



Technology in Teacher Education: Preservice Teacher Comfort Level with Instructional Technology in a Stand-Alone Technology Course

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Abstract: Instructional technology continues to be prevalent in research relating to classrooms. Much research states that there is a strong relationship between teacher comfort-level with technology and use of technology in the classroom. This study focuses on increasing comfort with instructional technology at the teacher education level in a stand-alone instructional technology course. Data for this study show significant results in increasing comfort with instructional technology from the beginning to the end of the course. In addition, preservice teachers were found to have a deeper understanding of the importance of technology integration and how it may benefit students.

Introduction

Integrating technology into the classroom is no longer an option due to the fact that being technologically literate is a requirement of the 21st century (Zakrzewski & Newton, 2022). In addition to using technology in daily life and the job market, many standardized tests are now computer-based requiring students to be familiar with technology in order to successfully pass these mandated tests (Ashford, 2018). Over the past few decades, the United States has spent billions of dollars to incorporate technology into classrooms (Liu et al., 2017). While technology is now prevalent in the hands of students, it is unclear whether schools are moving to more student-centered teaching and learning (Lindstrom et al., 2021).

Prior to COVID-19, teachers employed a low-level use of technology at best (Lindstrom et al., 2021). This might be substituting a dry erase board for a Smartboard or allowing students to turn assignments in digitally rather than a hard copy. However, during the pandemic, teachers were required to modify their curriculum almost overnight for online learning (Mielgo-Conde et al., 2021). While teachers were required to modify their curriculum for the COVID-19 pandemic, according to Winter et al (2021) the modifications from COVID-19 did not change teacher technology use upon returning to the classroom. Many teachers relied on colleagues for support during the pandemic to survive, but are now returning to more traditional methods along with concerns about implementing technology

(Winter et al., 2021). Therefore, researchers are back to their initial queries regarding integrating technology into the classroom.

Due to the rapid development of technology, the expectation is for teachers to integrate technology into their teaching (Bahcivan et al., 2019). According to Hartman et al. (2019), Gen Z students are currently most comfortable learning with technology such as YouTube and they often feel most of their learning occurs through technological mediums. Accordingly, teachers need to be ready to meet the needs of these 21st century learners (Ashford, 2018). However, negative beliefs about technology have often inhibited teachers from incorporating technology into the classroom (Bonitatibus, 2018). Therefore, the challenge is to consider how to overcome this obstacle.

Conceptual Framework

Teacher beliefs have a strong impact on whether or not technology is incorporated into the classroom (Caner & Aydin, 2021). According to Hartman et al. (2019), most teachers lack confidence and knowledge when it comes to technology, especially in relation to Gen Z students. Therefore, teachers need to learn at the preservice level to ensure they are prepared for integrating technology into the classroom (Birisci & Kul, 2019). Preservice teachers can be prepared to integrate technology through teacher educator courses focusing on technology integration and modeling conducted by preservice teacher educators (Caner & Aydin, 2021).

According to Brenner and Brill (2016), there are seven methods of instructing preservice teachers to transfer technology use to the classroom: hands-on authentic meaningful activities, meaningful context, modeling, opportunities for collaboration, opportunities for reflection, ability to practice and ask questions, and availability of an expert to approach for assistance. These seven methods were used throughout this study to help support preservice teachers in increasing their comfort with instructional technology. In addition, a self-directed approach was supported for several assignments throughout the study in accordance with Caner and Adyin (2021), which indicate that this is a critical support to guiding preservice teachers into integrating technology into the classroom.

Literature Review

Technology Importance

According to Caner and Aydin (2021), the current generation is described as digitally born expecting the use of technology in all aspects of their lives, including the classroom. Gen Z students prefer hands-on and active learning through collaboration with others (Hartman et al., 2019). Graziano (2018) states that technology can be a transformative tool in teaching and learning. Therefore, technology should not be incorporated as a one-time event (Bonitatibus, 2018).

