiences" (Garrison and Kanuka, 2004, p. 96). According to the National Center for Education Statistics, approximately 33% of undergraduate students took at least one distance course in 2017 (McFarland et al., 2019), with this percentage reaching nearly 100% due to higher education institutions being forced to transition to online formats in response to the COVID-19 pandemic (UNESCO, 2021). Blended learning can overcome barriers of purely online learning (e.g., socialization and collaboration) and face-to-face learning (e.g., time and location) to create meaningful learning experiences that combine modalities (Garrison & Kanuka, 2004; Graham, 2006; Hrastinski, 2019). Furthermore, Means et al. (2013) conducted a meta-analysis including 50 empirical studies, with results suggesting that both online and blended learning were more effective than face-to-face learning in improving learners' academic achievements, while the difference between blended learning and face-to-face learning (g = .35) was much larger than the difference between online learning and face-to-face learning (g = .05).

The adoption of blended and online learning in higher education has also created trends in instructional technology preparation in teacher education programs. According to a review from Zhu and Kumar (2023), 13 highly ranked educational technology departments or programs in the U.S. offer blended and online learning for their prospective graduate students. To enhance undergraduate preservice teachers' (PSTs) educational technology competencies, one of the most common approaches is offering stand-alone introductory educational technology courses (Morel & Spector, 2022). These educational technology courses are often provided in a blended format (e.g., Cai et al., 2017; Cheng et al., 2023), however, after the COVID-19 pandemic, educational technology practitioners have increasingly explored designing and implementing educational technology courses in a fully online format and have confirmed the effectiveness of delivering educational technology courses through online modalities (Lyublinskaya & Du, 2022; Zhang et al., 2023). At the same time, the schools where PSTs will work are increasingly offering blended and online options (Hathaway & Mehdi, 2020; Hodges et al., 2022).

As a result of these trends and realities, PSTs entering the education profession must be prepared to design and teach across diversified learning environments (i.e., face-to-face, blended, and online) (e.g., Ersin et al., 2020), and leverage educational technologies to support and enhance their teaching in these environments during their preparation programs (Foulger et al., 2019). To achieve these goals, it is imperative for teacher educators to understand how PSTs perceive their capabilities in technology integration, approach, and regulate learning in blended and online learning environments. Although research has explored differences between blended and online learning in other disciplines such as psychology and management (e.g., Broadbent, 2017; Larson and Sung, 2009), the differences between online and blended learners' learning in educational technology use are largely unknown. The primary objective of this study is to delve into the disparities in learning among PSTs in the realm of educational technology, specifically in relation to different learning modes (blended vs. fully online). In order to gain a comprehensive insight into the learning process, educational theorists (Bandura, 1986;

Zimmerman, 2000) and researchers (e.g., Broadbent & Poon, 2015) have underscored the significance of venturing beyond mere tangible learning outcomes such as course grades. More fully understand learners' learning beliefs and the strategies they employ to facilitate their learning journey is crucial in improving PST preparation. Therefore, the present study focuses on the differences in learner-centered factors including learners' self-efficacy (confidence to learn), self-regulated learning (SRL) (strategies used to learn), and actual learning (knowledge gain) between blended and online learners.

Literature Review

Self-Regulated Learning (SRL) and Learning Mode (Blended vs. Online)

Building upon Bandura's social cognitive theory, which assumes self-regulation occurs during the interaction of personal, behavioral, and environmental determinants (Bandura, 1986), Zimmerman defined self-regulation as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (Zimmerman, 2000, p. 14). To explicate the structure of self-regulatory systems, Zimmerman (2000) proposed a cyclical three-phase SRL model including forethought (the influential process that precedes efforts to act, setting the stage for subsequent actions), performance or volitional control (process that occurs during motoric efforts and impacts attention and action), and self-reflection (process that occurs after performance efforts and influence an individual's response to their experiences). SRL strategies have been used differently among the three phases. For example, learners frequently employ goal-setting and planning strategies during the forethought phase, task and resources management strategies in the performance phase, and self-evaluative strategies in the self-reflection phase, respectively (Zimmerman, 2000).

