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A Case Study Examining How Students in an Elementary, Early Childhood, and Exceptional Child Educator Preparation Program Acquire Technology Skills

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by

Jana L. Gerard

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Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work here at Lindenwood University and that I have not submitted it for any other college or university course or degree here or elsewhere.

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Abstract

This qualitative case study examined two sections of an educational technology class that was part of an elementary, early childhood, and exceptional child educator preparation program, to determine how students acquired educational technology skills for future teaching. As the ability to integrate educational technology skills into teaching and learning is vital to preservice educators, this study aimed to address possible changes needed in educator preparation programs to ensure preservice educators are ready to effectively teach with educational technology in their field experiences, student teaching, and future classrooms. In order to examine how students acquired educational technology skills, the researcher observed two sections of an educational technology class at a regional state university, as well as conducted interviews with students in the class. The researcher also used instructor-assigned application journals, pre- and post-surveys, and Philosophy of Educational Technology Integration Statements. The researcher also used a Modified STEBI-B, given to students at the beginning and end of the semester, to evaluate student self-perceived growth in 19 educational technology skills.

Through qualitative analysis of the data, the researcher ascertained that students acquired educational technology skills through instructor modeling of technology tools and skills followed by application assignments with the tools and skills. The researcher also ascertained that the digital competence of the instructor impacted the ability of students to acquire technology skills and that the use of a hybrid instructional design, one day face-to-face and one day online, for the course allowed students more time to interact with the technology and boosted student acquisition of educational technology skills. By completing qualitative data analysis on student application journals, the researcher also ascertained that the application journals ensured students spent time interacting with educational technology tools in a more in-depth manner. The researcher suggests that educator preparation programs support teacher educators in participating in technology professional development on an ongoing basis. The researcher also suggests that educator preparation programs carefully consider the instructional design of educational technology courses, as well as ensuring technology integration is embedded in all educator preparation coursework in a thoughtful and meaningful way, including content courses.

Keywords digital competence, educational technology, educator preparation programs, preservice educators, technology integration

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Chapter One: Introduction

Background of the Study

Digital technology, including educational, information, and communication technologies, is a relatively new phenomenon, especially when placing digital technology within the context of all human technological advancement throughout human history (Schaller, 1997). According to Schaller (1997), there have been more technological advances in the past 50 years than in all history of human technological advancement prior to World War II (p. 54). However, digital technologies are a ubiquitous part of daily life for most United States citizens, including students. Robinson (2019) asserted “the proliferation of information and communication technologies has created a globally digital and digitally global information society across almost every dimension of human life, education included” (p. 3). Digital technology is a component of living in the 21st century, and the use of digital technology is becoming more prevalent as more innovations of digital technologies are advanced (Schaller, 1997). Some economists propose that society is in a new technological revolution called the Digital Revolution (Atkinson & Castro, 2008). The COVID-19 global pandemic has highlighted the importance of understanding digital technology as the world adjusts to working and learning from a distance.

The COVID-19 global pandemic also pushed educators to find new ways to leverage digital technology for teaching and learning. According to Archambault et al. (2021) “the COVID-19 pandemic and K-12 schools’ shift to remote teaching made it critical for teachers to develop skills in remote teaching” which required “innovative” uses of educational digital technologies (p. 1827). As both P-12 and higher education were pushed to distance learning, digital technology became both necessary and critical to education and educators. Educators had to adjust to new and innovative ways of delivering instruction and keeping students engaged in learning. The global pandemic underscored the importance of digital technology for educators. Beyond the need for educators to understand how to use digital technology, the Council for the Accreditation of Educator Preparation (CAEP) requires educational technology skills, including digital technologies, be a component taught in accredited educator preparation programs (EPPs) (Council for the Accreditation of Educator Preparation [CAEP], 2019, 2020a, 2020b).

Statement of the Problem

Technology integration should be important in teacher education programs because in the 21st century, teaching is technology-enabled and appropriate digital tools support learning (Muller, 2020). The United States Department of Education Office of Educational Technology stated in the update to the National Education Technology Plan (Office of Educational Technology, 2017), teacher education programs need to better prepare preservice educators to use educational technologies as tools for transforming teaching and learning. The Missouri Department of Elementary and Secondary Education (n.d.c) requires preservice educators to become proficient with a variety of technology and communication tools and understand how technology and communication tools can be used for "purposeful" instruction (p. 16). Regional State University (2021a) requires students in its elementary, early childhood, and exceptional child educator preparation program to "demonstrate mastery of current P-12 educational technology tools" (para. 13).

While educator preparation programs (EPPs) often include technology courses, Selwyn (2014) stated that many of these courses are framed as something done to learners by stakeholders. However, Watulek (2018) asserted that educator preparation programs should integrate technology into teaching in ways to support “powerful and authentic student learning” (p. 166). Harris et al. (2009) and Polly et al. (2010) proposed that technology integration should be taught to preservice educators in ways that that will support how preservice educators will be expected to teach with technology in their future teaching. While there is much discussion among EPPs as to the importance of technology integration in EPPs, the focus of these conversations is primarily on stand-alone technology courses versus integrated technology approaches, while not much attention is given to how preservice educators actually learn educational technology skills (Watulek, 2018). This study examined a specific educational technology class in Regional State University’s elementary, early childhood, and exceptional child educator preparation program to assess if preservice educators that take the class, Instructional and Assistive Technology in a Universally Designed Learning Environment, acquire educational technology skills needed in future teaching.

Purpose of the Study

The purpose of this study was to examine an educational technology class that is part of an educator preparation program (EPP) at a regional state university in the Midwest to determine how students in that class acquired educational technology skills to be used in future teaching. The data collected in this study may assist EPPs in understanding how to better support teacher educators and preservice educators as they acquire educational technology skills needed for future teaching and learning. Using a case study methodology and two sections of Instructional and Assistive Technology in a Universally Designed Learning Environment, the researcher employed a self-efficacy scale, the Modified STEBI-B (Bleicher, 2004) to gather data on students' perceptions of educational technology skills acquired.

The researcher examined student pre- and post-technology skills surveys, journal prompts, Philosophy of Educational Technology Integration Statements, multi-week observations of the educational technology class, and eight interviews. The researcher investigated how students in an elementary, early childhood, and exceptional child EPP acquired educational technology skills for future teaching. Another topic investigated in the study was how opinions of students in an elementary, early childhood, and exceptional child EPP regarding teaching with educational technology changed during an educational technology class. This study also examined if prior technology skills affected how students in an elementary, early childhood, and exceptional child EPP acquire educational technology skills for future teaching. Last, the researcher gathered data to examine if the use of an application journal assisted students in an elementary, early childhood, and exceptional child EPP in acquiring educational technology skills for future teaching.

Data collected through application journal prompts assigned by the instructor, observations, and interview questions informed the research question, how do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program acquire educational technology skills to be used for future teaching? Application journal prompts assigned by the instructor and interview questions informed the research question, how do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program perceive that an application journal developed their educational technology skills to be used for future teaching? Data collected from observations, interview questions, application journal prompts assigned by the instructor, the Philosophy of Educational Technology Integration Statements assigned by the instructor, and the Modified STEBI-B given by the researcher informed the research, question how do opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program regarding teaching with technology change during an educational technology class? Instructor assigned pre- and post-surveys, Philosophy of Educational Technology Integration Statements assigned by the instructor, interview questions, and the Modified STEBI-B given by the researcher informed the research question, how do prior technology skills affect the opinions of students in a technology class in an early elementary, early childhood, and exceptional child educator preparation program learning educational technology skills to be used for future teaching?

This study hoped to clarify how students in an elementary, early childhood, and exceptional child educator preparation program gain mastery of crucial educational technology skills needed for future teaching. Research from this case study can help inform the teaching of educational technology classes in an elementary, early childhood, and exceptional child EPP, as well as add to an understanding of how preservice educators regard educational technology skills.

Importance of the Study

According to Nellis (2017), emerging technologies have created new learning paradigms and Gonzales and Donert (2014) asserted that technology affects trends in learning worldwide. Ideland (2021) stated that digitized classrooms require a teacher who is flexible and can successfully keep up with rapidly changing technology skills. Educator preparation programs (EPPs) must provide authentic application experiences for preservice educators to learn educational technology skills, so that preservice educators can integrate technology fully into teaching and learning (Tearle & Golder, 2008). Further, Richardson (2003) suggested that preservice educators' beliefs about teaching and learning with technology are shaped by personal experiences with technology. Schmidt-Crawford et al. (2018) stated that EPPs must integrate technology into teaching and learning so that preservice educators can be confident in their use of technology while using technology in the transformation of student learning. Preservice educators must be digitally literate to effectively integrate technology into teaching and learning (Dincer, 2018). Parra et al. (2019) emphasized the importance of preservice educators interacting with technology in ways that allow preservice educators multiple opportunities to apply technology to teaching and learning.

This case study examined two sections of Instructional and Assistive Technology in a Universally Designed Learning Environment, taught by the same professor at a regional state university in the Midwest. Regional State University catalog lists Instructional and Assistive Technology in a Universally Designed Learning Environment as "[this] course is designed for teacher candidates to investigate and implement the effective integration of technology into the P-12 curriculum" (Regional State University, 2020, para. 3). The 2020-2021 syllabus of Instructional and Assistive Technology in a Universally Designed Learning Environment states that the objectives of the course are to

> utilize and demonstrate current instructional technology resources by creating a universally designed learning environment for all students; demonstrate knowledge and implementation of assistive technology to support students' functional capabilities and academic achievement; promote and model digital citizenship by recognizing the rights, responsibilities, and opportunities of living, learning, and working in a digital world and acting/modeling ways that are safe, legal, and ethical; engage in professional development and life-long learning; be able to locate national and state standards and create aligned learning experiences while integrating technology; demonstrate current instructional resources to foster collaborative learning; apply appropriate use of technology to effectively communicate and collaborate with families; and create learning opportunities that challenge students to use a design process and computational thinking to innovate and solve problems. (Regional State University, 2021a, p. 4)

The instructor sought stakeholder input when revising the syllabus and educational technology skills to be taught in Instructional and Assistive Technology in a Universally Designed Learning Environment through the use of data collected from regional school districts regarding what technology was being used by regional school districts, as well as what educational technology skills regional schools believed were important. The data were collected from a survey conducted by Regional State University's educational innovation and technology center.

Standards

Preservice educator and teacher standards help define the necessary technology skills needed by preservice educators for future teaching. There are two sets of standards used to create the objectives of Instructional and Assistive Technology in a Universally Designed Learning Environment. The first set of standards are the Missouri Department of Elementary and Secondary Education (DESE) Teacher Standards 3C1, 3C2, 4C2, 6C4, 8C2, and 8C3 and the second set of standards used to create the objectives of Instructional and Assistive Technology in a Universally Designed Learning Environment are the International Society for Technology in Education (ISTE) 2017 Educator Standards; Standards 1, 1c, 3, 4c, 4d, 5, 6c, and 6d (Regional State University, 2021a).

In the coding of the Missouri DESE Teacher Standards, the first symbol represents the number of the standard, the second symbol represents the developmental category of the teacher, and the third symbol represents the quality indicator. The developmental categories are candidate, new, developing, proficient, and distinguished. All Missouri Teacher Standards used in the Instructional and Assistive Technology in a Universally Designed Learning Environment syllabus include the candidate designation:

> This level describes the performance expected of a potential teacher preparing to enter the profession and is enrolled in an approved educator preparation program at a college, university, or state-approved alternate pathway. Content knowledge and teaching skills are being developed through a progression of planned classroom and supervised clinical experiences. (Missouri Department of Elementary & Secondary [MODESE] Education, n.d.c, p. 6)

By ensuring preservice educators are meeting the Missouri Teacher Standards candidate designation quality indicators and the International Society for Technology in Education (ISTE) 2017 Educator Standards, Regional State University's Elementary, Early Childhood, and Exceptional Child (EESE) educator preparation program (EPP) is ensuring that preservice educators have demonstrated the ability to integrate technology into teaching and learning as in-service teachers.

Table 1

Missouri Teacher Standards with Quality Indicators

Standard Number and Name	Standard Definition	Quality Indicators
3 Curriculum Implementation	"the teacher recognizes the importance of long-range planning and curriculum development. The teacher develops, implements, and evaluates curriculum based upon student, district and state standards data"	Understands implementation of curriculum standards Can create lessons for diverse learners
4 Critical Thinking	"the teacher uses a variety of instructional strategies and resources to encourage students' critical thinking, problem solving, and performance skills"	Understands appropriate use of instructional resources to enhance student learning
6 Effective Communication	"the teacher models effective verbal, nonverbal, and media communication techniques with students, colleagues and families to foster active inquiry, collaboration, and supportive interaction in the classroom"	Develop ability to use technology and media tools
8 Professionalism	"the teacher is a reflective practitioner who continually assesses the effects of choices and actions on others. The	Demonstrate understanding of professional learning

	teacher actively seeks out opportunities to grow professionally in order to improve learning for all students”	Aware of professional professional rights, responsibilities and ethical practices

Note. Adapted from “Teacher Standards,” Missouri Department of Elementary & Secondary Education (n.d.c) pp. 4-5. https://dese.mo.gov/media/pdf/oeq-ed-teacherstandards. In the public domain.

Table 2

International Society for Technology in Education (ISTE) 2017 Educator Standards

Standard Number	Standard Definition
1	“educators continually improve their practice by learning from and with others and exploring proven and promising practices that leverage technology to improve student learning”
1c	“[educators] stay current with research that supports improved student learning outcomes, including findings from the learning sciences”
3	“educators inspire students to positively contribute to and responsibly participate in the digital world”
4	“educators dedicate time to collaborate with both colleagues and students to improve practice, discover and share resources and ideas, and solve problems”
4c	“[educators] use collaborative tools to expand students’ authentic, real-world learning experiences by engaging virtually with experts, teams and students, locally and globally”
4d	“[educators] demonstrate cultural competency when communicating with students, parents and colleagues and interact with them as co-collaborators in student learning”
5	“educators design authentic, learner-driven activities and environments that recognize and accommodate learner variability”

6	"educators facilitate learning with technology to support student achievement of the 2016 ISTE Standards for Students"
6c	"[educators] create learning opportunities that challenge students to use a design process and computational thinking to innovate and solve problems"
6d	"[educators] model and nurture creativity and creative expression to communicate ideas, knowledge or connections"

Note. Adapted from "International Society for Technology in Education ISTE Standards for Educators" International Society for Technology in Education (2021), paras. 2, 5, 10, 15, 18, 19, 20, 24, 27, & 28. https://www.iste.org/standards/iste-standards for teachers. Copyright 2022, International Society for Technology in Education (ISTE).

As an accredited EPP, Regional State University must also meet CAEP standards for teaching educational technology skills to preservice educators. The CAEP standards ensure that preservice educators are learning necessary and crucial skills for future teaching and learning. CAEP 2013 Initial-Level Standards, standard 1.5 stated: "Providers ensure that candidates' model and apply technology standards as they design, implement and assess learning experiences to engage students and improve learning; and enrich professional practice" (CAEP, 2019, p. 1). The CAEP 2022 Initial-Level Standards required the integration of technology in standard R1.3 Instructional Practice "providers ensure that candidates model and apply national or state approved technology standards to engage and improve learning for all students" (CAEP, 2020a, para. 3). R3.2 Monitoring and Supporting Candidate Progression, "the provider creates and monitors transition points from admission through completion that indicate candidates' developing content knowledge, pedagogical knowledge, pedagogical skills, critical dispositions, and professional responsibilities, and the ability to integrate technology effectively in their practice" and R3.3 Competency at Completion "The provider ensures candidates possess academic competency to teach effectively with positive impacts on diverse P-12 student learning and development through application of content knowledge, foundational pedagogical skills, and technology integration in the field(s) where certification is sought" (CAEP, 2020b, paras. 2 & 3). The Instructional and Assistive Technology in a Universally Designed Learning Environment course is one of the ways Regional State University's EPP meets these CAEP standards.

Definition of Terms

4Cs of 21st Century Learning: collaboration, communication, creativity, and critical thinking, also called the 4Cs of Future Ready Learning or Learning and Innovation skills (P21 Partnership for 21st Century Learning, n.d.).

Assistive Technology has two legal definitions.

Assistive Technology Device: any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, used to increase, maintain, or improve functional capabilities of a child with a disability (Individuals with Disabilities Education Act, 2004).

Assistive Technology Service: any service that directly assists a child with a disability in the selection, acquisition, or use of an assistive technology device (Individuals with Disabilities Education Act, 2004).

Children's Online Privacy Protection Act (COPPA): this Federal rule gives parents more control regarding personal information collected from children under the age of 13 online and applies to commercial websites and online services that may "collect, use, or disclose" personal information of children under the age of 13. This rule also applies to mobile apps, "smart toys," any online service that is "directed to" children under the age of 13 or any website or online service of any kind with "actual knowledge" that the website or service is collecting, using, or disclosing personal information of children under the age of 13 (Federal Trade Commission, 2020, para. 2).

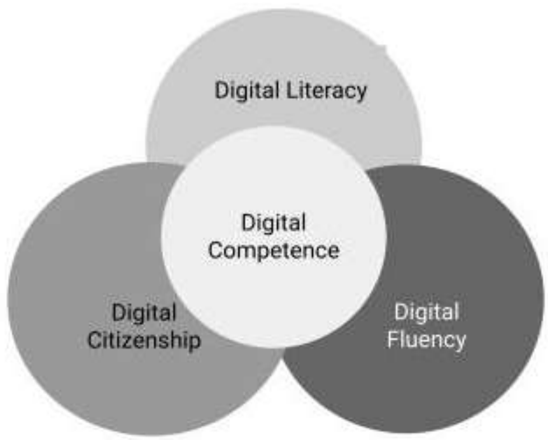
Council for the Accreditation of Educator Preparation (CAEP): the accrediting body used by the program in this case study. Standards in the 2013 Initial-Level Standards are Content and Pedagogical Standards; Clinical Partnerships and Practice; Candidate Quality, Recruitment, and Selectivity; Program Impact; and Provider Quality Assurances and Continuous Support. Initial-Level Standards for 2022 has seven standards that include Content & Pedagogical Knowledge; Clinical Partnerships & practice; Candidate Recruitment, Progression, and Support; Program Impact; Quality Assurance System and Continuous Improvement; Fiscal and Administrative Capacity; and Record of Compliance with Title IV of the Higher Education Act (CAEP, 2019, 2020c).

Digital Citizenship: recognizing the rights, responsibilities, and opportunities of living, learning, and working in an interconnected digital world, as well as acting in the digital world in ways that are safe, legal, and ethical. Digital citizenship for educators also includes the modeling of these behaviors for peers and students (Palacios Hidalgo et al., 2020).

Digital Competence: a combination of knowledge, skills, and attitudes towards the use of technology to perform tasks, solve problems, manage information, communicate, and collaborate, as well as the ability to create and share content effectively, appropriately, securely, critically, creatively, and ethically. Figure 1 shows how digital competence combines digital citizenship, digital fluency, and digital literacy skills (Palacios Hidalgo et al., 2020).

Figure 1

Digital Competence Venn Diagram



Digital Fluency: the demonstration of a range of technology skills, as well as the ability to “search solutions to technological challenges and roadblocks” (Kolomitz & Cabellon, 2016, p. 49).

Digital Literacy: acquisition of the knowledge and skills that allow individuals to navigate “media- and information-rich environments,” as well as the ability to use and understand information in many formats through an emphasis on critical thinking, not a reliance on information and technology skills (Chan et al., 2017; Sorgo et al., 2017).