Ashford (2018) states that teachers who do not use technology may be putting their students at a disadvantage. This is due to the fact that technology use is expected in the world beyond the classroom (Ashford, 2018). Additionally, when computers are used regularly in the classroom students score higher on standardized tests (Ashford, 2018). However, being

able to use technology does not mean teachers can implement it in a meaningful way in the classroom (Graziano, 2018).

A vast amount of funding has gone into supporting technology use in the classroom (Dogan et al., 2021). Therefore, the ability to use and incorporate technology into the classroom is important for all teachers (Birisci & Kul, 2019). However, teacher beliefs about technology often dictate how much technology is used in the classroom (Graziano, 2018). Teachers often struggle with the long-term support and effectiveness of technology (Ashford, 2018). More training is required to change teacher attitudes about incorporating technology into the classroom when they begin with a poor attitude toward technology (Ashford, 2018).

Challenges of Technology

According to Dogan et al. (2021), the definition of technology use is not standardized in education. Due to this lack of standardization, it is difficult to set clear expectations for technology use in the classroom. In addition, some teachers do not have the skillset to integrate technology into the classroom (Ashford, 2018). While teacher's need to use technology efficiently in their practice, many have not been taught how to do this (Graziano, 2018). Therefore, it is unfair to create technology expectations for all teachers when ability levels differ.

To overcome these obstacles, teachers need continued training and support to keep up with changes regarding technology (Ashford, 2018). However, teachers can feel frustrated and overburdened by technology (Hartman et al., 2019). In addition, it often takes time and effort to integrate technology well, which is often not a luxury afforded by teachers (Graziano, 2018). Therefore, it is critical that teachers enter the profession with exposure and understanding of instructional technology (Zakrzewski & Newton, 2022).

In addition to lack of training, some teachers have a fixed mindset when it comes to classroom instruction (Hartman et al., 2019). Teachers often choose teacher-centered instruction rather than student-centered technology driven instruction due to high-stakes testing (Lindstrom et al., 2021). When technology is integrated, it is often incorporated in low-level ways in the classroom (Liu et al, 2017). In other scenarios, teachers may passively resist technology by using it superficially (Hartman et al., 2019). Therefore, it is of great importance to modify the mindset regarding technology throughout teacher education programs.

Comfort of Technology

According to Bahcivan et al. (2019), there are two types of barriers to integrating technology: first-order barriers and second-order barriers. First-order barriers include external measures such as the amount of technology, while second-order barriers include factors intrinsic to the teacher such as self-efficacy (Bahcivan et al., 2019). In regards to first-order barriers, as mentioned previously, when teachers feel overwhelmed by technology they are less likely to incorporate technology. In addition, if ample time is not provided to develop an understanding of technology, teachers are less likely to incorporate the technology into their teaching (Kalonde & Mousa, 2016).

Beliefs are critical to how humans operate and dictate how we respond to a variety of elements throughout our lives (Bahcivan et al., 2019). In conjunction with this thought process, second-order barriers focus more on comfort with technology in accordance with technology integration. Graziano (2018) states that teachers who lacked comfort with technology did not integrate technology as often. Liu et al. (2017) concur with this statement by arguing that comfort with technology has a positive correlation with use.

When teachers are comfortable with technology, they are more likely to choose instructional technologies to integrate into their lessons to make lessons more engaging (Kalonde & Mousa, 2016). However, teacher self-efficacy can affect how much technology is incorporated into the classroom (Ashford, 2018). When teachers regularly use technology they have more comfort with technology and are therefore more apt to incorporate technology into their teaching (Kalonde & Mousa, 2016). Incorporating more technology then increases their confidence with technology (Graziano, 2018). However, the challenge is aiding teachers in becoming more confident with technology.

Increasing Comfort with Technology

Research has found that confidence and comfort with technology increases when teachers are knowledgeable regarding the technology being integrated (Dogan et al., 2021). Therefore, training is critical to teacher comfort with technology. However, according to Hartman et al. (2019), teachers who use traditional methods may feel more confident incorporating technology when they learn from a mentor who is also a friend. Therefore, training may need to be more formal for some and informal for others.