Compared to traditional face-to-face learning, the effective utilization of SRL strategies becomes even more crucial in blended and online learning environments. These environments, with their flexibility and fewer spatial and time restrictions, require a higher level of SRL strategies, such as help-seeking (Broadbent & Howe, 2023), goal-setting skills (Koehler et al., 2020), metacognitive skills, and resource management (Puzziferro, 2008). In both blended and online learning environments, learners are expected to take more ownership in navigating their learning experiences. For instance, in navigating asynchronous discussions, a common instructional strategy used in blended and online learning environments, learners are responsible for "identifying a goal for participation, selecting an appropriate time to enter a discussion and follow-up with peers, determining which peers to interact with, finding opportunities to join the conversation in meaningful ways, deciding how many discussion posts to read, adjusting personal strategies based upon the feedback from peers and the instructor, and managing challenges inherent of asynchronous online discussions" (Koehler et al., 2020, p. 67). In short, learners who can effectively regulate their learning in blended and online environments are more likely to reach successful outcomes. Two existing systematic reviews have synthesized the existing research on SRL strategies in higher education blended learning environments (Eggers et al., 2021) and fully online learning environments (Broadbent & Poon, 2015). However, to our knowledge, only two empirical studies comparing the differences in using SRL strategies between blended and online learners exist. Broadbent (2017) compared the usage of nine types of SRL strategies between 140 online undergraduate learners and 466 blended undergraduate learners and found that online learners demonstrated higher use of most types of SRL strategies such as elaboration, time management, effort regulation, and metacognition, with the exception of peer learning and help-seeking strategies. Broadbent et al. (2021) found that, compared to blended learners, online learners reported higher use in all types of SRL strategies including critical thinking, metacognition, time management, and effort regulation, although only effort regulation and time management approached significance. In teacher education specifically, multi-media-based learning approaches (e.g., online courses, workshops, video tutorials, and assistance menus within software packages) have been widely used to foster PSTs' technology integration skills (Kay, 2006). approaches require learners to possess proficient SRL skills, therefore enabling effective learning outcomes (Koehler et al., 2020; Zhang et al., 2023). While research suggests the significance of SRL skills in influencing PSTs' technology integration (Huang et al., 2021; Valtonen et al., 2017), differences in PSTs' SRL skills between blended and online learning modalities remain uninvestigated.

Self-Efficacy and Learning Mode (Blended vs Online)

Self-efficacy refers to "beliefs in one's capabilities to organize and execute the course of action required to produce given attainments" (Bandura, 1997, p. 3). Self-efficacy affects learning or performance by regulating learners' cognition, affection, motivation, and selection (referred to as the four mediating processes by Bandura [1997]). The indirect effect of self-efficacy on performance in online learning among PSTs has been revisited and validated through structural equation models by Zhang et al. (2023). Bandura (1977) also emphasized that self-efficacy is not a personal trait but a context-dependent system of beliefs when one deals with a given situation. Considering that the present study is contextualized in teacher educational technology preparation, we specifically explored PSTs' technology integration self-efficacy. Substantial research has explored PSTs' technology self-efficacy in either blended or online learning environments (e.g., Banas & York, 2014; Cheng et al., 2023; Zhang et al., 2023). However, our literature search yielded only two studies focusing on the comparison of blended and online learners' self-efficacy. Alkış and Temizel (2018) investigated the effect of motivational factors on academic performance in blended and online learning environments. Among 316 undergraduate students (189 online and 127 blended) enrolled in an information technology (IT) course, they found that online learners' self-efficacy for learning positively predicted their academic performance, while such a predictive effect was not found for blended learners. Broadbent et al. (2021) found that online learners perceived self-efficacy for learning in a psychology course was significantly higher than blended learners.