Elementary, Early Childhood and Special Education (EESE) Department: also known as elementary, early childhood, and exceptional child department, provides programs for the preparation of teachers at the undergraduate level, and the improvement of teaching at the master's degree level (Regional State University, 2019b).

Educational Technology, also known as Instructional Technology: the field concerned with the design, development, utilization, management, and evaluation of processes and resources for learning (Luppicini, 2005).

Educator Preparation Program (EPP): an educator preparation program, also called a teacher preparation program (TPP), is an academic program at an institution of higher education that leads to professional educator certification (MODESE, n.d.a).

Information and Communication Technology (ICT): any form of technology that allows communication or information gathering, usually by connecting to the Internet. ICTs are also known as digital technologies and Web 2.0 tools. (Hammond, 2020; Massimini & Peterson, 2009).

Family Educational Rights and Privacy Act (FERPA): the Federal law that protects the privacy of students' educational records, including electronic records and student information that is stored digitally (United States Department of Education, 2021).

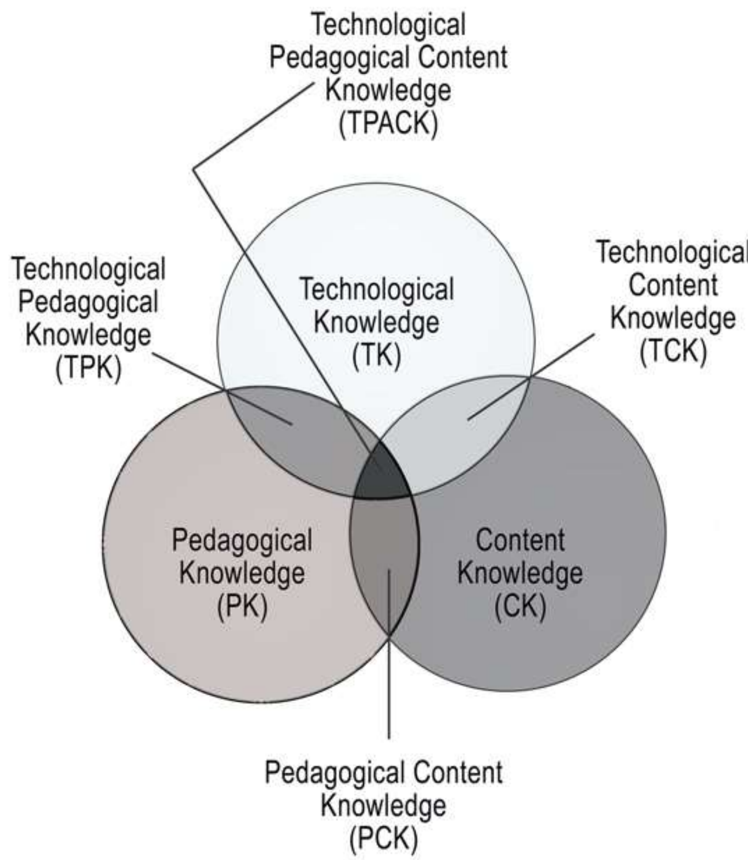
Preservice educators: also known as pre-service educators, preservice teachers, and teacher candidates, are students enrolled in an educator preparation program and working toward certification as a teacher, either in public or private schools (Goulette & Swanson, 2019).

Teacher Educators: those who prepare, teach, and facilitate the education of preservice educators (Even, 2012).

Technology Pedagogy and Content Knowledge (TPACK): TPACK is "a framework for teacher knowledge for technology integration called technological pedagogical content knowledge, originally called TPCK" (Koehler & Mishra, 2009, p. 60).

Figure 2

TPACK Framework Venn Diagram



Universal Design for Learning (UDL): the UDL framework includes three principles: multiple means of representation, multiple means of action and expression, and multiple means of engagement (Kennette & Wilson, 2019).

Limitations

The two class sections of the same course examined in this case study are part of an elementary, early childhood, and exceptional child EPP; any conclusions from data collected for this study may not be applicable to students that are part of a middle and or secondary education EPP. Due to COVID-19 quarantining, two students missed two weeks of class, which means they missed face-to-face instruction and attended class through web-conferencing, which may affect the data collected from those students. Further, there were no data collected to determine if being a first-generation college student affected the technology knowledge of students or the opinions of students regarding technology. One student was repeating the class, so that could impact data collection as well.

Regional State University reported a student population that was 60.9% female and 39.1% male for the relevant semester for this study (Regional State University, 2021b). The population of the class sections used in the study was 94.73% female, so the population was not representative of Regional State University. However, the population of the EESE department of the Regional State University EPP reported that the female population of the EESE department was 93.65% female, so the study population was commensurate with the population of the EESE department (Regional State University, 2021c). Further, Regional State University reported that the Black student population was 8.2%, 2.7% Hispanic, and 3.8% “other minority ethnic groups” (Regional State University, 2021b, para. 4), while the study population was 2.63% Black, 2.63% Hispanic, and 2.63% Asian. While the Hispanic population of the study was like the population of Regional State University, the Black and other ethnic minority populations of the study were not representative of the population of Regional State University.

Bleicher (2004) tested the Modified STEBI-B for validity and reliability; however, there was not testing of the validity or reliability of the version of Modified STEBI-B with the language changed to reflect technology used in this study. The only measures of opinion used in this study are the Modified STEBI-B and interview question 5; there was no other qualitative data collected to measure how the opinions of students regarding educational technology changed during the class.

The researcher had to accept that students answered the interview questions honestly and that students' self-perceived skills were a reliable measure for showing growth in educational technology skills. A further limitation was that studying two courses taught by the same instructor was sufficient to account for any variability between classes.

Summary

It is crucial to understand how preservice educators learn educational technology skills that they will use in future teaching and learning. Educator preparation programs (EPPs) must show how preservice educators are being prepared to teach effectively with technology as part of the accreditation process, as well as state reporting requiring information on how EPPs are preparing preservice educators to use educational technology skills in teaching and learning. Given the importance of understanding how preservice educators learn educational skills for future teaching, this research study sought to explain how preservice educators in an elementary, early childhood, and exceptional child EPP learned educational technology skills. An understanding of how preservice educators learn educational skills may inform how EPPs prepare their preservice educators to effectively teach and learn with technology. The researcher believed that the rapid pace of technological change, the digital competence of teacher educators teaching educational technology, how EPPs integrated technology into their education preparation classes, and integration of technological pedagogical and content knowledge into EPPs were factors worthy of study and are addressed in the next chapter.

Chapter Two: The Literature Review

Introduction

The ability of preservice educators to teach and learn with educational technology is critically important. However, research on educational technologies, their use in teaching and learning, and how students acquire educational technology skills is challenging for both researchers and scholars, as technology develops at an increasingly faster pace, and research on these technologies, therefore, cannot keep pace with changes, especially when compared to the pace of academic literature publication. There is extensive research on technological, pedagogical, and content knowledge (TPACK), which serves as a framework for research regarding the integration of technology; however, much of the research on technology in education focuses on the use of these technologies, not on learning the technologies themselves. Further, a closer look must be taken at the role that teacher educators play in how preservice educators learn about TPACK, technology integration, and educational technologies themselves. Of the research from the past five years regarding how students learn educational technologies, the focus is P-12 education, not preservice educators. The research that does exist from the past five years regarding educational technology and preservice educators comes mostly from Europe and Asia. While data from this research is informative, researchers should be cautious drawing conclusions from this data, as variations in education systems from country to country means research may not be fully applicable to educator preparation programs in the United States.

This chapter includes research that supports a constructivist theoretical framework as a lens for examining educational technology and research on the connection between

Bandura's (1977) Social Learning Theory as it applies to acquiring educational technology skills. This chapter also contains research on the rapid changes in educational technology in the recent past, research on the technological pedagogical and content knowledge (TPACK) framework for infusing technology into teaching, as well as research on the importance of teacher educators as models of technology integration and use. Further, there is research on educational technology in educator preparation programs (EPPs) as well as 21st century skills and international research.

Constructivism and Educational Technology

In 2015, Boytchev built on Seymour Papert's (1991) ideas regarding constructionism, which applies Constructivist learning theory to practical construction. Constructionism is building tangible artifacts that help model understanding of the world, which Boytchev (2015) asserted students can simply and easily use educational technologies to accomplish. However, when applying these principles to his university classes, Boytchev (2015) discovered four elements that were a barrier to students easily adopting educational technology to create learning models. The barriers were the time it took to learn the computer programming necessary to build the models, the conceptual barrier of visualization and rendering issues, the mathematical barrier of learning to use analytical geometry in a practical way, and a procedural barrier with meeting the number of criteria to fulfill the objectives of the learning experience. Boytchev (2015) addressed these barriers by changing the programming language to one the students were already familiar with, making visualization and rendering automatic, changing how students applied analytical geometry to the modeling process, and clustering the 25 criteria into five levels in a predefined order. These changes raised engagement with the process by 49%.

Applying the learning from this pilot project, Boytchev (2015) claimed that constructivism used in conjunction with educational technology is not simply constructionism, but also deconstructionism, which should be the first step in the constructionism process. Deconstructionism is “breaking down something into reusable entities” (Boytchev, 2015, p. 359). Boytchev asserted that it is crucial to begin with deconstructionism when teaching and learning with educational technologies as deconstruction allows the breakdown of problems into simpler pieces. Breaking down problems into simpler pieces allows for an easier solution to the problem, the basis of constructionism. Educational technologies, according to Boytchev (2015), may also be a way to make the process of deconstructionism and constructionism more available to students. Software can allow students to apply inquiry-based learning and problem solving to more learning and in unique ways not available with tangible objects.

Harvey (2015) argued that Boytchev (2015) is correct in asserting that deconstructionism is a crucial part of using Constructivist learning while leveraging educational technologies for teaching and learning, however, Boytchev (2015) did not fully explore the uses of deconstructionism in learning outside of digital technologies. Harvey proposed the use of deconstructionism in maker spaces while using physical tools, as well as tools, such as Lego bricks, which come “pre-deconstructed” (p. 365) to validate the idea that deconstructionism is not just for use in educational technologies. Harvey (2015) agreed with Boytchev (2015), however, that both deconstructionism and constructionism are important parts of learning, both with and without digital technologies. Harvey (2015) concluded by pointing to social relations in the classroom being as crucial to the educational process as Constructivism.

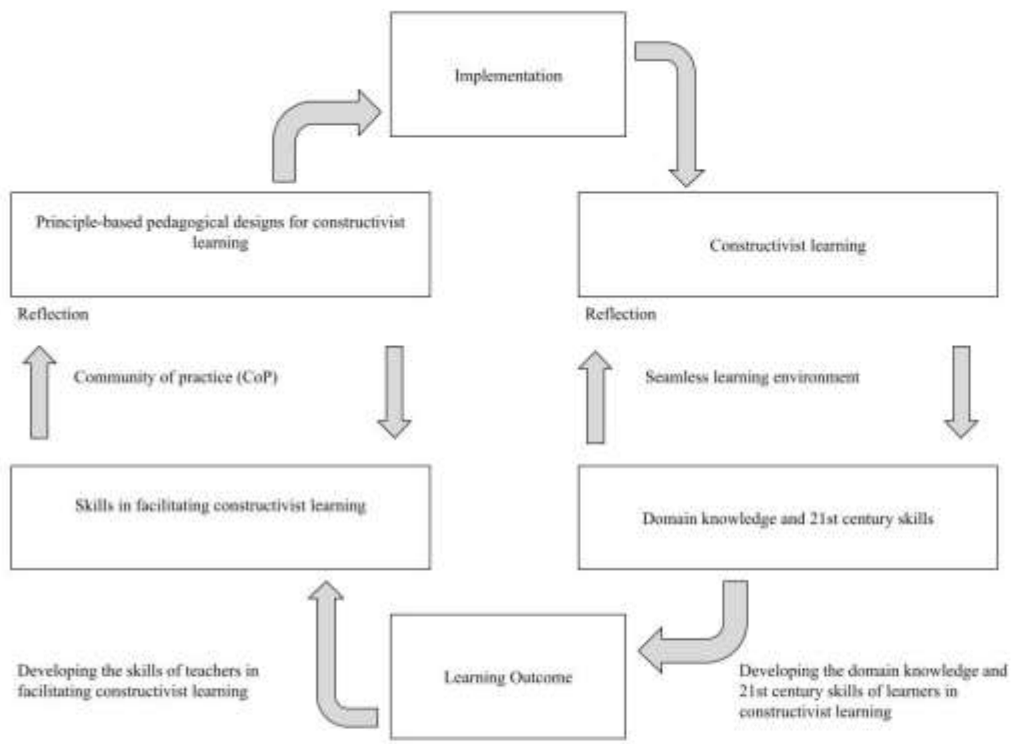
Building on the idea that social cooperation is important to learning, Kong and Song (2013) developed a teacher development model and pedagogical design framework for constructivist teaching and learning in digital classrooms, which Kong and Song called a “seamless learning environment” (p. 209). Kong and Song (2013) asserted that the development of digital technologies including mobile devices and social learning networks, as well of the continued use of these digital technology by educators and students, means that teaching and learning does not happen only within the walls of the classroom. The idea that learning happens outside the four walls of a classroom allows educators to shift from teacher-centered learning to learner-centered learning, leveraging the use of digital technologies to allow students to communicate with other students, as well as share information with peers, which allows for the collaborative construction of knowledge both in and out of the classroom and school day. Learner-centered teaching also infuses learning activities with the 4Cs of 21st Century Learning, also known as Future-Ready learning: communication, collaboration, creativity, and critical thinking. As constructivist learning assumes shared meaning develops within social groups, such as classes (Kirschner et al. 2006), Kong and Song (2013) proposed that digital technologies enable learners to develop deeper understanding of concepts using “diverse digital resources and tools for learning and communication (p. 209) and sharing information. Online interactions allow learners to collect research, store data, share multimedia resources, exchange ideas, and thoroughly discuss ideas, which promotes the construction of knowledge.

Extending learning beyond the walls of the classroom and the traditional learning day comes with challenges, however. Based on their research, Kong and Song (2013) discovered two major issues with teachers' implementing learning innovations supported by technology. The first issue was lack of teacher pedagogical competence in implementing innovative teaching practices supported by technology, which is the technology piece of the TPACK framework. The second issue was teacher confusion regarding innovative teaching practices supported by technology, as many teachers thought these innovations contravened "standard pedagogical design" (p. 210), the pedagogy piece of the TPACK framework. Due to these issues, Kong and Song (2013) posited that teachers needed a new developmental model so teachers could accept new innovative teaching practices and become competent with these new teaching practices.

The Principle-Based Pedagogical Design Framework for Constructivist Learning in a Seamless Learning Environment, as proposed by Kong and Song's (2013), shown in Figure 3, is a circular framework that focuses on two areas of development: developing skill in facilitating constructivist learning and developing the 21st century skills of learners in constructivist learning. The framework considers implementation, learning outcomes, community of practice, and the seamless learning environment. Community of practice focuses on the teacher and includes pedagogical design for constructivist learning and skill in facilitating constructivist learning infused with reflection by the teacher. The development of 21st century skills of learners involve constructivist learning and practicing 21st century skills, while including reflection by the students. Kong and Song's (2013) cyclical framework allows refinement of implementation, as teachers reflect on how the design of the learning affected learning outcomes and students reflect on how their use of 21st century skills also affected learning outcomes. Kong and Song (2013) suggested that the Principle-based Pedagogical Design Framework for Constructivist Learning in a Seamless Learning Environment model could be adapted for use by faculty in educator preparation programs, as a framework for assisting preservice educators in infusing both constructivist learning and pedagogical design with digital technologies.

Figure 3

Principle-based Pedagogical Design Framework for Constructivist Learning in a Seamless Learning Environment



Note. Adapted from "A principle-based pedagogical design framework for developing constructivist learning in a seamless environment: A teacher development model for learning and teaching in digital classrooms" by S. E. Kong & Y. Song, 2013, *British*

Journal of Educational Technology, 44(6), p. 211 (doi:10.1111/bjet.12073). Copyright 2013 by Wiley-Blackwell.

While Kong and Song (2013) proposed a principle based pedagogical design framework for constructivist learning. Reynolds (2016) proposed a “social constructivist digital literacy” framework that comprised six practice domains. These domains were create, manage, publish, socialize, research, and surf, grounded in Constructivism and social constructivism (p. 735). Reynold’s (2016) digital literacy theory is based on the idea that productive purposes drive technology use, meaning that technology use is task-driven, rather than skills-based. Reynold’s (2016) digital literacy framework also includes digital fluency in its conception of digital literacy as a social construct. The guiding theoretical framework for social constructivist digital literacy is based on Papert and Harel’s (1991) concept of Constructivism in education as a framework for action with distinct instructional design principles, as opposed to being purely theoretical. Reynolds (2016) proposed that learners use educational technologies to engage in “technologically mediated” artifacts in their educational environments (p. 741). Reynolds and Caperton (2009) first introduced the six domains as create, manage, publish, socialize/collaborate, research, and surf/play, but Reynolds and Caperton (2009) constructed the domains to be more authentic learning experiences specifically for game design. However, with the new domains Reynolds (2016) theorized that modifying the domains would allow their use for different learning purposes. These domains include the invention of original ideas, cultivating computational thinking, collaboration, cross-cultural connections, and social interactions online, which align with the 2016 ISTE Standards for Students. By allowing learning to be purpose- or task-driven as opposed to skills-based, these broad domains allow for the evolution of technology.

Using a longitudinal survey design, Reynold's (2016) research study investigated the representation of students' engagement with the practice activities in the domains and how the domains contributed and related to one another and to what extent the students' engagement at school with activities that were part of the domains changed their engagement with activities at home. The participants in the study were self-selected schools in high poverty areas of West Virginia, as part of initiatives through the West Virginia Department of Education and non-profit entities. Teachers in the program came from various discipline areas and trained collectively in a program prior to the school year. The use of confirmatory factor analysis established the validity of the six domains. Reynolds (2016) pointed out that the study did not measure actual learning of assessed outcomes; however, previous work with the domains did show a correlation between frequency of engagement, intrinsic motivation, and learning outcomes. Reynolds (2016) offered the task-driven framework as a way for researchers to allow for differing instructional designs and digital tools when studying digital literacy and even the digital divide. Reynolds' (2016) framework includes elements of Bandura's (1977) social learning theory, such as including reciprocal action between cognitive and environmental influences, discussed in the next section of the literature review.

Bandura's Social Learning Theory and Educational Technology

Bandura's (1977) social learning theory emphasized the importance of observing and modeling the attitudes and emotional reactions of others, as well as the importance of reciprocal interaction between cognitive, behavioral, and environmental influences in learning. Bandura's (1993) research on learning through observation centered on four processes: attention, retention, motor reproduction, and motivation. Bandura (1993) contended that learning by modeling is not simply mimicking an observation but a learned psychological behavior. Bandura (1977, 1993) also further emphasized that while observation begins the learning process, gaining subject expertise requires practice in combination with external and internal feedback.

Expanding on these ideas regarding Bandura's (1977) social learning theory and modeling, Kim et al. (2008) researched the connection between faculty modeling of educational technologies and preservice educator's perceptions of their intent to use the modeled technologies in their own teaching. Kim et al. (2008) used two surveys for measurement: Preservice Teachers' Perceptions of Faculty Modeling Survey (PTPFMS) and Intent to Use Computer-based Technology Survey (ITUCTS); both surveys used Likert scales (p. 279). The analysis of data showed that scores on the PTPFMS "significantly predicted" scores on the ITUCTS, which demonstrated a relationship between faculty modeling of technology and preservice educators' perceptions of intent to use technology in their teaching. While Kim et al.'s (2008) study underscores the concept from Bandura's (1977) social learning theory that modeling is an important piece of learning, the study does have many limitations to generalizing the results of the study. The most important of these limitations is that the study did not account for gender, age, or major when considering the relationship between the two surveys. Another impediment to applying Kim et al.'s (2008) research to current studies is that Kim et al.'s study is over 10 years old and was, therefore, only able to research technologies at the time of the study, such as CD-ROMs, basic computer graphics, and basic audio. The

Internet was also in its infancy at the time and did not have the plethora of research or social media platforms available today. Further, there was not the variety of platforms, apps, or other digital technologies to consider as part of the research.