Understanding the importance of technology use has an impact on how willing teachers are to incorporate technology into the classroom (Dogan et al., 2021). Because self-efficacy with technology is often linked to personal experience (Birisci & Kul, 2019), these experiences might be of use to engage teachers in understanding the importance of technology incorporation into the classroom. In addition, helping teachers feel more confident with technology is as important as teaching them about the technology (Graziano, 2018). When teachers are knowledgeable about a technology, they incorporate it more into the classroom (Dogan et al., 2021).

Teacher Education and Technology Integration

Training preservice teachers is critical to their development and success as a teacher (Ebersole, 2019). According to Ashford (2018), preservice teachers who have a positive outlook toward technology are more likely to incorporate technology. The more often preservice teachers are engaged with technology in their undergraduate work the more likely they are to be comfortable with technology (Graziano, 2018). Ebersole (2019) states that modeling technology can be useful in supporting preservice teachers in increasing their comfort-level with technology. Additionally, the amount of technology showcased and modeled in teacher education programs often transfers to how much teachers use technology in their own classroom (Caner & Aydin, 2021).

Considering the current generation is considered technology proficient, it is of interest to note how often preservice teachers have low self-efficacy when it comes to technology integration (Graziano, 2018). In terms of integrating technology into teaching,

preservice teachers often feel overwhelmed or threatened (Graziano, 2018). This may be due to the lack of sufficient training in teacher education programs (Birisci & Kul, 2019). In addition, the lack of teaching experiences using technology in educational settings may cause low self-efficacy in terms of implementation of technology (Birisci & Kul, 2019). Therefore, teacher education programs need to ensure their graduates are being effectively trained in technology integration in terms of pedagogy and comfort.

Purpose

Technology is an integral part of our society. The research shows that while billions of dollars have been spent on instructional technology, it is not being used efficiently or effectively in the classroom. Research suggests that comfort level with technology and technology integration are part of the reason that teachers often do not integrate technology into the classroom. Additionally, preservice teachers may be proficient in some technologies, but still struggle in implementing instructional technologies. Therefore, the purpose of this study was to incorporate Brenner and Brill's (2016) seven methods of instructing with preservice teachers in addition to adding a self-directed component to determine whether comfort-level increased during the course of the semester.

Methods

Participants

Participants in this study were a convenience sample. All preservice teachers in the College of Education are required to take a Technology for Teachers course during their college career. Education majors included in this class are as follows: Child Development, Early Childhood Education, Elementary Education, Middle Grades Education, High School Education, and Physical Education. During the 2020-2021 school year, approximately sixty preservice teachers took this course and thirty-one elected to participate in the study. A breakdown of the participants is provided in Table 1.

Table 1. Participants by Year and Major.

Year	<i>N</i>	Child Development	Early Childhood Education	Elementary Education	Middle Grades Education	High School Education
Freshman	5	0	2	0	1	2
Sophomore	15	1	6	4	0	4
Junior	11	0	9	1	1	0
Senior	1	0	0	1	0	0

Materials

Participants were asked to complete a six-question survey at the end of the semester (see Table 2). This survey included three Likert scale questions and three open-ended questions. The Likert Scale questions sought to determine preservice teachers' perceptions

regarding integrating instructional technology into the classroom at the start of the course and the end of the course. Open-ended questions explored preservice teacher perceptions of benefits and drawbacks of incorporating technology into the classroom in addition to determining whether preservice teachers felt they would incorporate technology into upcoming lesson plans during their college career.

Table 2. Participant Survey Questions.