Actual Learning and Learning Mode (Blended vs. Online)

Actual learning, along with perceived learning and satisfaction, are commonly used to determine the value of a specific learning experience (Martin et al., 2022). Unlike perceived learning and satisfaction which are typically identified by asking learners to reflect on personal expectations and perceived knowledge gains, actual learning "reflects a change in knowledge identified by a rigorous measurement of learning" (Bacon, 2016, p. 4). Actual learning can be measured by scores generated from tasks and tests, course grades, and grade point average (GPA). Researchers have explored the impact of learning modes (blended and online) on higher education students' actual learning. Interestingly, existing empirical studies consistently have found no differences in actual learning between blended and online learners across various courses: program evaluation (Lim et al., 2007), management information systems (Larson and Sung, 2009), child development (Yen et al., 2018), and cognitive psychology (Broadbent et al., 2021). However, Bicen et al. (2014) found that blended PSTs scored significantly higher than online PSTs on a multimedia-based project in an instructional development course.

The results of this literature review identified three research gaps. First, previous studies have primarily focused on comparing either online learning or blended learning with face-to-face learning, rather than comparing blended and online learning. Second, previous studies comparing blended learning with online learning have primarily focused on comparing learners' actual learning outcomes instead of their learning confidence or strategies. Third, the only comparison study conducted in the context of educational technology is one by Bicen et al. (2014), which investigated the difference in task performance between blended and online PSTs. Therefore, the present study aims to deepen understanding of the impact of learning mode (blended vs. online) on PSTs' educational technology learning by exploring the disparities in not only actual learning but self-efficacy and self-regulation. Specifically, the three research questions below guided our investigation.

1. Do PSTs enrolled in blended and online course formats demonstrate different levels of technology integration self-efficacy?
2. Do PSTs enrolled in blended and online course formats demonstrate different levels of usage of SRL strategies?
3. Do PSTs enrolled in blended and online course formats demonstrate different levels of actual learning?

Method

Research Design and Context

This study employed an ex post facto research design (Ary et al., 2019), a non-experimental research approach, to examine the effect of a preexisting independent variable (blended vs. online course formats) on PSTs' technology integration self-efficacy, use of SRL strategies, and actual learning in an educational technology course. This research design was appropriate for this investigation as the researchers lacked control over the independent variables. In this study, we determined that identifying PSTs who were already enrolled in either the blended or online format of the educational technology course was most appropriate, rather than assigning them to specific formats, to capture their natural engagement and attitudes towards the selected format.

This study was conducted in a 16-week undergraduate foundational educational technology course at a public research-intensive university in the U.S. The course aimed to prepare digital-competent PSTs by helping them plan, integrate, and evaluate educational technologies for teaching and learning. The course comprised three main instructional components: video lectures, online discussions, and weekly face-to-face two-hour labs (applicable only to the blended format). In addition to attending labs and participating in online discussions, students were required to work on three types of assignments to complete the course: (1) obtain six digital badges designed to enhance their technology skills (e.g., video editing and website development); (2) analyze eight authentic cases and address real-world educational issues by using technology in a pedagogically appropriate fashion; and (3) create an interactive online learning module as their final project (see Table 3 for details). The course was offered three times a year (spring, summer, and fall), with different formats available, including blended and fully online. In the blended format, students were expected to attend a two-hour lab each week to work on the digital badges with guidance from an assigned teaching assistant. In the fully online format, students were given access to pre-recorded lab videos and could schedule online meetings with their assigned teaching assistant as necessary. Except for the teaching assistant lab facilitation, the instructor, instructional content, learning materials, and assignments were consistent between the blended and online formats.

Participants and Data Collection

Upon receiving approval from the Institutional Review Board (IRB), we developed an online survey and distributed it using Qualtrics (Provo, UT) during the last week of each term in 2021 and 2022. The survey consisted of a demographic questionnaire (e.g., gender, academic year), a technology integration self-efficacy questionnaire, and an SRL questionnaire. While the survey did not ensure anonymity to link respondents with the allocation of extra credit, after extra credit points were granted, all personally identifiable information, including students' names, was removed, and encoded before data analysis. A total of 382 PSTs who were enrolled in the educational technology course in 2021 and 2022 were invited to participate in the survey, with the incentive of receiving five extra credit points (1.5% of the total score of 328 for the course). While the use of incentives may affect sample composition, given that motivated individuals tend to participate more readily than those who are not, the majority of the existing empirical studies have reported no significant effect of incentives on sample composition or response distributions (Singer & Ye, 2013). Conversely, research underscores that using incentives in web-based surveys is an effective approach to boosting response rates (Singer & Ye, 2013). Among the 382 PSTs, 325 completed the survey, resulting in a response rate of 85.1%.