According to Deaton (2015), students and their teachers emphasize Bandura's (1977) social learning theory through the use of social media platforms and educational technologies in classrooms. Social media platforms allow students and teachers to react to both attitudes and emotions through digital means, while also engaging in reciprocal interactions. The presence of social media platforms and technologies has increased exponentially over the past ten years (Kahveci, 2015); Pavlik (2015) asserted that the expansion of use of these social media platforms and technologies by students challenges traditional ideas of learning, as students use social media platforms and digital technologies for self-guided learning. Communication has moved from being one-way (teacher to student) to two-, three-, or more ways between students and teachers and is now a tool that is "interactive, immersive, and omnipresent" (Deaton, 2015, p. 2). Educational technologies allow for the integration of social media platforms in learning which improves not only communication but also attention, engagement, motivation, and internalization. As with all educational technologies, the inclusion of social media platforms within classrooms is not without difficulties. Teacher fluency with the chosen platform, social media platform privacy policies, and student age are all considerations when considering including social media as an educational technology for learning. For example, most social media platforms require users to be 13 years of age to use the platform and many social media platforms are not Family Educational Rights and Privacy Act (FERPA) and or Children's Online Privacy Protection Act (COPPA) compliant.

While Deaton's (2015) research focused on P-12 classrooms, the results of Deaton's research are applicable to higher education and preservice educators. On one side, social media platforms and their effect on social learning can have a positive impact on the educational technology use of preservice educators as preservice educators share what they have learned about using educational technology through social media platforms. On the other side, while age limitations and COPPA concerns do not affect higher education students, social media platform privacy policy concerns and social media fluency skills of teacher educators are still concerning factors when considering using social media as an educational technology learning tool. Social media platforms are one example of the changes in educational technology in the recent past; more changes are discussed in the next section of the literature review.

Changes in Educational Technology in the Recent Past

The rate of change and rapid innovation of educational technology "outpaces" the ability to "thoughtfully" integrate new technological tools into teaching practice, however, the use of technology adoption theory allows educators to explore pedagogical opportunities afforded by the capabilities of new educational technology (Sutton & DeSantis, 2017, p. 223). Sutton and DeSantis (2017) asserted that educators must accept that emerging technologies disrupt traditional patterns of teaching and learning and use technology adoption theory to "discover and integrate" emerging educational technologies in teaching and learning practices. Sutton and DeSantis (2017) offered three technology adoption theories to assist educators in integrating emerging technologies in teaching and learning.

The first technology adoption theory proposed by Sutton and DeSantis (2017) is the technology diffusion model introduced by Rogers in 1962, based on Ryan and Gross's (1943) research. The technology diffusion model proposed that sociological factors, such as peers or trusted sources adopting a technology impacted technology acceptance and diffusion. Rogers (2004) believed that technology diffusion was a "universal microprocess of social change" (p. 16) and named five factors as barriers to technology adoption: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). Rogers (2003) further asserted that technology diffusion theory was the most applicable technology adoption theory for higher education faculty and that the five factors heavily influence faculty willingness to adopt new technology into pedagogical practices.

The next technology adoption theory proposed by Sutton and DeSantis (2017) is Davis's (1989) technology acceptance model (TAM), developed from Ajzen and Fishbein's (1977) theory of reasoned action. Davis (1989) argued that the use of people's perceptions of technology could predict how likely people were to adopt the technology based on perceived ease of use and perceived usefulness. Perceived ease of use considers general beliefs about computers and computer usage; computer self-efficacy; computer anxiety; computer playfulness, or willingness to experiment with computers; and perceived external control, while perceived usefulness considers the degree to which a technology tool will help performance (Davis, 1989). Perceived usefulness influences perceived ease of use as the simpler a technology is to use, the more useful it is (Davis, 1989). TAM proposed that not only should new technology tools be easy to use, but clear communication to the user about how the tool can lead to improvements in teaching and learning is necessary (Davis, 1989).

The last technology adoption theory discussed by Sutton and DeSantis (2017) is Mishra and Koehler's (2006) technological pedagogical and content knowledge (TPACK) framework built on Shulman's (1986) work on pedagogical content knowledge (PCK). The TPACK framework allows for an intersection of pedagogy content and technology while acknowledging that there is not one specific technology tool that works in every teaching and learning context (Mishra & Koehler, 2006). Mishra and Koehler argued that the best educators include technologies with solid content knowledge, a repertoire of pedagogical techniques, and competence with emerging educational technologies. Mishra and Koehler (2006) further argued that the TPACK framework represents a "dynamic equilibrium" of content, pedagogy, and technology that should be the standard in teaching and learning, especially in higher education classrooms (p. 1029). According to Sutton and DeSantis (2017), using one of the three proposed technology adoption models will allow educators to "take advantage of the capabilities of recently emerged technologies" (p. 227), while educators who do not find a way to incorporate new and emerging educational technologies are ignoring changes in their teaching and learning environment, often called change blindness, from the work of Mack and Rock (1998). While Sutton and DeSantis (2017) discussed the importance of educational leadership using technology adoption theory to inform technology professional development for educators, they did not offer suggestions for how educational leaders should encourage educators to participate in technology development. Sutton and DeSantis (2017) also did not offer alternatives for educators who wish to learn more about emerging technologies but do not have technology professional development opportunities by educational leadership at their institutions.

While Sutton and DeSantis (2017) offered three technology adoption theories that could be used by higher education or P-12 educators when integrating emerging technology into teaching and learning, Nellis (2017) proposed that higher education institutions, especially those in the United States, are already changing dramatically, due in part to new technology. Emerging technologies are creating new learning paradigms and requiring curricula that enhance engagement, as well as stimulating innovation, entrepreneurship, integrated scholarship and concepts of sustainability (Nellis, 2017). Specifically, learning management systems, apps on mobile devices, and open-source learning modalities are ways that technology is “revolutionizing the way in which students learn” and Nellis (2017) further linked technology to a “learning revolution” (p. 156). Nellis (2017) argued, however, that technology does not change the importance of faculty to student learning or the opportunities for faculty to enhance learning even though technology is constantly changing course structures.

Technology affected trends in learning worldwide, including technology innovations for student learning environments, and institutions often adopted such innovations before they are mandated to do so (Gonzales & Donert, 2014). Nellis (2017) outlined deeper learning analytics, micro-credentialing, competency-based education, and flipped classrooms, and the use of open-educational resources as examples of innovations adopted by higher education institutions. Nellis (2017) further explained, however, that creating “a dynamic learning environment for students” requires faculty openness to “overcoming isolation and fragmentation” within disciplines and universities, as well as encouraging students to work in cross-disciplinary groups and use innovative technologies (p. 162).

According to Ideland (2021), there is a new definition of a "desirable" teacher in digitalized classrooms caused by the rapid changes in technology; a "desirable" teacher is flexible, coaches instead of lectures, customizes work to individual students, promises fun and creativity, and is educating workers for a knowledge economy, which are similar to "privileging" characteristics in valued in the information technology (IT) sector (p. 33). Ideland (2021) interviewed 25 "eduprenuers" selling professional development regarding digital technologies, hardware, and software to Swedish schools and takes into consideration the "eduprenuerial" market, which consists of digital platforms, learning games, digital teaching materials, and professional development materials covering these educational technology tools (p. 37).

From these interviews, Ideland (2021) came to several conclusions. First, as technology changes rapidly, there needs to be a cultural change is schools to keep up with rapidly changing skills and mindsets needed for students to be successful in the workplace. Second, there needs to be a "displacement of authority" from tradition top-down hierarchy to a flat organization to allow for coaching and collaborative learning (p. 39). Third, schools need to think beyond the traditional four walls and school hours to become "anywhere" schools leveraging the Internet and digital tools for creativity, critical thinking, communication, and collaboration (p. 41). One of the interviewees stated "teachers should … work with improving every student's communication skills, creativity, design thinking and innovation thinking" (p. 38). However, Ideland (2021) cautions that allowing the "ed-tech sector" too much power to shape the future of education can have negative consequences for schools, especially when businesses, politics, and pedagogy combine (p. 44). Selwyn et al. (2020) encouraged researchers to be aware of how corporations are shaping educational technology agendas worldwide, while Williamson (2019) argued that digitalization through technology has already changed cultural and pedagogical norms in schools.

While Ideland (2021), Selwyn et al. (2020), and Williamson (2019) all cautioned against allowing technology corporations too much power over pedagogy and learning standards, their research also acknowledged that technology has already changed how learning happens in schools. Technology frameworks allow educators to integrate technology into teaching and learning while incorporating content and pedagogy. The next section of the literature review examines the technological pedagogical and content knowledge (TPACK) framework. TPACK is the technology framework used in the course examined in this study.

Technological, Pedagogical, and Content Knowledge (TPACK)

Teaching with technology is complicated; teaching with digital technologies is even more complicated. Koehler and Mishra (2009) began their explanation of the TPACK model by defining "traditional pedagogical technologies," such as pencils and microscopes, characterized by specificity, stability, and transparency of function, as well as digital technologies such as computers, "hand held devices," and software applications, characterized by their multiple uses, rapidity of change, and being "opaque" in that their inner workings are not clearly visible or understood (p. 61). Due to their multiplicity of uses, how rapidly they change, and being opaque, digital technologies are more challenging for teachers to use in their teaching. Further complicating technology usage, technologies are not “neutral or unbiased” and come with “their own propensities, potentials, affordances, and constraints” (Koehler & Mishra, 2009, p. 61). Social and contextual factors must also be considered when examining the relationship between teaching and technology as not all institutions support technology integration nor do all institutions support teacher professional development with digital technologies used for teaching and learning. Ertmer (2005) stated that teachers are less likely to use technology for teaching and learning unless the technologies are consistent with the teachers’ pedagogical beliefs.

Koehler and Mishra (2009) proposed that a new approach was needed to assist educators integrating digital technologies into their teaching that considered contextual factors of specific educators and students. Koehler and Mishra (2009) stated,

> there is no ‘one best way’ to integrate technology into curriculum. Rather, integration efforts should be creatively designed or structured for particular subject matter ideas in specific classroom contexts. … understanding approaches to successful technology integration requires educators to develop new ways of comprehending and accommodating this complexity. (p. 62)

According to Koehler and Mishra (2009), there are three components to “good” teaching with technology, content, pedagogy, and technology, and a strong understanding of the relationships between these three concepts is crucial for contextual and quality technology integration in teaching (p. 62).

Based on Shulman’s (1987) work on pedagogical content knowledge (PCK), Koehler and Mishra (2009) conceived the technological pedagogical content knowledge

(TPCK) framework, which came to be known as technological pedagogical and content knowledge (TPACK). TPACK is built on the three components, technology, content, and pedagogy, and interactions between the three components, see Figure 1, which are represented as PCK, TCK, TPK, and TPACK, see Table 1. TPACK is the basis of effective integration of technology in teaching and learning and “an emergent form of knowledge that goes beyond all three ‘core’ components” (Koehler & Mishra, 2009, p. 66). TPACK requires an understanding of how to represent concepts with technology as well as pedagogy that incorporates technology into content appropriately. Koehler and Mishra (2009) argued that TPACK also allows for possibilities in research in educator preparation and education as well as in-service teacher professional development and use of technology and that TPACK helps preservice educators, in-service educators, and teacher educators to move beyond thinking of technology as a simple addition to teaching and think of technology in context with connections to pedagogy and content knowledge. Elwood and Saveyne (2015) reported increased use of TPACK in educator preparation programs assessments of preservice educators’ technology integration skills.

Researchers have noted a need for educator preparation programs (EPPs) to “better connect” preservice educators’ educational technology preparation with pedagogy and curriculum (Tondeur et al., 2020, p. 320). Many EPPs have adopted the technological pedagogical and content knowledge (TPACK) framework to contextualize integration of technology in to content and methods courses (Polly et al., 2010; Reyes et al., 2017); however, Tondeur et al. (2020) argued that strategies for supporting preservice educators’ TPACK integration, developed through a synthesis of qualitative data (SQD) mode l(Tondeur et al., 2012), can assist EPPs in assessing preservice educators’ preparation to use TPACK while controlling for preservice educators' attitudes toward technology. The six "micro-level" strategies, conceived by Tondeur et al. (2012) through literature review, include role models, reflection, instructional design, collaboration, authentic experiences, and feedback.

Role models include teacher educators using technology in context and content (Tondeur et al., 2020); Lavonen et al. (2006) suggested teacher educators use a mixture of demonstrations and practice for preservice educators to fully demonstrate integration of technology. Reflection must include discussion and written reflection about how to integrate technology and the affordances and constraints of using technology, as well as preservice educators' attitudes toward using technology and the role that technology plays in teaching and learning (Baran et al., 2019; Tondeur et al., 2020). In the context of the six strategies for supporting preservice educators' TPACK use, instructional design means EPPs providing multiple opportunities for preservice educators to design teaching and learning experiences with technology integration leveraging TPACK, which assists preservice educators in understanding how to select appropriate technology for a teaching and learning task (Tondeur et al., 2020). Collaboration with peers can help "mitigate feelings of insecurity" in preservice educators tasked with technology integration in teaching and learning (Tondeur et al., 2020, p. 322) while promoting willingness to take risks and reducing anxiety. Providing authentic experiences for technology integration allows preservice educators to apply their knowledge in classrooms with K12 students and leverages the relationships between EPPs and K12 school districts (Tearle & Golder, 2008). The use of an e-portfolio allows preservice educators to receive ongoing feedback on TPACK across the EPP (Tondeur et al., 2012; Tondeur et al., 2020).

Preservice educators' attitudes toward technology are determinants of preservice educators' willingness to integrate technology in teaching and learning and an influential factor of TPACK (Blackwell et al., 2016; Tondeur et al., 2020), Pynoo et al. (2011) proposed that the ease of use of technology was an especially strong determinant of preservice educators' willingness to integrate technology and major influential factor of Tondeur et al. (2017) showed a correlation between preservice educators' positive attitudes toward technology and high TPACK with perceived higher support from their EPP. Based on Tondeur et al.'s (2017) findings, Tondeur et al. (2020) used attitudes regarding technology integration and use in teaching and learning as a control variable during an examination of the relationship between preservice educators' TPACK and perceived support from EPPs. Using a mixed methods longitudinal study, Tondeur et al. collected data from final year preservice educators then collected data from the same participants who were beginning teachers. Tondeur et al. (2020) contrasted the results from the two time periods to discern whether the six strategies for supporting TPACK in preservice educators succeeded or failed. Tondeur et al. (2020) used a Dutch language version of Schmidt et al.'s (2009) TPACK self-report scale to collect data from a sample of 688 final year preservice educators from 20 separate EPPs across Belgium that included preservice educators from a broad spectrum of content areas.

Data analysis showed that role modeling was critical to TPACK and technology integration in beginning teachers. Respondents from EPPs that had teacher educators that demonstrated technology integration in teaching and learning reported that they (beginning teachers) used some of the same technology in their K12 lessons while beginning teachers from EPPs that did not have teacher educators that role modeled "inspiring examples" of technology were not using technology in their (beginning teachers) classrooms to the same degree (Tondeur et al., 2020, p. 333). Many beginning teachers that reported low levels of TPACK noted that teacher educators in their EPPs seemed to lack technology competencies. While almost all the beginning teachers in the study noted that their EPP widely used reflection across programs, not much reflection time was spent on TPACK or technology integration in teaching and learning. According to the beginning teachers sampled, most EPPs in the study did not offer many opportunities for intentional TPACK practice and technology integration in teaching and learning, which the beginning teachers felt negatively impacted their ability to use technology as practicing teachers. Further, the beginning teachers in Tondeur et al.'s (2020) study reported that their EPP "did not give the sufficient opportunities to work together, share ideas, to discuss about the role of ICT in education, etc." and the beginning teachers wished they had had more opportunities to work together; one study participant stated "you could actually learn much more from each other" (p. 334). The beginning teachers in the study also stressed the need for more authentic learning experiences during their time in an EPP so that they could have explored "the possibilities of technology" as preservice educators to enhance their ability to use technology in teaching and learning as beginning teachers (Tondeur et al., 2020, p. 335). Beginning teachers in the study also reported that their EPPs rarely gave feedback on TPACK or technology integration and the beginning teachers stated that they wished they had received consistent feedback on a continual basis to better prepare them to implement TPACK and technology integration as practicing teachers.

From the study data, Tondeur et al. (2020) concluded that EPPs should connect TPACK and technology integration learning to content areas and subject-specific pedagogy to ensure beginning teachers feel better prepared to integrate TPACK and technology into teaching and learning with K12 students. Further, teacher educators should receive professional development to enhance their TPACK and technology competencies to ensure that teacher educators understand how to effectively integrate TPACK and technology into teaching and learning and can demonstrate the effective and appropriate use of educational technology to preservice educators. Caution must be used when attempting to generalize the results of Tondeur et al.'s (2020) study as the model used for synthesis of qualitative evidence (SQD) model has not been widely used by other researchers and educational systems can vary from country to country. However, the results of Tondeur et al.'s (2020) study in regards to the importance of teacher educator role modeling and technology competence echo results from Carroll and Morrell (2006), Foulger et al. (2017), and Parra et al. (2019).

A survey conducted by Voithofer et al. (2019) with 842 teacher educators in educator preparation programs at 541 different institutions across 50 states showed low adoption of TPACK by teacher educators. The survey showed multiple factors, both personal and institutional, influenced TPACK adoption among teacher educators, even though the teacher educators surveyed had a "significant" amount of K12 and teacher education experience, as well as "high levels of comfort" with technological knowledge (Voithofer et al., 2019, p. 1427). These factors include the highest degree offered at an institution, self-rated TPACK scores, and adoption of International Society for Technology in Education (ISTE) standards. Kaufman (2015) illustrated how educator preparation programs (EPPs) offer technology integration to preservice educators impacts how preservice educators integrate technology in teaching and learning. Voithofer et al. (2019) demonstrated that TPACK is “critical” to EPP accreditation as the Council for Accreditation of Educator Preparation (CAEP) requires EPPs to show evidence of “candidates’ developing content knowledge, pedagogical content knowledge, pedagogical skills, and the integration of technology in all these domains” (CAEP, 2019, p. 2). Considering the evidence required by CAEP for accrediting EPPs, the low adoption rate of TPACK by teacher educators could be cause for concern.