Question	Response Option
What was your comfort level about integrating instructional technology in the classroom at the start of this course?	5 Point Likert Scale from Not Beneficial to Incredibly Beneficial
What is your comfort level now about integrating instructional technology into the classroom during your time in college?	5 Point Likert Scale from Not Beneficial to Incredibly Beneficial
What is your comfort level now about integrating instructional technology into the classroom when you have your own classroom?	5 Point Likert Scale from Not Beneficial to Incredibly Beneficial
What are some of the benefits of adding technology to a lesson as a future teacher?	Open Response
What are some of the drawbacks to adding instructional technology to a lesson as a future teacher?	Open Response
Can you see yourself incorporating instructional technology into lesson plans in upcoming courses? Why or why not?	Open Response
What was your comfort level about integrating instructional technology in the classroom at the start of this course?	5 Point Likert Scale from Not Beneficial to Incredibly Beneficial
What is your comfort level now about integrating instructional technology into the classroom during your time in college?	5 Point Likert Scale from Not Beneficial to Incredibly Beneficial
What is your comfort level now about integrating instructional technology into the classroom when you have your own classroom?	5 Point Likert Scale from Not Beneficial to Incredibly Beneficial
What are some of the benefits of adding technology to a lesson as a future teacher?	Open Response
What are some of the drawbacks to adding instructional technology to a lesson as a future teacher?	Open Response
Can you see yourself incorporating instructional technology into lesson plans in upcoming courses? Why or why not?	Open Response
What was your comfort level about integrating instructional technology in the classroom at the start of this course?	5 Point Likert Scale from Not Beneficial to Incredibly Beneficial

Procedure

During the semester the class met for fourteen weeks, twice each week. The first session of the week was used to introduce, model, and discuss various instructional technologies. Readings regarding the technology were discussed as a class. In addition, the class discussed the new technology and practiced from the teacher side of the platform and the student side of the platform. Assignments for the week were also introduced and discussed during this first class session.

During the second class session of the week, preservice teachers were provided the opportunity to work on assignments engaging with the technology introduced earlier in the week. This session offered preservice teachers time to engage with the technology, ask questions of peers and the professor, and develop activities with the technology to complete the pending assignment. All assignments were developed with future classrooms in mind. In addition, the goal was to ensure authenticity in integrating instructional technology into future classrooms for preservice teachers. Part of each assignment required preservice teachers to reflect on the technology and whether or not it would be beneficial to their classroom.

Throughout the semester, preservice teachers worked in teams based on their major. For example, early childhood education majors were placed into a group. Groups did not exceed four preservice teachers and the groups completed some assignments together. The goal of these groups was to ensure preservice teachers had others to discuss ideas and challenges with in addition to creating meaningful deep relationships as they moved throughout their program. Lastly, the final project required preservice teachers to choose a technology and develop a lesson based on the technology. The goal was to help the groups learn about their chosen technology through a hands-on activity and collaborate with their team to create an authentic lesson for deep learning.

Results

To begin, a paired t-test was conducted to determine whether results were significant or not. Tests were run by year in college (see Table 3) in addition to by major in college (see Table 4). Preservice teachers were asked in the survey what their comfort level was with technology at the start and end of the technology course. Selections included a Likert Scale rating of 1-5 with one representing a very low comfort-level and five representing a high comfort-level. In terms of year in college, all groups showed a significant difference between comfort-level at the start of the course and the end of the course with the exception of the senior because there was only one to review. In addition, the freshman group is too small to ensure validity in the results. However, overall results showed a significant difference.

Table 3. Paired t-Test by Year in College for Comfort Level with Technology Integration Before and After the Instructional Technology Course.

Year in College	N = 31	Beginning Rating		Ending Rating		t-test
		Mean	SD	Mean	SD	
Freshman	5	3.00	1.41	4.6	0.55	0.035

Year in College	N = 31	Beginning Rating		Ending Rating		t-test
		Mean	SD	Mean	SD	
Sophomore	15	2.67	1.29	4.33	0.62	4.593 x 10 ⁻⁵
Junior	11	2.82	0.60	4.45	0.52	5.310 x 10 ⁻⁵
Senior	1	3.00	NS	5.00	NS	NS
Overall	31	2.78	0.85	4.39	0.58	7.442 x 10 ⁻¹¹

When reviewing the paired t-test for comfort-level by major from the start to the end of the course (see Table 4), all majors showed a significant difference from the beginning of the course to the end of the course with the exception of the Child Development group and the Middle Grades group. These numbers were not significant as the number of preservice teachers in the course was too low to effectively review the statistics. While the High School and Elementary groups showed significant differences, it is unclear whether those results are valid as the samples are so small.