The participants were PSTs from a variety of teacher education programs (e.g., special education, elementary education, social studies education, mathematics education, and science education). The average age of the participants was 19.94, with a standard deviation of 2.77. Table 1 includes additional participant demographic information, including course format, gender, academic level, and previous online, blended, educational technology learning experiences. The gender distributions in both online and blended formats exhibited a similar pattern, with female PSTs substantially outnumbering male PSTs (ratio > 3:1). Independent samples t-tests were executed to explore potential significant differences in other demographic variables based on the course formats. The results indicated that none of these variables displayed significant distinctions between PSTs enrolled in online and blended formats.

Table 1
Demographic Information (N = 325)

Variables	Frequency	Percentage (%)
Course format		
Blended	275	84.6
Online	50	15.4
Gender		
Female	248	76.3
Male	77	23.7
Academic level		
Freshmen	98	30.2
Sophomore	118	36.3
Junior	79	24.3
Senior	30	9.2
Blended courses previously taken		
0–1	82	25.2
2–3	130	40.0
4–5	58	17.9
6 or more	55	16.9
Online courses previously taken		
0–1	75	23.1
2–3	118	36.3
4–5	68	20.9
6 or more	64	19.7
Educational technology courses previously taken		
0–1	282	86.8
2–3	34	10.5
4–5	4	1.2
6 or more	5	1.5

Variables and Instruments

Technology Integration Self-Efficacy

To our knowledge, the Technology Integration Self-efficacy Questionnaire (TISQ) developed by Wang et al. (2004) is the only survey instrument available for measuring pre-service teachers' (PST) technology integration self-efficacy. The TISQ is a 16-item instrument that employs a five-point Likert scale. Wang et al. (2004) conducted an exploratory factor analysis on the items of the TISQ, which indicated the single-factor structure of TISQ. Zhang et al. (2023) further confirmed its single-factor structure through confirmatory factor analysis and computed the reliability coefficient (Cronbach's Alpha = .95), demonstrating high internal consistency. A sample item of TISQ is "I feel confident about selecting the appropriate technology for instruction based on curriculum standards."

Self-Regulated Learning (SRL)

Many instruments exist for measuring SRL; however, one instrument that has been thoroughly validated and can be employed in both online and blended learning environments is the Online Self-Regulated Learning Questionnaire (OSLQ, Barnard et al., 2009). The OSLQ is a 24-item five-point Likert-scale instrument. Barnard et al. (2009) conducted both exploratory factor analysis and confirmatory factor analysis on the OSLQ items, which suggested a six-factor structure. These factors include goal-setting (five items), task strategies (four items), time management (three items), environmental structuring (four items), help-seeking (four items), and self-evaluation (four items). Barnard et al. (2009) also computed the reliability coefficients (Cronbach's Alpha) for each factor in both blended and online learning environments, which indicated acceptable internal consistencies. Table 2 presents the definition, sample items, and reliability coefficients of the six factors.

Table 2
Definition, Sample Items, and Reliability Coefficients of OSLQ

	Definition	**Sample items**	**Cronbach's Alpha (blended/online)**
Goal-setting	"setting of educational goals or subgoals and planning for sequencing, timing, and completing activities related to those goals" (Zimmerman, 1989, p. 337).	"I set short-term goals as well as long-term goals."	.86/.95
Task strategies	Decomposing a complex task and reorganizing it meaningfully (Pintrich et al., 1991).	"I work extra problems in online courses in addition to the assigned ones to master the course content."	.67/.93
Time management	Planning and scheduling study time (Printrich et al., 1991).	"I choose a time with few distractions for online courses."	.78/.87
Environmental structuring	"efforts to select or arrange the physical setting to make learning easier" (Zimmerman, 1989, p.337).	"I choose the location where I study to avoid too much distraction."	.90/.92
Help-seeking	"efforts to solicit help from peers, teachers, and adults" (Zimmerman, 1989, p.337).	"I find someone knowledgeable in course content so that I can consult with him or her when I need help."	.69/.96
Self-evaluation	"student-initiated evaluations of the quality or progress of their work" (Zimmerman, 1989, p.337).	"I summarize my learning in online courses to examine my understanding of what I have learned."	.78/.94