Table 3

Technological Pedagogical and Content Knowledge (TPACK) Framework

Component	Definition
Content Knowledge (CK)	Knowledge of subject matter
Pedagogical Knowledge (PK)	Knowledge of learning theories and teaching methods
Pedagogical Content Knowledge (PCK)	Ability to represent subject matter in ways that increase student understanding
Technological Knowledge (TK)	Knowledge of technology tools and their use in achieving specific tasks
Technological Content Knowledge (TCK)	Understanding how to use technology tools to support student learning in a specific subject matter
Technological Pedagogical Knowledge (TPK)	Understanding the relationship between teaching, learning, and the use of Technology

Note. From “Advancing educational technology in teacher preparation: Policy brief” by Office of Educational Technology, 2016, p. 12-13. https://tech.ed.gov/files/2016/12/Ed-Tech-in-Teacher-Preparation-Brief.pdf

Teacher Educators as Models of Technology Integration and Use

In a 2006 study, Carroll and Morrell compared the technology skills and attitudes of teacher education faculty and preservice teachers. Carroll and Morell's (2006) study compared 51 school of education faculty members and 378 student teachers from six Northwest United States liberal arts colleges to prove or disprove the widely held idea that students know more about, and are more comfortable with, technologies used for teaching and learning. Literature supports the idea that teachers teach the way they were taught (Judson & Sawada, 2002); combining these ideas, students know more about technology than faculty and teachers teach the way they were taught, suggested that educator preparation programs would struggle to model appropriate and effective uses of technology during instruction. Carroll and Morrell (2006) investigated the differences in preservice educator and education faculty self-perception of technology competence, skills with specific digital technologies, and technology use the National Educational Technology Standards (NETS) standards, which were in use before the International Society for Technology in Education (ISTE) created the ISTE Standards for students, educators, and education leaders. There were three categories for technology and technology skills: data management tools, web-based tools, and digital manipulation tools. Data processing tools included word processing, spreadsheets, presentation software, databases, statistical software, and qualitative analysis software. Web-based tools included email, on-line communication tools like bulletin boards, web browsers, web publishing tools, and learning management systems. Digital manipulation tools included graphing calculators and software, concept mapping tools, graphics software, scanners and cameras, video editing software, digital audio software, and digital lab tools such as digital microscopes.

Data comparison showed little difference between faculty and student self-perceptions of technology competency. The data also showed little difference between faculty and student competence with educational technologies, such as email, web browsers, and word processing. The faculty reported higher competence with spreadsheets, presentation software, statistical software, and digital lab tools. Students reported higher competence with on-line communication tools and graphing tools. Carroll and Morell (2006) pointed to higher student competence with on-line communication tools as an indicator of “generational differences in technology use” (p. 8). The study was an early effort to search out technology competency differences between education faculty and preservice educators, however, generalizing the findings of Carroll and Morell’s (2006) study can be problematic. First, all students and faculty in the study came from liberal arts colleges which means the sample may not be representative of public institutions. Further, the students in the study were all close to graduating or graduate students; results may differ with freshmen or sophomores. Applying the results of Carroll and Morell’s (2006) study to newer technologies is also problematic as many common educational technologies used currently did not exist in 2006, such as multimedia tools and social media platforms. However, educator preparation programs still cannot assume that students’ experiences with technology before they enter educator preparation programs will provide those students with sufficient technological expertise for teaching and learning.

Teacher educators’ beliefs about learning and technology use affect preservice educators’ beliefs about learning and technology use; those same beliefs also play a critical role in “transforming classrooms through the use of technology” (Bai & Ertmer, 2008, p. 93). Bai and Ertmer (2008) divided barriers to technology integration in learning into two categories: first-order and second-order. First-order barriers are extrinsic and include issues, such as lack of access to devices and lack of necessary support in using devices and software. Second-order barriers are intrinsic and include teacher belief systems about teaching and learning, as well as reliance on familiar teaching practices. Both second-order barriers are personal and harder to overcome and can affect “meaningful” technology integration (Bai & Ertmer, 2008, p. 94). Richardson (2003) suggested that teacher candidates’ most important sources of beliefs about teaching and learning come from personal learning experiences, especially as part of teacher preparation programs. Teacher educators with a constructivist background tended to use technology often and engaged their students in more technology-enhanced, student-centered learning, while teachers with more teacher-centered beliefs about learning tended to use less technology. Bai and Ertmer (2008) also investigated whether teacher educators’ attitudes toward technology use predict teacher candidates’ future use of technology.

Teacher educators’ beliefs were measured using the Teacher Beliefs Survey developed by McCombs and Whisler (1997), and teacher educators’ technology use was measured through a technology use survey while preservice teachers’ technology attitudes were measured by a questionnaire developed by Pelton and Pelton (1996). Data analysis revealed statistically significant relationships between learner-centered beliefs of teacher educators and preservice educators' learner-centered beliefs as well as nonlearner-centered beliefs of teacher educators' and preservice educators' nonlearner-centered beliefs. Further, there was a statistically significant relationship discovered between teacher educators' technology use and preservice educators' attitudes toward technology and the educational benefits of technology use. Limitations of Bai and Ertmer's (2008) study included a small sample size, which makes it difficult to apply the research to larger populations, however, the results suggest that teacher educators' have influence on preservice educators' technology use for teaching and learning.

In response to the United States National Educational Technology Plan's recommendation that teacher educators have common technology competencies to prepare preservice educators to teach with technology (Office of Educational Technology, 2016), Foulger et al. (2017) facilitated the creation of the Teacher Educator Technology Competencies (TETCs) through collaboration with national and international teacher education faculty, crowdsourcing of technology-related literature, use of the Delphi method for expert feedback, and an open call for public commentary. The TETCs include 12 competencies for teacher educators with related criteria as well as specifying roles and responsibilities for teacher educators who teach technology within their educator preparation courses (Foulger et al., 2017). Further, the TETCs defined competencies that all teacher educators need to support preservice educators as they prepare to teach with technology in their future classrooms; these competencies include knowledge, skills, and attitudes toward technology and teaching with technology (Foulger et al., 2017).

The belief that preservice educators' expertise with teaching with technology does not come solely from a separate technology course but from experiences embedded throughout educator preparation coursework was the foundation for the TETCs. Foulger et al. (2017) asserted that a key component of preparing preservice educators to teach with technology is “the involvement and influence of the teacher educator” (p. 417). Foulger et al. (2017) further asserted that the Technology Pedagogy and Content Knowledge (TPACK) framework was the most effective framework for infusion of technology integration throughout educator preparation programs, however, many teacher educators lack the necessary technology skills to effectively integrate educational technology into coursework. Borthwick and Hansen (2017) suggested that educational technology professional development for teacher educators may assist teacher educators in designing and implementing educational technology in methods and other coursework.

The creation of the 12 TETCs answered the question regarding “what knowledge, skills, and attitudes related to technology do all teacher educators need” (Foulger et al., 2017, p. 431). All 12 TETCs encourage teacher educators to design instruction with content-specific technologies that enhance teaching and learning as well as incorporate pedagogical strategies that prepare preservice educators to effectively use educational technology in future teaching and support the development of knowledge, skills, and attitudes toward technology that preservice educators will need in content-specific teaching, see Table 4.

Table 4

The Twelve Teacher Educator Technology Competencies (TETCs)

Teacher educators will:
Design instruction that utilizes content-specific technologies to enhance teaching and learning
Incorporate pedagogical approaches that prepare teacher candidates to effectively use technology
Support the development of the knowledge, skills, and attitudes of teacher candidates as related to teaching with technology in their content area
Use online tools to enhance teaching and learning
Use technology to differentiate instruction to meet diverse learning needs
Use appropriate technology tools for assessment
Use effective strategies for teaching online and/or blended/hybrid learning environments
Use technology to connect globally with a variety of regions and cultures
Address the legal, ethical, and socially-responsible use of technology in education
Engage in ongoing professional development and networking activities to improve the integration of technology in teaching
Engage in leadership and advocacy for using technology
Apply basic troubleshooting skills to resolve technology

Note. Adapted From "Teacher educator technology competencies" by T. S. Foulger, K. J. Graziano, D. Schmidt-Crawford, and D. A. Slykhuis, 2017, *Journal of Technology and Teacher Education*, *25*(4), pp. 432-433 (https://www.learntechlib.org/primary/p/181966/) Copyright 2017 by Society for Information Technology & Teacher Education.

During the creation of the TETCs, Foulger et al. (2017) referenced the Interstate Teacher Assessment and Support Consortium (InTASC) Standards, Council for the

Accreditation of Educator Preparation (CAEP) Standards, and the International Society for Technology Education (ISTE) ISTE Standards for Educators (CAEP, 2020a; Council of Chief State School Officers, 2011; International Society for Technology in Education, 2017) to ensure that the TETCs would be appropriate for use throughout United States educator preparation programs (EPPs). The TETCs were not meant to be a solution to technology integration in educator preparation programs; the TETCs were meant to be a tool for reform of technology integration practices in EPPs as well as a guide for assisting teacher educators in ensuring their own preparation for teaching preservice educators effective and appropriate technology integration for future teaching.

While Foulger et al.'s (2017) research focused on the creation of the TETCs meant to assist teacher educators in ensuring they were prepared to effectively teach with integrated technology, contrastingly Tondeur et al. (2019) investigated the ability of teacher educators to prepare preservice educators for integrating technology into future teaching. The study examined the attitudes of teacher educators towards information and communication technologies (ICT) in education, teacher educator self-efficacy in designing ICT-rich learning environments for preservice educators, teacher educator competency in using ICT in teaching, and teacher educator strategies for preparing preservice educators for technology integration in preservice educators' future teaching. The teacher educator strategies investigated comprised: teacher educators as role models for preservice educators; reflection on the role technology has in education; learning of how to use technology for purposeful design; collaboration with peers regarding technology usage; the scaffolded use of authentic technology experiences; and providing preservice educators with continuous feedback on technology use and integration

(Tondeur et al., 2019). Using the Teacher Educator Technology Competencies (TETCs) (Foulger et al., 2017) as a foundation, Tondeur et al.'s (2019) study began with the following beliefs: teacher educators play an important role in enhancing preservice ICT competencies; teacher educators are challenged by preparing preservice educators to integrate technology in future teaching; and much of the existing research on educator preparation programs and educational technology is focused on preservice teachers, not teacher educators. Tondeur et al.'s (2019) research was meant to assist in filling any gaps in the literature regarding teacher educators' ICT attitudes, ICT self-efficacy, ICT competencies, and teacher educator strategies for preparing preservice educators for technology integration in preservice educators' future teaching.

The first survey used in Tondeur et al.'s (2019) study measured teacher educator attitudes toward information and communication technology (ICT) in education and considered four dimensions: usefulness of ICTs in education, ease of use of ICTs in education, interest in using ICTs in education, and pleasure found in using ICTs in education. The next survey used measured teacher educator self-efficacy or belief in their competence in using ICTs to design ICT-rich learning environments and a scale to measure teacher educators' belief in their competence to foster use of ICTs to encourage preservice educators to think critically and creatively; teacher educators' belief in their ability to encourage preservice educators to use ICTs in problem solving through the use of information; and teacher educators' belief in their ability to support preservice educators in using ICTs to learn independently. The Synthesis of Qualitative Data (SQD) SQD scale from the SQD model, developed by Tondeur et al., (2012), measured educator strategies for preparing preservice educators for technology integration in preservice educators' future teaching.

Based on their research, Tondeur et al. (2019) concluded that teacher educators are "gatekeepers" of preservice educators' development of the use of ICT in education (p. 1203); teacher educators must model ICT integration to provide preservice educators with necessary skills to be competent with ICT integration in future teaching. Further, teacher educators' explicit use of ICTs in teaching and learning demonstrated to preservice educators how to use ICTs future teaching and learning. However, there are other factors that impact teacher educators' ICT use and integration in education. Pedagogical beliefs, support from leadership, and opportunities for ICT professional development also influence teacher educators' integration of ICTs in education. Further, Tondeur et al. (2019) only considered teacher educators in Belgium, so generalization of Tondeur et al.'s research to education systems outside Belgium is problematic.

Educational Technology Integration in Educator Preparation Programs

Technology integration in educator preparation programs (EPPs) is crucial. Schmidt-Crawford et al. (2018) concluded that preservice educators must have technology integration in EPPs to build "capacity to enable transformative teaching and learning" and create "confident users of technology who can effectively integrate technology to transform student learning" (p. 132). Towards that end, organizations that are involved in educator preparation and technology integration, such as the International Society for Technology in Education (ISTE), the American Association of Colleges for Teacher Education (AACTE), the Society for Information Technology and Teacher Education (SITE), the National Technology Leadership Summit (NTLS), and the

Department of Education Office of Educational Technology (DOE/OET), must work together to create sustainable systems of professional development for teacher educators who will be modeling technology integration for preservice educators (Schmidt-Crawford et al., 2018). Further, EPPs must consider the four principles for preparing preservice educators to teach with technology put forth by the DOE/OET: focus on active use of technology and enable teaching and learning through creation, production, and problem-solving; build sustainable systems of professional development for teacher educators; ensure preservice educators experience educational technologies program wide; and align technology integration in EPPs with research-based standards, frameworks, and industry wide credentials

To be able to integrate technology into teaching and learning, preservice educators must be digitally literate. Dincer (2018) examined the objectively measured level of digital literacy of preservice educators in comparison with the self-perceived level of digital literacy as reported by preservice educators. Dincer (2018) used the Technology Literacy Knowledge Test (TLKT), Technology Literacy Skills Exam (TLSE), created by Dincer in conjunction with a pool of preservice and in-service educators, Technological Pedagogical Content Knowledge Scale (TPACKS) (Kabakci Yurdakul et al., 2012) and a Personal Information Form to measure technology literacy in 370 preservice educators (Dincer, 2018, p. 2706). The results revealed that 27% of measured preservice educators had high knowledge, 48% had normal knowledge, and 25% had low knowledge according to the TKLT while 18% had high skill levels, 43% had normal skill levels, and 39% had low skill levels according to the TLSE (Dincer, 2018, p. 2708). Dincer (2018) used the average scores of the TLKT and TLSE to calculate a “total point of technology literacy (TLTP)" which revealed that 16.49% of measured preservice educators had high levels of technology literacy, 48.92% had normal levels of technology literacy, and 34.59% had low levels of technology literacy (p. 2708). The TPACKS scores of measured preservice educators demonstrated 45.40% had high levels of TPACK, 53.50 had normal levels, and 1.10% had low levels (Dincer, 2018, p. 2709).

Dincer (2018) performed Spearman's Rho Correlation Analysis to determine the relationship between TLKT/TLSE/TLTP and TPACKS; the analyses showed no significant differences between TPACKS-TKLT, TPACKS-TLSE, or TPACKS-TLTP (p. 2709). Dincer (2018) also used the Kruskal Wallis Test to determine if preservice educators' scores in TLKT and TLSE; analyses revealed no significant differences in group levels (p. 2709). Dincer (2018) then performed the Wilcoxen Signed-Ranks Test to investigate differences between the TLKT and TLSE scores of the measured preservice educators and the results showed significant differences between the scores on the knowledge test and the skills test (Z=-5.34, p=0.00); 202 of the 370 measured preservice educators scored higher on the knowledge test than the skills test (p. 2710). The data showed that preservice educators in Dincer's (2018) study had higher digital literacy self-perception, as measured by knowledge, than digital literacy skills, as measured by skill. Dincer (2018) concluded that the preservice educators in the study were not sufficiently prepared with digital literacy skills to effectively integrate technology into teaching and learning by their EPPs. Dincer (2018) acknowledged that a limitation of the study is that the population of preservice educators measured came from just Turkey, which means that generalization of the data could be difficult, given the differences in educational systems between countries. Another limitation is that Dincer (2018) did not differentiate between digital literacy skills, or the ability to apply critical thinking while using technologies, and digital fluency, the ability to use technological devices and tools.

While there is agreement among educator preparation organizations such as the Council for the Accreditation of Educator Preparation (CAEP), American Association of Colleges for Teacher Education (AACTE), and the Association for Advancing Quality in Educator Preparation (AAQEP) that integrating technology in Educator Preparation Programs (EPPs) is necessary, there is not agreement on the best way to ensure preservice educators receive the technology skills they need to be effective with technology in teaching and learning. Buss et al. (2015) compared a “stand-alone” technology course with a “technology-infused” systemic approach to technology integration in a specific EPP (p. 160). The research questions asked in the study were as follows: to what extent to stand-alone and technology-infused courses facilitate learning of technological pedagogical content knowledge (TPACK) domains; are there differences in the rates of learning of TPACK domains across the two types of courses; and what accounts for TPACK learning and perceptions of technology integration abilities of preservice teacher education candidates (Buss et al., 2015, p. 162). There were two cohorts of study participants, 98 participants in the stand-alone course and 188 participants in the technology-infused course, and all study participants were preservice educators enrolled in an elementary, secondary, and special education programs.

The study employed a mixed-method design with pre- and posttest measures of TPACK knowledge domains using a 53-item Likert scale, based on the work of Schmidt et al. (2009), to assess knowledge of TPACK domains: content knowledge (CK), technological knowledge (TK), pedagogical knowledge (PK), technological pedagogical knowledge (TPK), content pedagogical knowledge (CPK), and TPACK (Buss et al., 2015, p. 163), see Table 3. Analyses of quantitative data used multivariate repeated-measures of variance procedures with follow-up analyses of variance (ANOVAs) of time effect (pre- vs. posttest scores), time-cohort interaction effect, and between-subjects effect (stand-alone vs. technology-infused courses). CK was the only domain shown to be significantly different between cohort groups in the between-subjects effect, with the mean for cohort 2 being significantly higher: 4.2 versus 3.96 (Buss et al., 2015, p. 164). The within-subject effect of time effect (pre- vs. posttest scores) was significant and follow-up ANOVAs for all posttest TPACK knowledge scores were significantly higher than the pre-test scores, with all TPACK domains showing large effect sizes for within-subjects design according to Cohen's (1988) criteria with the exceptions of TK showing medium effect size and CK showing small effect size (Buss et al., 2015, p. 164). The within-subject interaction effect for time of testing within cohorts was significant while follow-up ANOVAs showed TK, CK, PK, and TPK developed at different rates from pre- to posttest for the two cohorts, while PCK and TPACK did not grow at different at different rates from pre- to posttest by cohort. Interestingly, TK and TPK developed at faster rates in the stand-alone course cohort while PK and CK grew at faster rates for the technology-infused course cohort. Cronbach's coefficient alpha reliabilities (Olejnik & Algina, 2000) showed a range well above the minimal acceptable range of .70 which answered research question 1 regarding whether courses facilitated learning about TPACK, where α=.93 for TK, .89 for CK, .90 for PK, .85 for PCK, .94 for TPK, and .93 for TPACK.

To collect qualitative data, Buss et al. (2015) used nine focus groups that included 55 preservice educators and asked nine questions including “how well do you feel prepared to teach elementary (secondary) students to use technology to work towards content standards” and “what would prepare you better to integrate technology into your instruction” (p. 163). Buss et al. (2015) organized the qualitative data into themes: exposure to various skills and technologies in courses, which prepared the preservice educators to integrate technology into teaching and learning; intention to integrate technology into teaching and learning while concerned about ability to do so; and course limitations and suggestions for improving courses (p. 165). Results for the first theme indicated that most preservice educators in the study felt that they had learned to use a variety of technology tools and approximately half of the preservice educators in the study indicated that they felt well prepared to integrate technology into teaching and learning. Further, study participants reported that teacher educators had provided strategies to assist with integrating technology into teaching and learning, including embedding technology in lessons and requiring preservice educators to create something with the technology and encouraging preservice educators to collaborate and share. Study participants also stated that they felt comfortable with digital media and felt comfortable using digital media in teaching and learning to foster critical thinking and problem-solving skills (Buss et al., 2015, pp. 166-167). Preservice educators were able to articulate how they would integrate technology in teaching and learning but were concerned about the ability to practically apply technology for technology integration, which is theme two. Specifically, preservice educators indicated that they were comfortable with word processing and presentation tools but were more concerned about their ability to integrate multimedia technology or emerging technologies (Buss et al., 2015, p. 167). For theme three, preservice educators in the study expressed concerns regarding limitations of the technology in courses due to time constraints and limited knowledge of teacher educators with regards to technology integration. Further, preservice educators suggested that more technology tools should be introduced with more modeling from teacher educators as well as more time for application use of the technology, especially in-class practice sessions (Buss et al., 2015, pp. 167-168).