Table 4. Paired t-Test by Major for Comfort Level with Technology Integration Before and After the Instructional Technology Course.

Major	N = 31	Beginning Rating		Ending Rating		t-test
		Mean	SD	Mean	SD	
Child Development	1	1.00	NS	4.00	NS	NS
Early Childhood Education	17	2.71	0.92	4.41	0.62	4.923 X 10 ⁻⁶
Elementary Education	6	3.17	1.33	4.67	0.51	0.028
Middle Grades Education	2	3.5	0.71	4.5	0.71	NS
High School Education	6	2.67	1.21	4.33	0.52	0.004
Overall	31	2.78	0.85	4.39	0.58	7.442 x 10 ⁻¹¹

In addition, descriptive statistics were calculated and analyzed in terms of likelihood to integrate technology in a future classroom. Preservice teachers responded via a 5-point Likert Scale with one reflecting a very low-likelihood of incorporating technology and five reflecting a high-likelihood of incorporating technology in a future classroom. Table 5 shows the data by year in college. According to the mean, most preservice teachers were likely or very likely to incorporate technology into their future classroom. Table 6 displays the data by major showing preservice teachers were neutral to likely to incorporate technology into their future classroom. Overall data show that preservice teachers were likely to incorporate technology into their future classroom.

Table 5. Descriptive Statistics by Year for Comfort Level Integrating Technology into a Future Classroom.

Year in College	N = 31	Mean	SD
Freshman	5	4.40	0.55
Sophomore	15	4.07	0.70
Junior	11	4.55	0.52
Senior	1	5	NS
Overall	31	4.17	0.41

Table 6. Descriptive Statistics by Major for Comfort Level Integrating Technology into a Future Classroom.

Major	N = 31	Mean	SD
Child Development	1	3.00	NS
Early Childhood Education	17	4.41	0.62
Elementary Education	6	4.33	0.82
Middle Grades Education	2	4.5	0.71
High School Education	6	4.17	0.41
Overall	31	4.32	0.64

In addition to analyzing quantitative data, qualitative data were analyzed using a Grounded Theory approach. The first question analyzed was, "What are some of the benefits of adding technology to a lesson as a future teacher?" Within this question three themes arose from the feedback: engagement, opportunities, and support. Most preservice teachers listed engagement as a reason to use technology in the classroom. They felt students would be more engaged in the lesson when technology was incorporated. One preservice teacher stated, "The benefits of this is that it more efficiently helps assess the students and engages them more effectively. Furthermore, technology is a tool, and as such, can be used to enhance lessons in meaningful ways that may not be done without it." The second theme focused on opportunities. Many preservice teachers felt using technology increased opportunities for students to become more fluent with technology as it will continue to be part of their world. Support was the last theme and this focused on preservice teachers using technology to differentiate instruction and ensure students were receiving the appropriate support and interventions. One preservice teacher stated, "It makes the lesson more personalized for each student and helps teachers insert and record formative assessments!"

The second question analyzed was, "What are some of the drawbacks to adding instructional technology to a lesson as a future teacher?" For this question two main themes arose with one subtheme. The main themes were technology failure and distraction while the subtheme was hindering relationships. Throughout the results preservice teachers were mainly concerned with technology failure and distractibility caused by technology. However, the subtheme hindering relationships also surfaced. Several preservice teachers noted that technology might cause relationships to suffer between teacher and student and student to student. One preservice teacher stated that, "I worry that it may take away from some of the personal relationships built between teachers and students."