Actual Learning

In the present study, we chose to use learners' course final letter grades to reflect their actual learning in technology integration. Table 3 presents the course assignments and their corresponding percentages of the final grades.

Table 3

Course Assignments and Corresponding Percentages

Assignments	Percentage (%)
Six digital badges (e.g., online assessment, information literacy, website development)	22.6
Eight case studies	30.9
Three online discussions (e.g., current issues in educational technology)	6.2
Ten short quizzes	21.7
Interactive learning module (i.e., course final project)	18.6

Data Analysis

The two learning modes (blended and fully online) served as the independent variable, and participants’ technology integration self-efficacy, six types of SRL strategies, and course performance served as dependent variables. Both descriptive and inferential statistics were applied to understand the impact of course format (blended versus online) on each of the eight dependent variables. Descriptive statistics such as mean and standard deviation were computed to describe the central tendency and dispersion of the distribution of data. The one-way Analysis of Covariance (ANCOVA) was applied to examine whether blended and online learners had significantly different levels of technology integration self-efficacy, SRL, and course performance and account for the confounding effects of demographic variables such as gender, age, and academic level.

As suggested by previous research (e.g., Wang et al., 2013), demographic variables could affect learners’ self-efficacy, SRL, and actual learning. Major assumptions for conducting ANCOVA were tested and met. For example, two diagnostic statistics and their acceptable ranges, skewness $\pm$ 3 and kurtosis $\pm$ 10, were used to test for normality (Kline, 2005), Levene’s test was applied to test for the homogeneity of variance, and interaction effects of covariates and the independent variables were used to test the homogeneity of regression coefficients. As highlighted by Blanca et al. (2017), the F-test used in ANCOVA is robust when dealing with unequal sample sizes across groups, therefore the imbalance of sample size would not invalidate the results of this study. All the data analytic procedures were completed in SPSS Version 28.0.

Results

Descriptive Results

Table 4 presents the means and standard deviations of the blended and online learners’ technology integration self-efficacy, six types of SRL strategies, and course final grades. The descriptive results revealed that on average (1) online learners' technology integration self-efficacy and course final grades were comparable with blended learners, with online learners earning slightly higher grades and reporting slightly higher self-efficacy scores; (2) online learners reported higher use of most types of SRL strategies than blended learners such as goal-setting, task strategies, time management, and environmental structuring, with the exception of help-seeking and self-evaluation, which were lower than blended learners; (3) among the six types of SRL strategies, both blended and online learners reported lowest use of task strategies and highest use of environmental structuring strategies.

Table 4
Means and Standard Deviations of Dependent Variables

	Blended learners (N = 275)		Online Learners (N = 50)	
	Mean	**SD**	**Mean**	**SD**
Goal-setting	4.01	.66	4.10	.64
Time management	3.23	1.03	3.53	.88
Task strategies	2.86	.99	3.07	.74
Environmental structuring	4.13	.74	4.19	.66
Help-seeking	3.45	.73	3.10	.86
Self-evaluation	3.28	.89	3.10	.80
Technology Self-efficacy	4.35	.62	4.37	.61
Course Final Grade	9.96	3.12	10.22	2.80

Note. SD = standard deviation
[a] In SPSS, item choices of TISQ and OSLQ were coded as: "strongly disagree" – 1, "somewhat disagree" – 2, "not disagree or agree" – 3, "somewhat agree" – "4", "Strongly agree" – 5.
[b] In SPSS, course final letter grade was coded as: "F" – 1, "D-" – 2, "D" – 3, "D+" – 4,…, "A-" – 11, "A" – 12.