Buss et al.'s (2015) study demonstrated that preservice educators learned about technology integration throughout all TPACK domains for teaching and learning, regardless of whether the course was taught as a stand-alone technology course or a technology infused methods course. However, it is important to note that there were differences between stand-alone and technology-infused courses, especially in terms of the number of different technologies the preservice educators were exposed to and the amount of time that was available to use for application experiences with technologies. Further, the stand-alone course was taught by teacher educators with expertise in using technology, which strengthens the importance of the connection between teacher educator competence with technology and preservice educator ability to integrate technology into teaching and learning. Another consideration regarding the results of Buss et al.'s study is that the study was conducted in 2015 and new educational technologies have been developed that could change the results of the study.

Technological pedagogical content knowledge (TPACK) and the International Society for Technology in Education (ISTE) 2017 Teacher Standards were used as the framework and standards to revamp a stand-alone technology course in Parra et al.'s

(2019) case study. The face-to-face course, Integrating Technology with Teaching (ITT), incorporated 22 students and their feedback as an important element of course redesign along with other key stakeholders including local school districts and state administrators. To address lack of “functional knowledge”, and based on stakeholder information, three themes were incorporated into the design of ITT: tools utilized by districts, a willingness to learn and demonstrate skills with technology and blended learning and managing social media (p. 70). Tools taught during the semester included Google Classroom, Remind, Flipgrid, Canva, Khan Academy, Kahoot, Padlet, and IXL as well as the basics of using a Chromebook (Parra et al.’s, 2019, p. 71).

The redesigned ITT course addressed the idea that social media created distractions and problems so the curriculum included specific TPACK demonstrations and other techniques to with social media management from both a learner and student perspective. Twitter was used as a reflection tool and a focus on digital citizenship and Personal Learning Networks (PLNs) afforded students opportunities to engage with social media in “meaningful ways” (Parra et al., 2019, p. 70). To keep the number of technologies and tools available for teaching and learning from being overwhelming, students in ITT engaged with tools in categories such as PLN, STEM/Makerspace, and game-based learning, which assisted students in reducing frustration regarding the ever-evolving nature of technology. ITT also addressed technology integration budget concerns by introducing free, open, and low-cost tools such as Google Docs, Twitter, and Podomatic, a podcasting tool. The main takeaways for improving course design were balancing rich technology content within the course organization and building and sustaining networks. Parra et al. (2019) also stressed the importance of TPACK emphasis within the course as well as a focus on critical thinking and problem solving. Parra et al's (2019) study provides more information on how technology courses can assist preservice educators in integrating technology in teaching and learning but care must be taken in generalizing the results as the population of the study was small and included education preparation students taking the course as an elective as well as preservice educators.

21st Century Skills and International Research

The National Education Association (NEA) (2008) placed 21st century skills in three categories: learning and innovation skills; information, media, and technology skills; and life and career skills. Learning and innovation skills include creativity and innovation, critical thinking and problem solving, communication, and collaboration. Information, media, and technology skills are information literacy and technology literacy while life and career skills encompass flexibility and compatibility, entrepreneurship, and leadership and responsibility (NEA, 2008). Missouri's Show-Me Standards have four goals: acquire knowledge and skills to gather, analyze, and apply information and ideas, which is critical thinking; acquire knowledge and skills to recognize and solve problems, which combines creativity and critical thinking; acquire knowledge and skills to communicate effectively "within and beyond the classroom", which is communication and collaboration; and acquire knowledge and skills to make decisions, which is critical thinking (Missouri Department of Education, n.d.b, p. 2). Collaboration, communication, creativity, and critical thinking are also known as the 4Cs of 21st century learning or the 4Cs of Future Ready Learning (P21 Partnership for 21st Century Learning, n.d.).

Using Gunuc's (2017) definition of effective technology integration from Gunuc's (2017) engagement and technology integration theory which combined cognitive commitment, affective commitment, and behavioral commitment to create effective technology integration, Yilmaz (2021) investigated connections between 21st century skills, academic achievement, and "effective technology integration" among preservice educators in Turkey (p. 166). There were three stages to Yilmaz's (2021) mixed methods research: no technology integration, basic/medium technology integration, and advanced technology integration provided to preservice science educators as they practiced pedagogy in a science course. The data show that preservice educators' 21st century skills, especially critical thinking skills, increased as technology integration increased. Yilmaz (2021) further concluded that technology integration is most effective when introduced gradually and technology integration requires technology literacy. Yilmaz (2021) also stated that technology is now a necessity, not a privilege, and due to societal changes caused by rapid technology development, education systems, regardless of country of origin, must also evolve to keep pace with these societal changes.

While Yilmaz's (2021) study shows a correlation between 21st century skills, technology integration, and academic achievement, there are limitations to applying the research from Yilmaz's (2021) study in a general way. First, the higher education system in Turkey varies from the higher education system in other countries. Second, data collection for Yilmaz's (2021) research happened during the COVID-19 pandemic and all student learning was remote. Technology integration and technology usage could be different during face-to-face or hybrid learning. Third, the emphasis of Yilmaz's (2021) research was science preservice educators so the research may not reflect the behaviors and attitudes of preservice educators in other disciplines.

A link between 21st century skills, digital competencies, social justice, and critical pedagogy among student teachers in Scotland was the subject of an article by Coker (2020). The Scottish government requires the incorporation of digital skills into initial teacher education as critical skills for learning, living, and working in the 21st century (The Scottish Government, 2016). Due to the importance of P-12 students needing 21st century and digital skills to be successful in learning and living in a digital world, Coker (2020) claimed that not only are 21st century and digital skills a required skillset for student teachers but arguably the purpose of education. Coker (2020) first examined the link between social justice and digital and 21st century skills.

In the context of Coker's (2020) research, social justice is embracing social values of sustainability, equality, and justice; committing to the principles of democracy through inclusion of all regardless of age, disability, gender or gender identity, race, ethnicity, religion, or sexual orientation; valuing and respecting social, cultural, and ecological diversity; demonstrating a commitment to engaging learners in real-world issues; and respecting the rights of all learners (General Teaching Council for Scotland, 2012). Coker (2020) concluded the context of 21st century learning diffuses throughout this particular definition of social justice as these skills require critical thinking. First, consideration of sustainability, due to the consumption of materials to produce digital resources such as devices and storage. Next, respect for all persons, democracy, global citizenship, and real-world issues permeates throughout digital and 21st century contexts in the form of online interactions and digital connectivity. Machado-Casas et al. (2017) proposed that

21st century skills and digital literacy skills are crucial for bilingual teachers and other teachers that will reach “culturally and linguistically diverse” learners (p. 53), a component of social justice. Machado-Casas et al. (2017) also explained that the digital literacy and 21st century skills of in-service teachers are dependent on the digital literacy preparation teachers receive in educator preparation programs; technology-focused teacher education includes technology integration and the use of digital media, which allows preservice educators to become comfortable with combining pedagogy and culturally responsive content not available in traditional curriculum materials.

According to Coker (2020), student teachers demonstrated the need for critical pedagogy by ubiquitous use of “poor quality and often misinformed” websites rather than scholarly peer-reviewed journals (p. 137). Digital literacy skills and critical thinking combine to create critical pedagogy, an awareness of sources and purposes of information as well as personal filtering skills for online information. Coker (2020) asserted that digital learning is important at all levels of initial teacher training and must include multiple digital skills, 21st century skills, and digital competencies. Further, Coker (2020) concluded that everyone involved with designing, developing, and delivering teacher education need to include digital tools, spaces, and skills throughout teacher education programs as these tools, spaces and skills are “central to both pedagogy and practice in the 21st century” (p. 139). While Coker’s (2020) examination of a link between 21st century skills, digital competencies, social justice, and critical pedagogy among student teachers illuminates the need for 21st century and digital skills, Coker’s (2020) focus was on Scottish student teachers. As education systems can vary from country to country, information from Coker's (2020) study could have limited application on a global scale depending on the requirements of a specific country's education system.

The European Parliament has identified eight competences for lifelong learning: competence of communicating in the mother tongue; competence of communication in a foreign language; mathematical competence in science and technology; digital competency; competency of learning to learn; social, intercultural, and citizenship awareness competencies; initiative and social entrepreneurial competencies; and cultural awareness and expression competencies (Komisyonu, 2005). Kan and Murat (2020) examined the self-efficacy, grounded in Bandura's social learning theory, of teacher candidates' lifelong learning key competences, based on the European Parliament's eight competences for lifelong learning, and educational technology standards at Firat University in Turkey. The definition of educational technology in Kan and Murat's (2020) study was human-technology interaction, performance technologies, computer-aided education, and virtual education (Simsek et al., 2009) and as a set of academic systems that effectively design teaching and learning environments; solve problems in teaching and learning; and enhance the quality of teaching and learning (Isman, 2002). The educational technology standards used in Kan and Murat's (2020) study were the 2017 International Society for Technology (ISTE) Standards for Educators.

One assertion of Kan and Murat's (2020) research is the idea that if teachers possess lifelong learning competencies those competencies will have a positive effect on their students as well as the assertion that as technology and technology standards evolve so must the qualifications of teacher candidates evolve. Kan and Murat (2020) used the Likert 5-type Lifelong Learning Key Competences Scale developed by Sahin et al. in

2010 as well as the Likert-5 type Competences Scale for Educational Technology Standards developed by Coklar in 2008. The findings of Kan and Murat's (2020) research include self-perception of teacher candidates regarding lifelong learning competences is high among all areas except competence communicating in a foreign language. Teacher candidates also reported a high level of self-perception of learning as an unfinished process and a high level of competencies related to educational technology. While Kan and Murat's (2020) data are only somewhat applicable to educator preparation programs in the United States due to variations in educational systems, one major area of note is that the data does not match teacher candidates' self-perceptions. Further, the data does not fully support the assertion that teacher lifelong learning competencies positively affect students.

Karakoyun and Lindberg (2020) investigated preservice teachers in Turkey and Sweden views regarding 21st century skills through a qualitative survey. The Organization for Economic Cooperation and Development (OECD) defined 21st century skills as competences that individuals need to become effective workers and citizens in an information age society (Ananiadou & Claro, 2009), the Partnership for 21st Century Learning (P21) defined 21st century skills as learning and innovation skills; information, media, and technology skills; and life and career skills (P21 Partnership for 21st Century Learning, n.d.) and North Central Regional Library (NCREL) defined 21st century skills as digital-age literacy, inventive thinking, effective communication, and high productivity (Dede, 2010). While these definitions vary slightly, they all refer to what students can do with knowledge and how they can apply knowledge in "authentic contexts" (Karakoyun & Lindberg, 2020, p. 2354), as well as the need for student competence with educational technologies as well as information and communication technologies (ICTs), which means that integration of educational and ICTs into classrooms and classwork is necessary. Barriers to such integration include misconceptions regarding the relationship between pedagogy and technology and teachers' beliefs about educational and ICTs as barriers, among others.

Given that barriers to effective educational and ICT integration lie in misconceptions regarding pedagogy and technology and belief that technology can be a barrier to learning, it is critically important to develop preservice educators' experiences with educational and ICTs to assist preservice educators in gaining self-confidence while using technology as well as developing preservice educators' understanding of the positive relationship between technology and pedagogy. According to Karakoyun and Lindberg (2020), preservice educators in both Turkey and Sweden associated 21st century skills with technology, digital citizenship, communication, and information literacy as well as the use of digital tools, social media platforms, and digital literacy. Preservice educators in the study also mentioned the need for both teachers and students to be able to use technology tools and digital spaces effectively for teaching and learning as well as for problem solving currently and in the future. While the authors emphasized that teacher-training programs need to "allow future teachers to gain the necessary knowledge, skills, and experience to support their professional careers" there was not a comprehensive plan suggested for furthering 21st century skills (Karakoyun & Lindberg, 2020, p. 2367). The only concrete suggestion for educator preparation programs was that faculty members should model effective technology use in educational environments. As with other international research, the study has limited implications for United States institutions given differences in educational systems between Turkey, Sweden, and the United States.

Summary

Research showed that Constructivism and Bandura’s (1977) Social Learning Theory can inform how preservice educators learn educational technology skills for future teaching. Research on digital technologies in learning, however, is complicated by the rapid pace at which digital and educational technologies change, especially when compared to the rate at which academic research is published. While there are frameworks for teaching technology to preservice educators, the most widely used being TPACK, research also shows that the digital competence of teacher educators is a crucial factor impacting how preservice educators learn technology skills for future teaching and learning.

As educator preparation programs (EPPs) review and modify how technology is taught within their programs, EPPs must consider a variety of factors. These factors include the digital competence of EPP faculty, institutional support for technologies and technology professional development, and rapid changes in educational technologies. Further complicating how EPPs implement technology instruction for preservice educators is much of the recent research on EPPs, preservice educators, and technology comes from international sources. Caution must be exercised when generalizing international research as educational systems and processes for developing educators varies from country to country. The research conducted in this study aimed to examine how students in an elementary, early childhood, and exceptional child EPP acquired educational technology skills for future teaching. The methodology used in this study is outlined in the next chapter.

Chapter Three: Methodology

Introduction

This research was a qualitative case study that examined how preservice educators in an elementary, early childhood, and exceptional child educator preparation program (EPP) acquired educational technology skills to be used in future teaching. All data were collected from preservice educators in two sections of the course, Instructional and Assistive Technology in a Universally Designed Learning Environment, taught by the same instructor. Methods of collecting data included interviews and pre- and post-surveys about technology skills, class observations of the two sections, application journals, Philosophy of Educational Technology Integration Statements, and a modified STEBI-B that was given to students in the first two weeks of class and the last two weeks of class.

Research Design

Parra et al. (2019) examined a case study conducted to explore the structure of a learning technologies class to meet the needs of preservice educators for future teaching with technology. The foundational framework of the study was TPACK, the "complex interrelations of content, pedagogy, and technology" (Parra et al., 2019, p. 69). Parra et al.'s (2019) case study also used the International Society for Technology in Education (ISTE) 2017 Educator Standards for guidance in reimaging the learning with technologies course, as well as to map learning objectives (p. 69). Lee and Kim (2017) conducted a case study examining the implementation of Version III of the TPACK model into an undergraduate technology integration course in an educator preparation program. Version III of the TPACK model assisted students in evaluating "student-centered, technology-integrated activities" and allowed students to "provide constructive suggestions or alternative strategies for improving activities" (pp. 1649-1650). These two studies suggested that case study research design is effective when examining technology integration courses in educator preparation programs. Stake (1995) cited case study research extensively in his examples of the Harper School in his book on case study research.

Observations require taking note of actions, using all of a researcher's five senses, and involve note taking, usually with an instrument that allows for recording the observation for scientific purposes (Angrosino, 2007). Observations come from the research purpose, the research questions drive the observations (Creswell & Poth, 2018), and researchers consider observations a critical tool for collecting data in qualitative research (Yin, 2014). Creswell and Poth (2018) proposed that observations should include notations regarding the physical setting, notes about the participants, the activities participants are engaged in, and any interactions and or conversations between participants. Observer notes should be as inclusive as possible, but observers cannot note everything (Lofland & Lofland, 1995). However, observations can be broad at the beginning then focus more narrowly on the purpose of the research and research questions (Marshall & Rossman, 2015).

Before beginning observations, the researcher must decide on how involved the researcher will be with actions and conversations of those observed. This level of involvement may change over time and the researcher may evolve from being a strict observer to some level of participation with those observed (Creswell & Poth, 2018). Other issues the observer must consider include any potential deception of those observed, management of impressions, and any potential marginalization of the researcher, if it is a new setting (Atkinson, 2015). Identifying who or what is going to be observed, when the observations should happen and how long each session of observation should last are the next steps in creating an observational procedure (Creswell & Poth, 2018).

Interviews are one of six crucial data collection methods for qualitative research and interviews are a valid method of collecting data for case studies (Creswell & Poth, 2018). Needs of the research dictate the exact number of interviews conducted, as well as the type of qualitative study and the depth and breadth of data collection (Creswell & Poth, 2018). Rubin and Rubin (2012) stated that an interview is a social interaction based on conversation, and Brinkmann and Kvale (2015) proposed that an interview is where “knowledge is constructed in the interaction between interviewer and interviewee” (p. 4). Brinkmann and Kvale (2015) further specified that a qualitative research interview “attempts to understand the world from the subjects’ point of view, to unfold the meaning of their experience, to uncover their lived world” (p. 3). During the interview protocol construction process, the researcher must carefully consider who to interview and what questions to ask (Creswell & Poth, 2018); interview questions are often sub-questions of the research questions.

The eight interview questions created for this study were drafted from the research questions: how do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program acquire educational technology skills to be used for future teaching; how do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program perceive that an application journal developed their educational technology skills to be used for future teaching; how do opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program regarding teaching with technology change during an educational technology class; and how do prior technology skills affect the opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program learning educational technology skills to be used for future teaching?

The qualitative research process requires an extensive collection of data and documents to provide critical insight during the data collection process (Creswell & Poth, 2018, p. 52), and Merriam (1998) stated that documents can provide context to qualitative research. According to Daiute (2014), there are four types of patterns for making meaning from qualitative data: similarities, differences, change, and coherence. Strauss and Corbin (1990) delineated three categories to use to describe phenomenon in qualitative research: causal conditions, intervening conditions, and consequences or outcomes (Strauss & Corbin, 1990). Corbin and Strauss (2015) suggested a consequential matrix that assists a researcher in making connections between broad and specific connections influencing phenomenon. Documents allow a researcher to find patterns and make connections within data and are a crucial piece of the puzzle of data collection for qualitative research.

Creswell and Creswell (2017) proposed that journals use the language and words of the participants and provide a written representation of the thoughts of participants, as well as demonstrating concepts to which participants have given thought (p. 310). Creswell and Poth (2018) concluded journals can give insight into the thoughts and perceptions of participants, even though not all participants will have the same level of articulation. Halfpenny and Procter (2015) proposed that journals can also represent change over time, especially when used in conjunction with digital data collection means, if the researcher asks participants to use journaling in a way that lends itself to such data collection. Nicholas et al. (2010) concluded that using digital means in document collection can provide a less threatening and more comfortable environment for participants and when used with journaling may allow participants to feel more at ease to discuss certain topics. In this study, journaling was captured through the application journal.

Likert Scales and surveys are legitimate forms of qualitative research when used to describe relationships between data. Landrum and Garza (2015) stated "Likert-type data fit somewhere between the two end points on the spectrum of the interface of knowledge and appear to be an example of quantitizing [sic] whereby a dimension of agreement (qualitative) is rendered in terms of quantity (quantitative)" (p. 201).

Modified STEBI-B, a survey using a Likert Scale, is a document that provides information on similarities, differences, and change between data from the beginning of the data collection period to the end of the data collection period. The researcher also accessed pre- and post-surveys regarding student's prior technology skills and student Philosophy of Educational Integration Statements, assigned by the instructor, to provide context to a pattern of coherence in the data (Daiute, 2014; Merriam, 1998).

Research Site

The site of the research was a regional state university in the Midwest. The student population of the university during the fall 2021 semester was 8,929 undergraduate and 1,072 graduate students, with 525 undergraduate transfer students (Regional State University, 2021b, paras.1 & 2). The student population is 61.5% female, 38.5% male, 85.9% Caucasian, 8.4% Black, 2.3% Latinx, and 3.4% other ethnic groups (Regional State University, 2021b, paras. 3 & 4). The average age of undergraduate students is 22 and the faculty to student ratio is 19:1 (Regional State University, 2021b, paras. 8 & 14). Students attended classes in the research study on main campus in the education and psychology building in the innovation and technology center's flexible classroom. The course chosen for the study, Instructional and Assistive Technology in Universally Designed Learning Environments, is part of the degree program of the Elementary, Early Childhood, and Special Education (EESE) department that is part of the educator preparation program (EPP) at Regional State University. All students seeking a degree in Early Childhood Education, Elementary Education, Elementary Education/Middle School Language Arts, Math, Science, and Social Science, Exceptional Child: Early Childhood Special Education, or Exceptional Child: Mild/Moderate Cross Categorical must take Instructional and Assistive Technology in Universally Designed Learning Environments as part of their required coursework. The EPP at Regional State University was accredited by the Council for the Accreditation of Educator Preparation (CAEP).