The final question analyzed was, “Can you see yourself incorporating instructional technology into lesson plans in upcoming courses? Why or why not?” In relation to this question, all preservice teachers stated they could see themselves using technology within the classroom. In further analyzing the data, three overall themes emerged: engagement, need, and comfort. Several preservice teachers alluded to the fact that technology is engaging and interesting for students. One student stated, “Absolutely! I feel that technology has unlimited potential for making innovative and imaginative lesson plans.” In terms of need, several preservice teachers stated that technology is necessary within the classroom and to function within our society. One preservice teacher stated that, “it will make my students more successful.” Comfort was the third theme that arose and several students stated they felt more confident in their technological skills, allowing them to feel more comfortable using technology in the classroom.

Discussion

Overall, the t-tests showed significant effects for increasing comfort-level over the course of a semester in a stand-alone technology course. However, when scores were broken down further into classifying groups several groups showed either insignificant results or groups were too small to ensure results are valid. The results for Early Childhood Education and Sophomores did have a significant amount of preservice teachers in those samples. Those two samples were found to have a significant difference from start to finish in increasing comfort-level with technology. Therefore, the seven methods used for instructing preservice teachers according to Brenner and Brill (2016) may have been of use throughout this study and increasing comfort level overall for preservice teachers.

In terms of descriptive statistics, all groups except for Child Development felt it was likely they would incorporate technology into their classrooms in the future. Across year, preservice teachers indicated they would incorporate technology into the classroom as well. This may highlight the importance technology has in society and the classroom in addition to feeling more confident with instructional technology. Having a positive outlook toward technology supports incorporation of technology in the classroom (Ashford, 2018). Therefore, preservice teachers may be more likely to incorporate technology into their classrooms due to a positive outlook in addition to increased comfort-level.

In analyzing the benefits of using technology, most themes were pretty typical when considering technology. Classroom engagement, when technology is used, has been well-researched and is often a consideration when trying to increase classroom interest (Dinc, 2019). Additionally, opportunities was a standard answer to this type of question. Preservice teachers focused on the fact that students will need to know how to use and incorporate technology as they move into real-world situations. The last theme was a bit unexpected. It was clear in analyzing the data that preservice teachers saw the value in using technology to support learning and differentiation. In addition, they spoke about using technology to streamline data collection.

Drawbacks regarding technology were also pretty typical answers with the exception of the subtheme. Often teachers are worried about technology failure and this dissuades them from incorporating technology (Bai, 2019). Therefore, this was a pretty standard answer. In addition, distraction was another typical answer. Preservice teachers are often worried that technology will be more of a distraction than a support which dissuades them

from incorporating technology. The subtheme hindering relationships was surprising. It may be due to the COVID-19 pandemic that preservice teachers now have the online experience and worry about how technology may hinder their students' experiences in the classroom. Preservice teachers all stated they would use technology in their future classrooms. Within the three themes that arose, responses were fairly typical. Preservice teachers felt students would be engaged with technology and needed to understand technology for the technological world they will be entering. Comfort showed growth from the comments preservice teachers made in the survey. They stated they felt more confident using technology and this might be of use as they enter the classroom, which is in line with Dinc (2019).

Limitations

Within this study there were several limitations. Having a small sample caused some limitations in data analysis. Collecting data over several semesters may be useful. In addition, the survey was conducted once allowing students to rate the beginning of the semester comfort at the end of the semester. This may have caused inaccurate data. A solution would be to conduct a survey at the beginning of the semester and one at the end of the semester.

Future Research

Comfort has been researched often when considering teachers in the field. However, little research has been conducted regarding increasing preservice teacher comfort with technology prior to entering the teaching field. Therefore, it is critical to understand whether increasing comfort with technology at the teacher education level will help teachers in the field. This study would benefit from a follow up study after the preservice teachers have graduated to determine how much technology they incorporate into their classrooms and how they use technology.

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