Inferential Results

Technology Integration Self-Efficacy

The ANCOVA results indicated that the differences in technology integration self-efficacy between blended and online learners were not significant (F =.152, p =.70) after controlling for the effects of participants' demographic variables including gender, age, and academic level.

Self-Regulated Learning (SRL) Strategies

The ANCOVA results indicated that, after controlling for effects of participants' demographics variables including gender, age, and academic level, online learners reported significantly higher use of time management (F = 6.69, p =.01) but significantly lower use of help-seeking strategies (F = 3.99, p = .04) than blended learners while the differences of using other four types of SRL strategies were not significant.

Actual Learning

The ANCOVA results indicated that the differences in PSTs' actual learning outcomes between blended and online learners were not significant (F = .50, p = .48) after controlling for the effects of gender, age, and academic level.

Discussion

We investigated the differences in self-efficacy, usage of six types of SRL strategies, and actual learning achievements between PSTs enrolled in blended and online learning formats of the same educational technology course. Our study yielded three major findings that provide insight into how teacher educators can differentiate instruction and model effective technology integration and learning experiences for PSTs in both blended and online settings.

Self-Regulated Learning (SRL) and Learning Mode (Blended vs Online)

First, the results of our study indicated that compared to blended learners, online learners reported higher use of most types of SRL strategies including goal-setting, task strategies, time management, and environmental structuring but shared lower use of help-seeking and self-evaluation strategies. However, only the differences in time management and help-seeking reached statistical significance. These findings align with previous research that also found that online learners self-identified more proficiency in using most types of SRL strategies than blended learners, while less proficiency in using SRL strategies that demand socialization and interaction such as peer learning and help-seeking (Broadbent, 2017; Broadbent & Fuller-Tyszkiewicz, 2018; Broadbent et al., 2021). The higher reported use of SRL strategies by online learners is not surprising given that online learners must be autonomous, self-managing, and self-directing (e.g., Broadbent, & Poon, 2015). However, online learning is not without issues or challenges, among which, the most critical one is promoting online learners' collaboration and interaction (Oncu & Cakir, 2011).

As argued by Garrison and Akyol (2015), despite the difficulty in building a collaborative online community, doing so is vital given learners' cognition is always socially situated and shared. These challenges offer insight as to why online learners rarely seek help from their peers and instructors compared to blended learners who were provided opportunities to interact with others in a face-to-face manner. The effectiveness of learners' self-evaluation is also largely dependent on the social dimensions of a learning community (Zimmerman, 2000). From a social cognitive perspective, Zimmerman (2000) emphasized social comparison and collaboration as two major criteria that learners often employ to assess their own learning. This may explain one of our SRL findings—online learners used less self-evaluative strategies than blended learners although the difference was not significant. Our findings implied that "granularity" matters when conducting SRL research as different SRL strategies have different relationships with contextual variables such as learning mode and learning variables such as actual learning (Means et al., 2013) and self-efficacy (Broadbent & Howe, 2023). Specifically, along with other SRL researchers (e.g., Lee et al., 2019), we suggest examining SRL at a finer level by considering various SRL strategies individually rather than using SRL as a global concept.

Self-Efficacy and Learning Mode (Blended vs Online)

Our study's second major finding indicated that learning mode (blended vs online) had no impact on PSTs' self-efficacy in using and integrating educational technologies into learning and teaching. This finding contradicted findings from previous research (Broadbent et al., 2021) suggesting that in an undergraduate psychology course online learners had a significantly higher level of self-efficacy than blended learners. One possible reason for this inconsistency could be the disciplinary differences between these two studies (educational technology vs. psychology). According to Bandura's self-efficacy theory (1986, 1997), learners' self-efficacy is not a personal trait but a set of contextualized beliefs that tends to vary across subject areas. Also, research investigating disciplinary differences in online learning across students' perceptions of community and affective learning outcomes suggests that students from different disciplines perceive and value components of online environments differently (e.g., Lim & Richardson, 2022). Our findings generalized this characteristic (i.e., contextualization) of self-efficacy to the field of teachers' educational technology, suggesting that learners' academic majors may potentially moderate the relationship between learning mode and perceived self-efficacy.