Participants

Each section of Instructional and Assistive Technology in a Universally Designed Learning Environment taught at Regional State University has an average class size of 21 students enrolled (Regional State University, 2019a) and is a three-credit hour course. The researcher selected two sections of the course to help mitigate differences in the data collected potentially caused by interactions among students within a section. The two sections of the course selected for the study had the same instructor during the same semester to eliminate variations in collected data potentially caused by differences in how instructors teach the class.

Class section designated 2 originally consisted of 24 students, however, two students dropped the class after week one, which dropped the class size to 22. Class section designated 3 had 16 students, which combined, created a sample size of 38 students. The two sections of the course had 36 self-identified female students and two self-identified male students. Of the 38 participants, 35 students were Caucasian, one student was Black, one student was Asian, and one student was Latinx. The students in selected sections of the course were between the ages of 19 and 38, with a median age of 21.24 years. Eighteen students identified as transfer students, 12 students were Pell-grant eligible, 15 students were first-generation college students, five students were out-of-state students, and one student was repeating the class. The instructor divided both selected class sections into A and B groups. Group A met on Tuesday and Group B met on Thursday and the instructor assigned asynchronous online work for each group on the day that the class did not meet in person as part of instruction. The previous two semesters that the instructor taught Instructional and Assistive Technology in Universally Designed Learning Environments, COVID-19 protocols at Regional State University necessitated the AB format to create smaller class sizes to accommodate social distancing during in-person learning. Due to positive feedback from students and instructor perceptions of student learning, the instructor retained the AB format for Instructional and Assistive Technology in Universally Designed Learning Environments after Regional State University rescinded social distancing COVID-19 protocols for in-person learning.

Sample size was determined by purposeful sampling as the classes chosen will help inform the research questions (Creswell & Poth, 2018, p. 158).

Research Questions

The theoretical framework used in the development of the research questions for the study is based in Constructivism and Bandura's (1977) Social Learning Theory. Constructivism is a learning theory that asserts that learners actively construct knowledge and make meaning from the world around them, based on experiences (Dewey, 1938). Further, Constructivism posits that learners construct learning and learners do not simply have learning transmitted to them (Elliot et al., 2000). The two main ideas of Constructivism are that prior knowledge influences the building of new knowledge and learning is an active, not passive, process (Narayan et al., 2013). Bandura's (1977) Social Learning Theory proposed that the interaction between environmental and cognitive factors influences learning. Building on behaviorist learning theory, Bandura's (1977) Social Learning Theory also argued that learning involves mediating processes that occur between stimuli and responses, as well as the idea that learned behavior comes through the process of observational learning (McLeod, 2016, para. 2). As Robinson (2019) asserted that education is now an integrated part of a digital society and Schaller (1997) stated that digital technology is a daily component of living in the 21st Century, online learning is included in the stimuli and responses that encompass observational learning. There were four research questions in this study.

1. How do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program acquire educational technology skills to be used for future teaching?

2. How do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program perceive that an application journal developed their educational technology skills to be used for future teaching?
3. How do opinions of students in a technology class in an early childhood elementary and exceptional child educator preparation program regarding teaching with technology change during an educational technology class?
4. How do prior technology skills affect the opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program learning educational technology skills to be used for future teaching?

Instrumentation

The Science Teaching Efficacy Belief Instrument (STEBI-A) is a teaching efficacy belief instrument that contains 25 items using a Likert Scale originally designed, validated, and tested for reliability by Riggs and Enochs (1989) to measure elementary teacher self-efficacy, focusing on science content. Enochs and Riggs (1990) modified the instrument with language for use with preservice elementary science educators, removed two items, and then tested the instrument for reliability and validity with preservice educators in 1990. STEBI-B became the new 23 item instrument and became the starting point for multiple instruments that measure teacher efficacy in other subjects. The STEBI-CHEM was developed for chemistry (Rubeck & Enochs, 1991), the Self Efficacy Beliefs About Equitable Science Teaching (SEBDST) was developed to measure teacher beliefs towards science teaching, while considering ethnicity, language minorities, gender, and socioeconomic factors (Ritter et al., 2001), and the Mathematics Teaching Efficacy Belief Instrument (MTEBI) was developed to measure self-efficacy and outcome expectancy preservice educators beliefs towards teaching mathematics (Enochs et al., 2000). Bleicher (2004) tested the STEBI-B to monitor if the instrument remained valid and reliable. After analyzing the results, Bleicher (2004) modified items 10 and 13 due to cross-loading and low-values (p. 386). The resulting instrument became the Modified STEBI-B (Bleicher, 2004). Bleicher gave permission to the researcher to use the Modified STEBI-B with technology verbiage substituted for science verbiage and to modify the number of items used (R. Bleicher, personal communication, August 10, 2021).

The researcher constructed eight interview questions based on research in question construction from Brinkmann and Kvale (2015), Creswell and Poth (2018), and Rubin and Rubin (2012). Content of the research questions was informed by the research of Blackwell (2016), Buss et al. (2015), Dincer (2018), Lavonen et al. (2006), and Parra et al. (2019). The eight interview questions were:

1. What educational technology skills do you believe you have learned in [class]?
2. How do you believe you learned those skills?
3. Which type of learning did you feel was most helpful: in class, on Zoom, online assignments, or another type of learning?
4. Do you feel that the application journal helped you learn educational technology skills? Why or why not?
5. Have your opinions about teaching with technology changed since the beginning of [class]? Why or why not?

6. Has your belief in your skills with teaching with technology changed since the beginning of [class]? Why or why not?
7. What is the most important thing you have learned in [class]?
8. Is there anything else you would like to share with me about [class]?

The course instructor developed the pre- and post-survey instrument as part of course materials. The instructor also constructed the journal prompts, the Philosophy of Educational Technology Integration Statement, and the Philosophy of Educational Technology Integration Statement rubric as class materials for the course.

Table 5

Research Questions with Instrumentation for Measurement

Research Question	Instruments for Measurement
How do students in a technology class in an early childhood, elementary, and exceptional child educator preparation program acquire educational technology skills to be used for future teaching?	Observations Application journal prompts assigned by instructor Interview Questions [1,2,3]
How do students in a technology class in an early childhood, elementary, and exceptional child educator preparation program perceive that an application journal developed their educational technology skills to be used for future teaching?	Observations Application journal prompts assigned by instructor Interview Question [4]
How do opinions of students in a technology class in an early childhood, elementary, and exceptional child educator preparation program regarding teaching with technology change during an educational technology class?	Observations Interview Questions [5,6] Modified STEBI-B Application journal prompts assigned by instructor Philosophy of Educational Technology Integration Statement assigned by instructor
How do prior technology skills affect the opinions of students in a technology class	Observations Interview Questions [5,6]

in an elementary, early childhood, and exceptional child educator preparation program learning educational technology skills to be used for future teaching?	Modified STEBI-B Application journal prompts assigned by instructor Pre- and post-survey given by instructor Philosophy of Educational Technology Integration Statement assigned by instructor

Procedure

The Dean of the appropriate college at Regional State University gave site permission June 2021 (personal communication, June 10, 2021). The Institutional Review Board (IRB) at Lindenwood University gave approval for the study in July 2021. Regional State University gave IRB approval for the study in July, 2021. The instructor of the course received the study Consent Form from the researcher in person the week before classes began in August 2021 and 36 students received research study Consent Forms in person from the researcher during the first two weeks of classes in August and September 2021. Two students were in quarantine, due to COVID-19 the first two weeks of class and received the study Consent Form by email. All 38 students consented to participate in the study.

Students filled out the first Modified STEBI-B in August and September 2021, during the first two weeks of classes. The researcher delivered the first Modified STEBI-B in person to the students present at the in the face-to-face classes, and the researcher emailed the Modified STEBI-B to quarantined students through official university email. Students received the second Modified STEBI-B in November and December, 2021 in weeks 15 and 16 of class. The second Modified STEBI-B was delivered in person by the researcher to all students. The Modified STEBI-B was chosen as one instrument to measure how opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program regarding teaching with technology change during an educational technology class, as well as how prior technology skills affect the opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program learning educational technology skills to be used for future teaching. To ensure that the researcher could compare the first and second Modified STEBI-B by student, the in-person Modified STEBI-B was given to each student with student names on the paper. The results were entered into a spreadsheet by the researcher by study number, also called student number in the results, then the paper copies of the Modified STEBI-B containing student names were locked in a file cabinet only accessible by the researcher. The two Modified STEBI-B that were administered to students by email by the researcher were printed, labeled with student names, then stored in the locked file cabinet. The emails were then deleted permanently from the researcher's email. The Modified STEBI-B instrument measured how opinions of students changed during class as, well as how prior technology skills affect opinions of students during class, as Bleicher (2004) validated Modified STEBI-B as a way of measuring opinions of preservice educators' self-efficacy beliefs, which their opinions inform.

The class chosen for this research study was Instructional and Assistive Technology in a Universally Designed Learning Environment, as the material taught in this class specifically relates to the research questions. Observations of the class took place September 21 and 23, 2021, and November 2 and 4, 2021. The researcher observed Tuesday and Thursday sections and both time slots of the course, due to how the instructor divided the class. The researcher chose week five of classes for the first set of observations, as students were more comfortable with the class environment, the instructor, the researcher, and the structure of the class after several weeks of instruction. The second set of observations took place during week 11 of classes to avoid class disruptions caused by mid-term exams, the Thanksgiving holiday, and final exams. Each class was 75 minutes long and observations lasted the entire class period to minimize interruptions.

Design of the observational protocol allowed for both reflective and descriptive notes (Angrosino, 2007) and included the physical setting, activities that occurred, and the researcher's reactions to all activities (Bogdan & Biklen, 1992). The role of the observer was meant to be that of a complete observer, but due to student and instructor needs, the researcher's role evolved into partial participant (Creswell & Poth, 2018). After each set of observations, timely notes were prepared to create a narrative description from the notes (Emerson et al., 2011). This observation design followed best practices developed by Creswell and Poth (2018) in, *Qualitative Research & Design: Choosing Among Five Approaches*.

The researcher conducted student interviews in person November and December 2021. To ensure equal representation from both sections of the course, the researcher utilized wheelofnames.com, a digital random name picker that is open source and does not save any data entered, to sort anonymous student study numbers into groups by section. The researcher randomly selected two students for interviews from class sections 2A, 2B, 3A, and 3B utilizing student anonymized study numbers and by entering all student study numbers into wheelofnames.com. The needs of the research and type of research dictated the number of interviews, eight (Creswell & Poth, 2018), and all eight students consented to be interviewed. The researcher used a digital camera to record the interviews. The use of any digital technology comes with increased ethical concerns, such as privacy, confidentiality of information, and secure data storage (James & Busher, 2009; Marshall & Rossman, 2015). Secure storage in a password protected, university owned, secure cloud storage platform, on a password protected device, as well as data anonymization ensured privacy and confidentiality of information from the interviews. Brinkmann and Kvale (2015) suggested that the design of the interview protocol include questions phrased in ways that allow interviewees to understand the questions, but also include questions at the beginning that set the interviewees and comments at the end of the interview thanking the interviewees for their time. Warren and Xavia Karner (2015) also suggested that interviews should be in a conversational tone and open-ended questions added at the end to allow interviewees to add additional information they feel is important to the interview.

The researcher asked all eight students selected for interviews eight open-ended questions developed from the research questions of the study. After obtaining permission from each interviewee, the researcher recorded then transcribed each interview. For transcription, the researcher uploaded the videos to a university-owned, secure video transcription site, Canvas Studio, then deleted from Canvas Studio after transcription and downloading. The researcher compared each transcription to the original interview recording for accuracy and corrected as necessary, then removed all identifying information and stored the data in a secure, university-owned Google account. The researcher accessed all application journal prompts, assigned by the instructor, from the learning management system (LMS) in September 2021 then sorted each prompt, one per page, to a Google Sheets spreadsheet in an institution-controlled Google Drive (De Felice & Janesick, 2015). In December 2021, the researcher accessed student application journal answers then sorted those answers into the Google Sheets spreadsheet by answer (De Felice & Janesick, 2015). After accessing the pre- and post-survey of prior technology skills, created by the instructor, from the LMS in early October 2021, the researcher created a Google Sheets spreadsheet and sorted the questions, one prompt per page and by student study number (Grbich, 2013). The researcher received student responses to the pre-survey of prior technology skills in October 2021, then sorted the responses into the appropriate page of the Google spreadsheet (Grbich, 2013). In mid-December 2021, the researcher received the answers to the post-survey of prior technology skills from the LMS, then sorted the responses into the correct pages of the Google spreadsheet (Grbich, 2013). The researcher accessed the instructor-assigned Philosophy of Educational Technology Integration Statements from the LMS mid-December 2021 and removed student names. The statements were then stored in folders in the secure Google Drive, labeled only with class sections and study numbers, not student names, for sorting into themes later (De Felice & Janesick, 2015).

Data Analysis

Creswell and Poth (2018) identified a data analysis spiral for qualitative data that begins with data collection and ends with reporting findings from the data, see Table 6.

Table 6

Creswell and Poth's Data Analysis Spiral

Spiral Loop	Data Analysis Activity
Loop 1	Manage and organize data
Loop 2	Read and memo ideas
Loop 3	Describe and classify codes into themes
Loop 4	Develop and assess data interpretations
Loop 5	Represent and visualize data

Note. Adapted from "Qualitative Inquiry and Research Design: Choosing Among Five Approaches (4th ed.)" by J. W. Creswell and C. N. Poth, 2018, p. 185. Copyright 2018 by Sage Publications, Inc.

First, the researcher removed all identifying information from the data, then the researcher assigned each student a randomized study number. At the beginning of the semester when the random study numbers were assigned, there were 40 students enrolled in the two sections of Instructional and Assistive Technology in a Universally Designed Learning Environment; however, two students dropped the class the first week of classes. That meant that the study numbers assigned to the students who dropped the class were not used in the study, numbers 32 and 35. The researcher used wheelofnames.com to assign randomized study number to each student and each page of data analysis in the Google spreadsheet only listed students' study numbers. After organizing all data into a password protected, institution-controlled Google Drive folder with subfolders for each type of data collected, to ensure data were easily searchable and organized, each folder and subfolder received a consistent naming convention.

After storing the data collected from observations digitally as a portable document format (PDF) as suggested by Grbich (2013), the researcher added annotations and notes in the margins of the PDF (Bazeley, 2013). Next, the researcher circled and noted key phrases, key ideas, and key concepts, which Miles et al. (2014) described as memoing. After memoing the PDF of the observations, the researcher placed the reflective and descriptive notes in a Google Sheets spreadsheet by class to make the notes more easily sortable into themes (Bazeley, 2013).

Within the main research folder, the researcher created a Google Sheets spreadsheet inside the university owned Google Drive with a page for each method of data collection, including the Modified STEBI-B, observations, interviews, journal prompts and responses, the pre- and post-surveys given by the instructor, and the Philosophy of Educational Technology Statements assigned by the instructor. To score the Modified STEBI-B the researcher used a scoring guide, see Table 3, then assigned each study participant a score based on the scoring guide. Once the Modified STEBI-Bs were scored, the researcher averaged the scores; the highest possible score was 16, the lowest possible score -16, with a mean of 0, see Table 7.

Table 7

Scoring Guide for the Modified STEBI-B

Question	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	2	1	0	-1	-2
2	-2	-1	0	1	2
3	2	1	0	-1	-2
4	2	1	0	-1	-2
5	2	1	0	-1	-2
6	2	1	0	-1	-2
7	-2	-1	0	1	2
8	2	1	0	-1	-2

Note. Statements two and seven reflected negative aspects of self-efficacy and were, therefore, scored with negative numbers for strongly agree and agree and positive numbers for disagree and strongly disagree.

To ensure all data were properly anonymized and sorted into the correct spreadsheet, the researcher read and reread all data. After rereading the data, the researcher sorted the data into broad themes (Creswell & Poth, 2018). To assist with sorting data into more specific themes, the researcher used an initial limited number of codes, called lean coding (Creswell & Poth, 2018). Once the data were sorted by the initial set of codes, the data were read and re-read and expanded into finalized themes. Once the data were sorted into final themes, the researcher interpreted the data, a process Lincoln and Guba (1985) called making sense of the data.

Summary

The population of this research study was 38 preservice educators in two sections of Instructional and Assistive Technology in a Universally Designed Learning Environment, taught by the same instructor in an elementary, early childhood, and exception child educator preparation program (EPP). The case study employed interviews, observations, pre- and post-surveys, modified STEBI-B, application journals, and educational technology integration statements to collect data. The researcher then used Creswell and Poth's (2018) data analysis spiral for qualitative data including managing and organizing the data, reading and memoing emergent ideas, describing and classifying codes into themes, developing and assessing interpretations of the data, and representing and visualizing the data to answer the four research questions regarding how preservice educators acquire educational technology skills for future teaching. The results from this qualitative case study are examined in the next chapter.

Chapter Four: Results

Introduction

The purpose of this study was to examine how students in a technology class in an elementary, early childhood, and exceptional child (EESE) educator preparation program (EPP) acquired educational technology skills to be used in future teaching. This study also examined how students in a technology class in an EESE EPP perceived an application journal to develop educational technology skills to be used in future teaching, how opinions of students in a technology class in an EESE EPP regarding teaching with technology change during the class, and how prior technology skills, affect the opinions of students in a technology class in an EESE EPP. To answer these research questions, the researcher used observations, interviews, and a modified STEBI-B, as well as several assignments from the course. The assignments included application journals, pre- and post-surveys, and Philosophy of Educational Technology Statements. The students in the study were all part of two sections of Instructional and Assistive Technology in a Universally Designed Learning Environment, taught by the same instructor.

To analyze the data, the researcher used a data analysis spiral, identified by Creswell and Poth (2018). The researcher applied Creswell and Poth’s (2018) data analysis steps to the observation notes, interview transcriptions, modified STEBI-B results, application journal answers, pre- and post-survey results, and Philosophy of Educational Technology Statements, and the results of the data analysis were categorized into themes that are discussed in this chapter. Thirty-four of 38 students demonstrated growth in all 19 educational technology skills measured in the pre- and post-surveys, see Tables 8 and 9. Four students’ data were not included in Tables 8 and 9, as four students did not submit the post-survey and, therefore, growth in their skills could not be established by the data in the surveys. In Table 8 and Table 9, one point was assigned for each step of growth from, *this is completely new to me,* to, *I know a little about this* to *I am comfortable using this,* to, *I am an expert and can teach others about this topic*, which meant there were three points of growth available per skill, per participant, unless the participant marked the skill, I am an expert and can teach this to others, on the pre-survey. In Table 9, if the participant marked a skill, *I am an expert and can teach this to others,* on the pre-survey, no points were assigned to that skill for that participant.