Actual Learning and Learning Mode (Blended vs. Online)

Third, we found that PSTs' actual learning outcomes, as indicated by their final grades in the educational technology course, were not influenced by the mode of learning (blended vs. online). This finding aligns with the majority of previous comparative studies conducted in various disciplines including psychology, child development, human resources, and business and management (Broadbent et al., 2021, Larson and Sung, 2009, Lim et al., 2007, Yen et al., 2018). However, it was inconsistent with a study conducted in an educational technology context by Bicen et al. (2014), which found that PSTs completing a multimedia-based project in a blended format outperformed PSTs participating in an online format. Differences between our study and the findings of Bicen et al.'s (2014) study can be attributed to how actual learning outcomes were measured. While our study, along with the other four comparative studies, relied on course grades, test scores, or aggregated scores from a combination of formative and summative tasks, Bicen et al. (2014) assessed their participants' actual learning using a single multimedia-development project. The disparity suggests that the level of detail in the measurement of actual learning plays a crucial role when comparing blended and online learning. Specifically, learners' actual learning outcomes in a certain task are likely to differ depending on the learning mode, but this discrepancy diminishes as additional components are incorporated into the measurement of actual learning. Overall, this finding underscores that PSTs can be effectively prepared to use educational technologies regardless of course format.

Implications for Designing and Facilitating Educational Technology Courses

Our findings have important implications for teacher educators, instructional designers, and program coordinators involved in the educator preparation programs and specifically the design and facilitation of educational technology courses. First, incorporating face-to-face components such as weekly labs and lectures in an educational technology course, alongside online instruction, may not necessarily enhance PSTs' self-efficacy in technology integration or their actual technology competencies acquired from the course. These two factors (technology self-efficacy and competency) are two essential predictors of PSTs' intention to use technologies in their future classrooms (e.g., Baturay et al., 2017).

Currently, blended educational technology courses are more frequently used than fully online options, suggesting that teacher educators and instructional designers should reconsider the effectiveness of offering educational technology courses in blended learning formats in achieving desired outcomes (e.g., heightened educational technology competencies and long-term impact on PSTs' technology integration after entering profession). When preparing preservice teachers to effectively use instructional technologies, best practices include modeling effective instructional technology use, prompting reflection on educational technology use, and providing collaborative opportunities for PSTs to learn by design (Foulger et al., 2019). Therefore, when using a blended or online format for an educational technology course, teacher educators should be intentional with how they are using environmental affordances to model appropriate design and support techniques and keep in mind that PSTs' self-efficacy is a set of contextualized beliefs.

For instance, at the beginning of a course, teacher educators can draw attention to the affordances of the modality or modalities being used, facilitate a discussion regarding how PSTs can use this to support their own learning, and point out specific challenges inherent to the environment. At the same time, giving PSTs opportunities to design and implement both blended and online learning experiences is important not only to prepare them for their future realities, but as a chance to reflect on their own experiences with participating in blended and online formats. By making sense of their own experiences, beliefs, and strategies, PSTs can navigate blended and online modalities more intentionally both as a student and a future teacher.

Second, combining face-to-face instruction with online instruction could largely influence the development of PSTs’ SRL skills. Specifically, compared to the blended learning mode, PSTs who take a purely online educational technology course may experience significant improvement in their time management skills, while their help-seeking skills may be weakened. Therefore, when designing and teaching a blended educational technology course, teacher educators should intentionally employ effective instructional strategies or interventions to improve PSTs’ time management skills. As suggested by previous research, such instructional strategies or interventions include time management workshops (Wilson et al., 2021), reflecting and tracking weekly workload and time allocations via mobile devices (Tabuenca et al., 2022), and enhancing instructors’ presence by setting clear expectations and sending weekly check-in emails (Ensmann et al., 2021).