Table 8

Self-perceived Growth in Educational Technology Skills from Pre- to Post-Surveys by Participant

Student Number	Total points of growth for 19 skills pre- to post-survey (57 possible points)
1	13
2	33
3	32
4	26
5	24
6	36
7	27
8	28
9	28
10	21
11	35
12	19
13	30
15	25
16	29
17	28
18	35
19	24
20	-1
21	21
22	32
23	31

24	48
25	32
27	30
28	15
29	23
30	14
33	30
34	36
36	21
37	17
38	19
39	41

Table 9

Overall Self-perceived Growth in Measured Educational Technology Skills of All Participants between Pre- and Post-surveys, by Skill

Skill	Average points of growth, 3 is highest	Number of students that marked expert for the pre- and post-survey
UDL	2.06	1
Accessibility Features	1.16	2
Google Drive	1.08	10
Google Docs	.93	20
Hyperdocs	1.82	0
Google Forms	1.59	7
Google Slides	1.44	18
Google Sites	1.88	0
Google Classroom	1.43	6
Spreadsheets (Excel/Sheets)	.77	4
Google Chrome Extensions	1.45	1
QR Codes	1.18	1
Screencasting	1.53	4
Podcasting	2.06	1
Video/Audio Editing	1.34	2
Digital Citizenship	2.38	2
Copyright, Fair Use, OER	1.76	1
VR/AR	1.79	1
Coding	1.94	0

Note. This table includes data for 34 of 38 students. The average points of growth for each skill were calculated by averaging the point totals of growth per skill for all participants, minus the number of participants that reported being an expert in the skill on both the pre- and post-surveys.

Research Question 1

How do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program acquire educational technology skills to be used for future teaching?

Data collected to answer the first research question included student interviews, class observation notes, application journal prompts, and post-survey open-ended questions; four themes emerged from the data to answer the question. Interview question answers and observation notes were used to inform theme one; observation notes, interview question answers, and post-survey open-ended question answers informed theme two; observation notes, post-survey open-ended question answers and application journal prompts informed theme three; and observation notes, interview question answers, and post-survey open-ended question answers informed theme four.

Theme One: Hybrid Instructional Design of the Class Impacted Students' Acquisition of Educational Technology Skills

The hybrid instructional design of the course, including in-person instruction combined with the asynchronous online learning format of the course, the way the learning management system portion of the course was designed, and the consistent flow of the class impacted how students acquired educational technology skills. Student 18 specifically mentioned the organization of coursework in the post-survey open-ended questions, when they stated, “I like how the Canvas page was formed and organized,” Observation notes suggested that during in-person learning the instructor demonstrated technology skills and gave examples of how technology skills could be applied during teaching and learning, then had students perform guided application practice while the instructor walked around the class and answered questions and gave guidance to students. Students consistently reported that the combination of in-person learning and online learning was important to the development of their technology skills; five out of eight students interviewed specifically mentioned the combination of in-person application learning and online learning through application assignments as important to the development of their technology skills. During their interview, the researcher asked participants which type of learning they felt was most helpful: in class, online assignments, or another type of learning. Student 1 stated

> I think having them [in-person and online formats] together. I don't think I would have learned as much in this class if it was strictly online because I think having it in person, the face-to-face part definitely made what we were learning online make . . . more sense. And I also don't think without the online part, I would have learned anything

The researcher asked how participants thought they learned educational technology skills during [class] during interviews and Student 14 replied

> I learned [educational technology skills] mostly through . . . going over them in class, but like what really cemented them was like going home and trying them out for myself. . . . So, I got like the basic understanding from [the instructor] . . . but what really helped was going on to be able to do it by myself if I needed to trial and error a little bit . . . So be able to do

half of it in class and ask questions face to face if I need them is super helpful and being shown like right here in front of me. But then also being able to go home and learn in my own comfortable space the other day is very calming and very helpful to me

Observation notes further showed that the online application assignment was linked to in-person learning demonstration and guided practice, which further supported the theme that the instructional design played a role in how students acquired educational technology skill. The observation notes also showed consistency of the online and in-person portions of the course format, the connection of each in-person class with prior and future learning, and that during each in-person class, goals were made clear and connected to learning objectives. The instructor shared with the researcher that the hybrid instructional design of the course began as a COVID-19 mitigation strategy; however, based on feedback from students and improvement in application of technology skills, the instructor adopted the hybrid instructional design format to teach [class] after COVID-19 mitigation strategies were no longer required by Regional State University.

Theme Two: Application Learning Was Pivotal in Acquiring Educational Technology Skills for Future Teaching

The ability to apply educational technology was important to how students learned educational technology skills. Observation notes described a consistent instructor process for teaching educational technology skills in every class: the instructor demonstrated with a specific technology tool or skill, then students practiced the tool or skill with instructor guidance, followed by an asynchronous online application assignment that required application of the technology tool or skill practiced in class.

Five of the eight interviewed students specifically mentioned application learning when asked about how they believed they learned educational technology skills, see Table 10.

Table 10

Application Learning Focused Answers to Interview Question 2

Student Number	Answer
29	"we have a chance to use them, and we have to demonstrate that we know how to use them. So you come to class, you sit and we bring our device and we play with it and [the instructor] gives us class time to play with it, to work so we're competent with it"
36	"I think a lot of it was honestly just hands on with it … if you don't do it, you're not going to remember how to do it. But I actually had to, like, go in and make my own newsletter and I had to go in and make my own Bitmoji and make my own slideshows and my own podcasts … So I think a lot of that helped with actually having to do it"
1	"putting it to work, making sure we really know how to do it and then asking those questions if we need to. It really like actually helps you learn how to do it. And not just in theory, because I can learn a lot of stuff in theory without putting it to work for me"
14	"what you've just been showing us in classes … let's show you what this button does, illustrate what this button does. I'll tell you what this button does. So buttons that I've never touched before and Google Docs, Google slides in any G Suite really know, I know what they actually do"
22	"it was more of a fun way to learn them rather than from the textbook. This is what you're going to do. So hands on, but in an online way"

In answer to the optional open-ended question, post-survey question, *do you have any other feedback or anything else you want to tell me about [class]*, student 25 remarked "I feel the way that [class] was taught was very beneficial. I enjoyed doing the hands-on work."

Theme Three: The Educational Technology Competence of the Instructor of the Course Impacted the Educational Technology Learning of the Students

This research study used the definition of digital competence proposed by Palacios Hidalgo et al. (2020): digital competence refers to a combination of knowledge, skills, and attitudes towards the use of technology to perform tasks, solve problems, manage information, communicate, and collaborate, as well as the ability to share content effectively, appropriately, securely, critically, creatively, and ethically. The instructor of the course demonstrated competence with educational technology in multiple ways, which afforded students the opportunity to learn more educational technology skills and learn more educational technology tools to be used in future teaching. Observation notes showed that the instructor demonstrated a wide variety of digital skills and tools, then demonstrated to students multiple means to use the demonstrated tools and skills in teaching and learning. Further, the instructor demonstrated digital competence through the ability to assist students with troubleshooting technology issues as well, as a thorough knowledge of the tools and skills when answering student questions regarding the demonstrated skills, tools, and application learning. In week five, the instructor shared a digital newsletter with students that the instructor had created using Canva. The students then created Canva accounts while the instructor assisted specific students with problems encountered, while attempting to create their Canva accounts. Once all students had created their Canva accounts, the instructor demonstrated three ways students could use Canva to create digital newsletters. The students were given time to begin creating digital newsletters, while the instructor moved among the students to assist and answer questions.

During the eight sections of the class observed by the researcher, the instructor demonstrated and showed application examples from Google Chrome, Google Drive, Google Slides, Google Classroom, Google Jamboard, Google Forms, Google Sites, Canva, Apple Pages, Adobe Spark, Microsoft Sway, and Canvas. The application journal prompts show the instructor asked students to answer questions regarding Universal Design for Learning (UDL) guidelines, screencasting, podcasting, digital newsletters, digital surveys, digital citizenship, blogging, 3D printing, Fair Use, Google Forms, Google Docs, Google Classroom, Bitmoji classrooms, video creation and video editing, and Flipgrid.

All eight students interviewed mentioned how comfortable the instructor was with all the technology demonstrated in the class and how the instructor was able to work with a variety of educational technology to help students gain educational technology skills with a range of tools, see Table 11. Participants also noted the instructor's digital competence skill in the open-ended question in the post-survey: do you have any other feedback or anything else you want to tell me about [class], see Table 11.

Table 11

Participant Quotes Regarding Instructor Digital Competence

Student Number	Source	Quote
29	Interview	"[the instructor] goes through a section and says, here's this and here's all these applications that go along with this and I'll show you how to use them"
4	Interview	"I think [the instructor] does a good job of explaining it in class and like showing us step by step so that when we're on our own, we have the fundamentals of like the base knowledge so we can explore more of the good stuff, like all the deeper stuff"

9	Post-survey	"I thought you taught the criteria very well and if anyone had questions, you answered them right away"
1	Post-survey	"I love [the instructor] … Teachers who teach like technology things, it's important to have good ones"

Theme Four: Class Culture Affected How Students Acquired Educational Technology Skills

The instructional design of the course encouraged a positive relationship between the instructor of the course and the students in the course, which impacted students' acquisition of educational technology skills. Observation notes showed that the instructor always called students by their names, asked students how they were doing and how they were feeling, and encouraged students to ask questions throughout the class. Some students came to class early or stayed after class to ask questions, even if the questions were not directly related to technology skills or tools. Each class section ended with discussion and reflection, and that discussion and reflection changed as the semester progressed with more participation and more positive comments from students, especially with regards to their own abilities with technology. During week five class observations, students hesitated to offer examples from their own work or comment on the work of others, while during the week 11 class observations students did not hesitate to comment on their own work or the work of others. Further during week five, observation notes showed that out of the 22 students that participated in class discussions, 19 students made comments that focused on negative interactions with technology. By contrast, in week 11 observation notes showed that 26 students participated in class discussion and only three students' comments focused on negative interactions with technology. During the interviews and in answer to the post-survey open-ended question, students commented on how their relationship with the instructor impacted their learning, see Table 12.

Table 12

Participant Quotes Regarding Class Culture

Student Number	Source	Quote
14	Interview	"It was just a very fun, open class. I like the smaller number because it felt like more of a kind of family feel and I like a discussion feel. [the instructor] was an amazing teacher … coming in to [the class], there would be like a breath of fresh air"
36	Interview	"I think [the instructor]'s a great teacher. [The instructor] makes things fun and interesting to do… I'm still learning what I need to learn, but it's not stressing me out. Yeah, I have the opportunity to, like, relax and learn, because I think if students are stressed out and they're learning it, it doesn't help"
1	Post-survey	"I would not have learned as much if it weren't for you and the way you taught us"
29	Post-survey	"I loved this class. I learned so much from it. The best part was always how enthusiastic and excited you were to teach it. It made me excited to learn"
27	Post-survey	"This course was so engaging. I learned so much and had a great experience doing so"

Research Question 2

How do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program perceive that an application journal developed their skills to be used for future teaching?

Data collected to answer the second research question included student interviews, class observation notes, application journal prompts, and application journal responses; two themes emerged from the data to answer the question. Interview questions and answers informed theme one while application journal prompts and application journal responses informed theme two.

Theme One: Students Perceived the Application Journal to be of Limited or No Help in Learning Educational Technology Skills or as a Tool for Remembering Skills

Observation notes suggested that application journal prompts were related to the in-person and asynchronous online learning each week and supplemented instruction on that week's digital tools, topics, and strategies. For example, week five observation notes showed that during in-person learning the instructor discussed digital communication tools and strategies to communicate with families as a teacher. The instructor then facilitated small group, student discussion of digital communication tools and strategies through Google Jamboard. After small group discussion, the class came together and the instructor facilitated whole group discussion of digital communication tools and strategies by having each group share their Jamboard with the class and discuss what they had posted to the Jamboard. During the whole group discussion, the instructor ensured the concept of using data collected from parents/guardians via digital surveys was discussed; two small groups in two different classes introduced the topic of parent/guardian surveys into the whole group discussion without being prompted by the instructor. After the whole group discussion, the instructor demonstrated a way to build digital newsletters with Canva that included a mock parent/guardian survey. The asynchronous online assignment for the week required students to use a digital tool to build a digital newsletter that included a mock parent/guardian survey. The application journal prompts were due before the beginning of each face-to-face class. The application journal prompt for week five was explain why parent/guardian surveys are important . . . what are the potential implications of using them in your classroom?

Interview question number four asked students if they felt the application journal helped them learn educational technology skills and why or why not. Three of eight students interviewed felt the application journal was of limited help in learning educational technology skills, see Table 13, while four of the eight interviewed students perceived the application journal to be more helpful to remember skills and tools, rather than a way to learn skills and tools, see Table 14. Only one of the interviewed students perceived the application journal as a helpful learning tool, Student 15, who commented "I think I definitely learned more from the questions that [the instructor] has us answer [in the journal prompts]."

Table 13

Application Journal of Limited Help Focused Answers to Interview Question 4

Student Number	Answer
39	"Yeah, I feel like some of the entries on it did because some of them were more questions than the other ones were like actual technology things we didn't link to the application journal"
36	"I think I would know as much as I do if I didn't do the application log … but I do think that … some of it does help a lot"
14	"Yes and no. It definitely makes me go out of my way to find these answers to questions that I probably wouldn't personally have thought of … but maybe if it was directly tacked on to the assignment, it would have helped me a little bit more"

Table 14

Application Journal as Memory Aid Focused Answers to Interview Question 4

Student Number	Answer
1	"I don't think necessarily the application journal itself is helping us. I think doing it is a good way to recap the skills that and like summarize it briefly. And it's a good thing for us to be able to go back on like in a couple of years. … doing that alone, I wouldn't say, is helping me learn the skills. It's a good way for me to remember
4	"I don't know that it's helped me learn … it's maybe a good refresher to go back on later. ... I don't think I had an immediate effect"
22	"it was kind of yes and no … I'm sure there are some things because those links might be helpful to go back. And I have research ... Probably not for use till next semester"
29	"I think it's more applicating at the time. It's not a bad idea to think to think about"

Theme Two: Students Went More In-depth with Educational Technology Skills Through the Application Journal

In contrast to the answers of seven of the eight interviewed students, the application journal prompts and responses showed that students went into more detail and interacted more fully with certain educational technology tools and skills and considered how those skills will be able to be implemented in future teaching and learning through the application journal. For example, week five journal prompts asked students to explain why parent/guardian surveys are important and what the implications of using surveys in their future classrooms could be. While the asynchronous online assignment for week five had students create a digital newsletter with a parent/guardian survey, which ensured that students demonstrated proficiency creating a survey, the application journal prompt encouraged students to consider why using parent/guardian surveys may be important in their future classrooms. The student answers to the week 5 journal prompt revealed that students had to consider the purpose of parent/guardian surveys and consider why the use of parent/guardian surveys in their future classrooms would be important to teaching and learning, as well as clear parent/guardian communication. The week 5 journal prompt pushed students to explain why parent/guardian surveys matter, which went beyond the basic fluency skill of the ability to create surveys, see Table 15.

Table 15

Student Answers to Week 5 Journal Prompt

Student Number	Answer
1	"Parent/guardian surveys are a very easy, convenient way for a teacher to communicate with children's parents. They can be used for class data such as student and parent names and contact information; surveys about class parties; and even feedback on an assignment from the parent perspective. By using these, parents/guardians will feel as though they are building a strong relationship with their child's teacher and will feel actively involved in their child's education"
31	"it gives the parents a voice. Not only do they know what is going on in the classroom or what will go on, but they feel that they have the option to be in contact with the teachers. A survey allows parents/guardians to voice any concerns or worries they may have for their students. At the end of the day, they are the ones who know the most about their students"
40	"Parent/guardian surveys are important so that you can build a relationship with the parent or guardian. … These surveys are also important to gather contact information, allergies, interests, and values that their students possess. As teachers, we need to be inclusive to all students in the classroom"

The 28 journal prompts asked questions about Bitmoji, UDL guidelines, screencasting, communicating with parents, Google Forms, digital citizenship, Google

Classroom, podcasting, video creation and editing, and 3D printing. UDL, screencasting, Google Forms, digital citizenship, Google Classroom, podcasting, and video editing and were also skills measured in the pre- and post-surveys. The 34 of 38 students that submitted post-surveys either marked themselves as an expert in the pre- and post-surveys or demonstrated growth in UDL and digital citizenship. Thirty-three of 34 students either reported being an expert in Google Forms on the pre- and post-surveys or showed growth in Google Forms. Twenty-eight of 34 students either marked expert on the pre- or post-surveys or showed growth in Google Classroom, while 31 of 34 students either claimed expert status with screencasting on the pre- and post-surveys or showed growth with screencasting. Thirty-two of 34 students reported being an expert in podcasting and video editing on the pre- and post-surveys or showed growth in podcasting and video editing.

Table 16 denotes how students responded to the week 4 journal prompt, “describe a specific example of how a teacher could use screencasting for teaching a mathematics concept” and “describe a specific example of how students can use screencasting as a form of student action and expression.” Further, Table 16 indicates how students had to connect the use of screencasting for teaching and learning to UDL principles to enhance the learning of their future P-12 students. Table 16 compares the self-perceived student skill level with screencasting tools reported by the student in the pre-survey with the self-perceived skill level with the same tools on the post-survey. Growth with the tool is demonstrated by the quotes in the table. Table 16 demonstrates that students had to stretch beyond the digital fluency skill of creating a screencast and think about how screencasting could improve teaching and learning in their future classrooms through in-depth thinking regarding the use of screencasting in their future classrooms.

Table 16

Student Answers to Week 4 Journal Prompt with Perceived Skill Levels

Student Number	Pre-/Post- Skill Level	Answer
11	New/Expert	"A teacher can use screencasting for teaching a mathematics concept by showing example work while talking about what was wrong and how it was wrong and what was right. The teacher can also record her voice teaching the math lesson while being on a website that shows math problem examples. Students can use screencasting as a form of student action and expression by including their voice and opinions and you get to hear their process while they are recording their screen"
17	Know a Little/Comfortable	"A teacher could use screencasting to teach mathematics by recording her screen when they are writing a formula or solving a problem. It would be easier for the students to see what the teacher was doing rather than the teacher just talking about it"
27	Know a Little/Expert	"A teacher could use screencasting for teaching a mathematics lesson by utilizing this technology on an iPad. By using a drawing function, a teacher can visually complete the work for students to follow along with. She can break down the steps and model the method students should be utilizing"
33	Know a Little/Expert	"An example of how a teacher could use screencasting for teaching a mathematics concept consists of providing students with a video of h

		how to work through homework a assignments. … By providing s students with a link to the video … the students would have immediate a access to their teacher's explanations if they find themselves stumped on a math problem at home"

Table 17 illustrates student responses to the journal prompt for week six which asked students to

> think about and identify 3 related issues or challenges that children, teens, young adults or adults may face in regard to the digital world; identify one potential teaching challenge or concern related to integrating digital citizenship lessons into your classroom; and explain a possible solution for overcoming the challenge stated above.

Further, Table 17 compares the self-perceived student knowledge level of digital citizenship topics reported by the student in the pre-survey with the self-perceived knowledge level of the same topics on the post-survey. Growth in knowledge about the topic of digital citizenship is demonstrated by the quotes in the table.