On the other hand, teacher educators should promote collaboration and interaction in their online educational technology courses, providing PSTs with more opportunities to learn from or seek assistance from their peers and instructors. Research suggests that integrating an intelligent tutor agent providing immediate metacognition feedback (Roll et al., 2011) could improve online help-seeking skills. Additionally, Ertmer and Koehler (2018) emphasized the importance of establishing a positive social climate in online discussion forums and its impact on online learners’ engagement and willingness to interact with others. They also suggested that strategies such as directing student attention, using humor, and addressing students by their names in online discussion forums can be employed. Broadbent and Howe (2023) furthered the understanding of online learners’ help-seeking behaviors by exploring the interactive effect between online learners’ help-seeking strategies and their learning self-efficacy. They found that confident online learners engaged more often in help-seeking than those lacking confidence. Accordingly, we suggest instructors of online educational technology courses pay particular attention to supporting less confident PSTs when facilitating their development of help-seeking skills. Instead of assuming that students possess innate learning navigation skills, it is also crucial for online teacher educators to initiate an upfront open dialogue, offer follow-up built-in support, and collaboratively explore specific strategies enabling PSTs to seek assistance when confronted with challenges.

Limitations and Future Research

Given that previous research has predominantly focused on comparing blended and online learners’ actual learning outcomes, our study additionally explored the motivational dimensions of PSTs’ learning including their usage of specific SRL strategies and learning self-efficacy. In addition to focusing on learner-centered variables, investigating additional elements beyond learner-centered variables would be beneficial. For instance, considering how learning mode relates to teaching-centered variables (e.g., instructional strategies, online teaching readiness, and teaching presence), social dimensions (e.g., social presence, socially shared regulation), and institutional support is worthy of future investigation. By examining these factors, a more comprehensive understanding of the relationship between learning mode and various aspects of the learning experience can be achieved.

We adopted self-reported measures to gauge PSTs' use of online SRL strategies. Despite the validity, reliability, and robustness of the selected measures, responses obtained through self-report measures might be influenced by the participants' individual perspectives, memory recall capabilities, and tendencies to present themselves favorably in responses (Bråten & Samuelstuen, 2007). Future investigations could consider combining the use of objective measures (e.g., clickstreams sourced from learning management systems) and self-reported measures to achieve triangulation, thereby providing a more comprehensive understanding of how PSTs engage with online SRL strategies.

Regarding data analysis, although we adopted ANCOVA to control for the effects of participants' demographic variables including gender, academic year, and age, future studies could consider measuring participants' academic achievement (e.g., GPA), self-efficacy, and SRL capacity before enrolling in an educational technology course. Including these entry-level variables in the inferential analysis may enhance the validity of the statistical conclusions of a comparative study. Lastly, our study found that online learners exhibited greater capability in regulating most of their learning behaviors compared to blended learners, aligning with existing SRL theories and research that emphasize SRL as an essential competency for online learning (e.g., Broadbent & Poon, 2015). Future research examining whether learners' SRL skills develop along a continuum that includes face-to-face, blended, synchronous online, and asynchronous online learning, with increasing proportions of online instructions would be intriguing. Exploring this progression can provide further insights into the development of SRL skills across different learning modalities.

Conclusion

The present study was conducted in the field of educational technology to examine the influence of learning mode (blended vs. online) on PSTs' technology integration self-efficacy, use of SRL strategies, and their actual learning outcomes. The findings revealed that both blended and online PSTs showed similar levels of technology self-efficacy and actual learning outcomes after completing the educational technology course. However, there were notable differences in their development of SRL skills. Online PSTs demonstrated a higher overall level of SRL capacity, while their utilization of socially regulated strategies, such as help-seeking, was limited. These results underscore the importance of tailoring instructional strategies to the specific needs of blended and online educational technology courses and the affordances of each modality. Considering the unique requirements and characteristics of each learning mode when designing and facilitating these courses is essential in modeling appropriate educational technology design and increasing awareness of effectively navigating each environment.

Declarations

The authors declare no conflicts of interest. The authors declare no funding for this research.
Permission to conduct research with human subjects was granted by the Institutional Review Board (IRB) of Purdue University, USA.

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