Table 17

Student Answers to Week 6 Journal Prompt with Perceived Skill Levels

Student Number	Pre-/Post- Skill Level	Answer
3	Comfortable/Expert	"… One potential challenge or concern I have about integrating digital citizenship lessons into my classroom is that students may think they only need to follow digital citizenship procedures when they're at school and not when they are at home. One solution I could use for students not thinking they need to be digital citizen when at home is lessons that reflect what they should

		do online when they are at home and how to be safe while using the Internet at home”
24	New/Expert	“… One potential teaching challenge related to integrating digital citizenship lessons into my classroom is the lack of interest … They are so comfortable with the Internet and social media, they don’t understand the dangers… It would be a challenge to get the students to understand how important these issues are to not only protect t themselves now, but also their future. A possible solution for overcoming the challenge … could be to bring in people they know to share bad experiences they had o online… Bringing the topic close to home may inspire them to take digital citizenship more seriously…
23	New/Expert	“… One potential teaching challenge … while teaching digital citizenship would be explaining how strangers can exploit children for information … on the Internet … it will be hard to get the students to understand that strangers are not always nice … A possible solution to my problem would be to … use an example like if they had something they are not allowed to share like a Chromebook that some people would try to ask for it but it is important to say no …

The Week 10 journal prompt asked students to, “describe one way that video recording/editing can be used for teacher instruction . . . (go beyond screencasting or using video streaming - YouTube as examples)” and reply with a video response in Flipgrid. The observation notes showed that the instructor ensured the application journal prompt(s) were directly related to the face-to-face and online work for each week.

In week four, class instruction, demonstration, and discussion focused on using Google Forms and other survey tools to create parent/guardian surveys and in week five class instruction, demonstration, and discussion focused on using technology tools to create newsletters and facilitate communication with families, as well as ways to use the results from parent surveys to foster communication with families. The application journal prompt for week five asked students to explain the importance of parent surveys and potential implications of using parent/guardian surveys in their future classrooms. The online work for week four required students to create a parent/guardian survey, share it with at least two classmates, then take at least two parent/guardian surveys that had been shared by other classmates, while the online work for week five has students create an example class newsletter that could be shared with parents/guardian that leveraged information collected in the parent/guardian survey.

Research Question 3

How do opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program regarding teaching with technology change during an educational technology class?

Theme One: Students' Opinions about Teaching with Technology Became More Positive as Students' Ability to Teach with Technology Grew

Data collected to answer the third research question included class observations, pre- and post-surveys, interview questions, and the first and second Modified STEBI-B; two themes emerged from the data to answer the question.

Class observations showed class discussions and group reflections became more positive between week five and week 11 as students grew more confident in their educational technology skills. Week five students were hesitant to comment on their own work or the work of others and when they did participate, the comments were focused on negative aspects of their interactions with technology. However, in week 11, students were eager to comment on their own work or the work of others and were focused on positive aspects of the technology or skills applied in class. The overall average score for the first Modified STEBI-B was 5.66, while the overall average score for the second Modified STEB-B was 9.26; a difference of 3.60, see Table 18.

Table 18

Growth in Opinions About Educational Technology as Measured by the Modified STEBI-B, by Student

Student	Score 1	Score 2	Difference
1	6	11	5
2	11	15	4
3	6	14	8
4	7	6	-1
5	7	14	7
6	5	12	7
7	8	8	0
8	6	6	0
9	0	3	3
10	7	7	0
11	8	6	-2
12	3	7	4
13	4	8	4
14	6	10	4
15	1	4	3
16	8	8	0
17	4	5	1
18	4	8	4
19	10	11	1
20	7	9	2
21	8	12	4
22	3	10	7
23	3	11	8
24	8	12	4
25	3	7	4

26	11	8	-3
27	7	12	5
28	5	11	6
29	8	11	3
30	8	11	3
31	7	12	5
33	-1	7	8
34	6	9	3
36	5	9	4
37	-5	14	14
38	8	9	1
39	7	13	6
40	6	7	1
Average	5.66	9.26	3.60

The eight Modified STEBI-B statements linked self-efficacy with technology to opinions about technology. The first Modified STEBI-B was given weeks one and two of class and the second in weeks 15 and 16. Thirty-one students showed overall growth, four students showed no growth, and three students showed negative growth; statements number four and seven reflected the most growth, see Tables 18 and 19.

Table 19

Change in Opinions Regarding Educational Technology as Measured by the Modified STEBI-B, by Question

Question	Number of students with positive changes	Number of students with negative changes	Number of students with no change
1	7	2	29
2	17	4	17
3	17	2	19
4	22	3	13
5	14	6	18
6	18	2	18
7	23	6	9
8	13	4	21

Statement number four, I understand educational technology concepts well enough to be effective in teaching early childhood, elementary, and exceptional child students, showed 22 students with growth, as 36 of 38 students marked strongly agree or agree, one student marked undecided, and one student marked disagree on the second Modified STEBI-B as compared to the first Modified STEBI-B, where 21 students marked strongly agree or agree, 11 students marked undecided, and six students marked disagree.

Statement number seven, I wonder if I will have the necessary skills to teach with educational technology, showed 23 students with growth, as on the second Modified STEBI-B 25 of 38 students marked disagree or strongly disagree, seven students marked undecided, and six students marked agree. By comparison, on the first Modified STEBI-B five students marked strongly disagree or disagree, nine students marked undecided, 18 students marked agree, and six students marked strongly agree.

Interestingly, the statement that showed the most negative growth, seven students, was statement two, even if I try very hard, I will not teach with technology as well as I will without technology. On the first Modified STEBI-B eight students marked strongly disagree, 12 students marked disagree, 11 students marked undecided, four students marked agree, and three students marked strongly agree, while on the second Modified STEBI-B four students marked strongly disagree, 19 students marked disagree, eight students marked undecided, four students marked agree, and three students marked strongly agree.

The statement with the least growth was statement one, I will continually find better ways to teach with technology, however, statement one also had the most students, 37 of 38, that marked strongly agree, 29, and agree, eight, and one student that marked disagree on the first Modified STEBI-B while on the second Modified STEBI-B all 38 students marked strongly agree and agree; 32 students marked strongly agree, and six students marked agree.

Theme Two: Growth in Perspective, Mindset, and/or Abilities

One of the open-ended questions on the post-survey asked with regards to instructional and assistive technology, explain how your perspective, mindset, and/or abilities have changed over the course of the semester. 33 of 34 students that submitted the post-survey reported that they had a shift in their perspective, mindset, or abilities with regards to teaching with technology, see Tables 20 and 21. Further, of the 18 students that reported the most growth, 28 points or more, 17 students reported a shift in perspective, mindset, and or abilities, see Tables 20, 21, and 22.

Table 20

Self-perceived Growth in Educational Technology Skills Compared to Self-reported Shift in Perspective, Mindset, or Abilities

Student Number	Total points of growth for 19 skills pre- to post-survey (57 possible points)	Reported positive shift in perspective, mindset, or abilities
1	13	Abilities
2	33	Abilities
3	32	Perspective, Mindset, Abilities
4	26	Abilities
5	24	Perspective, Mindset, Abilities
6	36	Abilities
7	27	Mindset
8	28	No shift reported
9	28	Perspective
10	21	Abilities
11	35	Abilities
12	19	Mindset
13	30	Abilities
15	25	Abilities
16	29	Abilities
17	28	Abilities
18	35	Abilities

19	24	Abilities
20	-1	Perspective
21	21	Mindset
22	32	Perspective
23	31	Abilities
24	48	Perspective, Mindset, Abilities
25	32	Mindset, Abilities
27	30	Abilities
28	15	Perspective, Abilities
29	23	Perspective, Mindset
30	14	Abilities
33	30	Perspective, Mindset, Abilities
34	36	Abilities
36	21	Perspective, Abilities
37	17	Abilities
38	19	Perspective, Mindset, Abilities
39	41	Abilities

Note. This table includes data for 34 of 38 students. Four students did not submit a post-survey so no data was available. The total points of growth for each student were calculated by adding a point for each step of growth a student reported for each skill from the pre- to post-survey.

Table 21 compares the number of growth points demonstrated by students on the pre- and post-surveys to student answers to how or why students believe their perspective, mindset, or abilities regarding technology have changed. Table 21 further connects student growth points with student descriptions of changes to perspective, mindset, or abilities regarding technology. Student 1 reported that their belief in their ability changed through growth in skill, while Student 5 related their perspective, mindset, and abilities had grown due to learning more educational technology skills and tools. Student 7 related their shift in mindset to being more confident with teaching and technology, while Student 9 relayed that their perspective shift was based on their enhanced learning of technology skills, see Table 21.

Table 21

Responses to How Perspective, Mindset, or Abilities have Changed

Student Number	Growth Points	Answer
1	13	"I truly believe in myself and my abilities to use technology, of any kind, in my classroom. At the beginning of the semester, I definitely felt as if I was not savvy enough"
5	24	"I feel as though my perspective, mindset, and abilities have grown and improved … I love that I was able to learn about some super helpful programs and tools"
7	27	"My mindset has definitely changed drastically. I used to be … intimidated by teaching with technology but now I feel much more comfortable and confident …"
9	28	"My perspective of … technology has changed quite a bit throughout the semester. I never realized so much goes into teaching with technology. … I learned how to work with technology that I had not really worked with yet, but I knew I would need to in the future"

Table 22 connects student growth points of students with the highest growth points with student description of changes to perspective, mindset, or abilities regarding technology. Student 6 had 36 growth points and pointed to their enhanced knowledge of accessibility features as key to how their abilities with technology have changed, while Student 24 had 48 growth points and related their increased ability with UDL principles to their increased ability with educational technology skills. Student 25, with 32 growth points, reported a shift in mindset, due to better understanding how technology can be used in their future classroom, as well as an increase in ability, due to increased confidence in their use of technology tools. Student 39 had 41 growth points and relayed that their ability to use instructional and assistive technology grew with their comfort level using those technologies, see Table 22.

Table 22

Responses to How Perspective, Mindset, or Abilities have Changed in Students with the Most Growth

Student Number	Growth Points	Answer
6	36	“I feel like I have enough ability now to help my students who may have a disability still be able to use technology. I know how to get to those features and what those features do”
24	48	“… I had also never heard of UDL guidelines and I am very confident in my ability to incorporate this in my teaching”
25	32	“My mindset has changed because before [class], I didn’t know how much technology could be used within the classroom … My abilities have changed as well … Now, I feel very confident that I could use more technology tools than I could before”
39	41	“My abilities to use instructional and assistive technology have grown greatly. I feel a lot more comfortable using technology and teaching it”

During the interviews, students mentioned growth in mindset, perspective, and or abilities multiple times in answer to three interview questions. The questions were what is the most important thing you have learned in class, question seven, and when asked if there was anything else they would like to share about [class], question eight, and has your belief in your skills with teaching with technology changed since the beginning of [class], why or why not, question 6, see Table 23.

Table 23

Growth in Mindset, Abilities, or Perspective Answers to Interview Questions 6, 7, and 8

Student Number	Question Number	Answer
1	7	"I think kind of the whole mindset of it's [using technology for learning] easy. It's actually really easy"
4	7	"there's more out there for me like that will help me as a teacher … I still need to learn every day … before I just I wouldn't even know where to start"
29	7	"more growth mindset about technology. I'm definitely going to keep at it and I'm going to keep going on after this class … I realize it's going to be an ongoing process"
22	8	"at first I was like, Oh, I don't want to take it [class] because I don't like technology … in fact, I caught up a little bit [with P-12 students in the field"
1	6	"Yeah, I liked technology before, I like being able to use it but I was not very good at it at all. … But learning how to like hyperlink things and make Slides pretty and podcast and video and so I definitely learned way more and I've gotten way better at effectively using technology'
29	6	"Oh yes. I'm much more I'm doing much better now than, than the first day I remember I went to [class] and I sat down and I couldn't even sign on Canvas. I didn't e even know how to use it. I didn't even know how to use Kahoot. I mean it was bad. So I'm definitely doing much, much better than I was"

The interview answers quoted in Table 23 demonstrate student self-perceived growth in perspective, mindset, or abilities with regards to technology. Student 1 had 13 growth points, student 4 had 26 growth points, student 29 had 23 growth points, and student 22 had 32 growth points, so all students that mentioned growth in perspective, mindset, or abilities in their interview question answers showed positive skill point growth.

Research Question 4

How do prior technology skills affect the opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program learning educational technology skills to be used for future teaching?

Data collected to answer the fourth research question included pre- and post-surveys and interview questions; one theme emerged from the data to answer the question.

Theme One: Prior Technology Skills Impacted Opinions of Students Who Showed Growth

Interview question five asked, have your opinions about teaching with technology changed since the beginning of [class] and why or why not. This data was compared to growth in educational technology skills measured by pre- and post-surveys, see Table 24.

Table 24

Self-perceived Growth in Educational Technology Skills in Interviewed Students Between Pre- and Post-surveys, with Expert Ratings

Student	Total points of growth for 19 skills pre- to post-survey (57 possible points)	Number of skills marked expert on pre- and post-survey
1	13	4
4	26	0
15	25	0
22	32	2
29	23	0
36	21	4
39	41	0

Note. Data for seven of eight interviewed students. The total points of growth for each student were calculated by adding a point for each step of growth a student reported for each skill from the pre- to post-survey.

Three out of eight interviewed students revealed that their opinions regarding teaching with educational technology had changed in a positive manner over the course of the semester, while three of the eight interviewed students stated that they always believed that teaching with technology was important. One of the interviewed students, Student 15, answered that their opinion had not changed, even though that student showed growth in skills, see Table 24. The eighth interviewed student, Student 14, reported five skills as New, six skills as I know a little about this, six skills as I have learned about this in other courses or on my own and am fairly comfortable with this, and two skills as I am an expert and can teach others about this topic on the pre-survey; but, Student 14 did not submit a post-survey, so there was no way to determine growth in technology skills.

The three students that reported during interviews they felt that their opinions about teaching with educational technology had changed in a positive manner during the class, students 4, 22, and 36, all had over 20 points of growth, 26, 32, and 21 respectively. Further, student 4 reported nine skills as new, eight skills as I know a little about this, and two skills as I have learned about this in other courses or on my own and am fairly comfortable with this on the pre-survey; but, reported all skills as I am comfortable with this in the post-survey. In answer to interview question 5, student 4 stated “I would say yes, just because . . . I didn't have a lot of experience with it [technology]. So I didn't have much opinion before. I feel like it's a great thing, . . . before there's just a lot of the stuff, I didn't even think about doing or using, because I had never had it done with me. I feel like I have more of an opinion now. . . . So, I think it's a great thing that is very helpful, especially like the special education world, which is where I'm going.” On the pre-survey, student 22 reported six skills as new, seven skills as I know a little about this, four skills as I have learned about this in other courses or on my own and am fairly comfortable with this, and two skills as expert, while on the post-survey student 22 reported five skills as I am comfortable with this and 14 skills as I am an expert and can teach others about this topic. In response to question five in the interviews, student 22 replied

> I'm a lot more comfortable with it [technology] now . . . I'm not a tech savvy person. I learned that from the beginning. I was like, I can't do that, but I can do it . . . I do feel like I've definitely progressed . . . I know how to use a majority of the bases . . . I do still have things to work on, but I feel like it's definitely improved since the beginning

Student 36 reported seven skills as new, five skills as I know a little about this, two skills as I have learned about this in other courses or on my own and am fairly comfortable with this, and five skills as expert on the pre-survey. On the post-survey, student 36 reported four skills as I know a little about this, five skills as I am comfortable with this, and ten skills as expert, then answered interview question five with

> Yes, . . . I think that a lot of teachers think . . . it's scary to use technology and it's not even that I don't know how to use it. It's like when you give it to children, are they going to be able to use it and are they going to use it appropriately? . . . I think it helped a lot just because technology gives you access to accommodate or modify to those who need it . . . so my opinion changed.

There were commonalities between skills reported on the pre- and post-surveys among all three students: on the pre-survey students 4, 22, and 36 reported Google Site, Digital Citizenship, Media Licensing, and VR/AR as new skills and Google Forms as I know a little about this while on the post-survey all three students reported coding as I am comfortable with is, which reflected growth for all three students.

Table 25 shows the answers to interview question five from students whose opinions did not change regarding educational technology but who stated they always felt educational technology was important.

Table 25

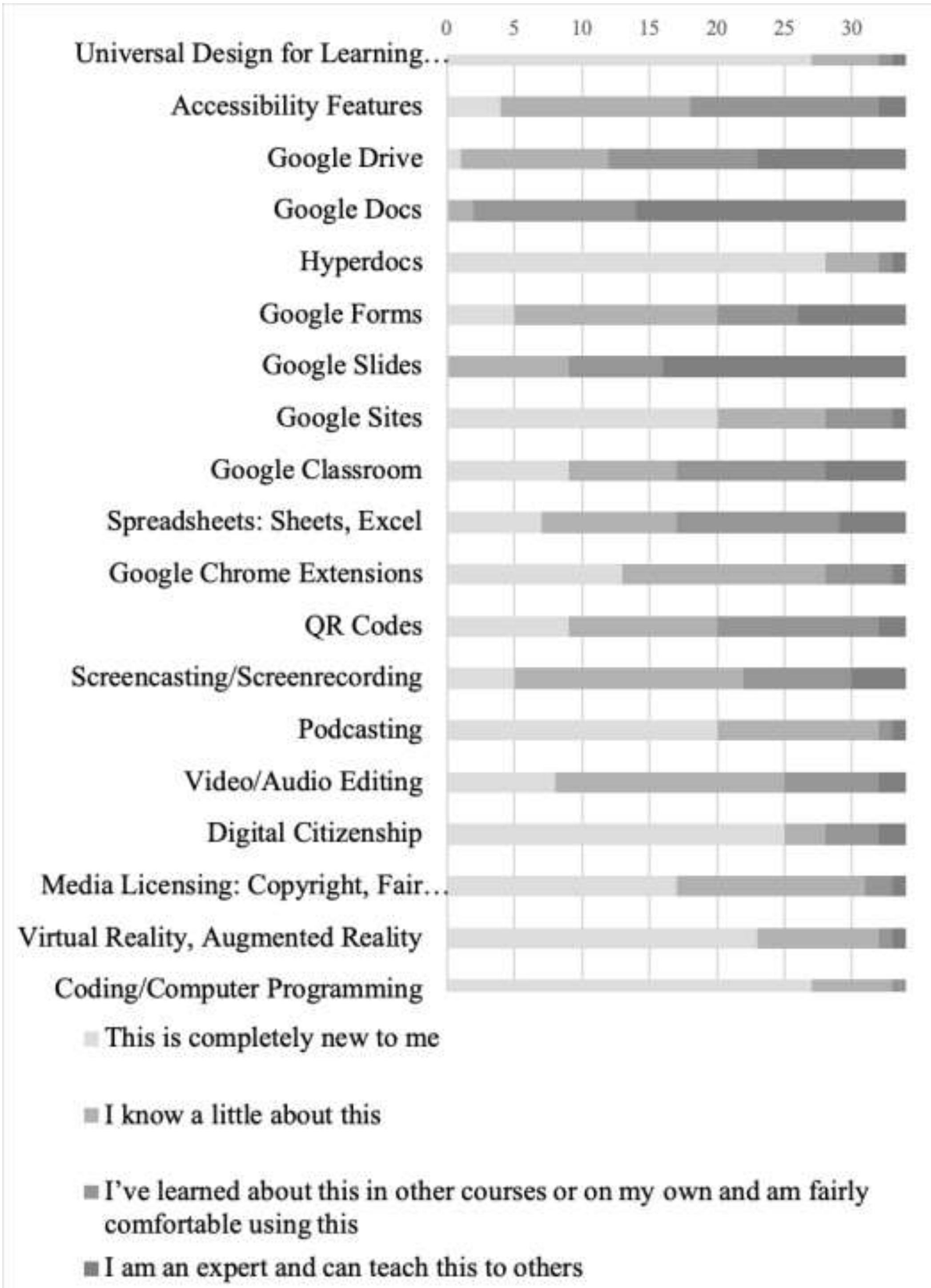
Interviewed Students with No Opinion Change

Student Number	Answer
29	"I have the technology and to ignore that kind of a resource, it's just crazy if you really want to reach everybody because you can … I think that a lot of times the people with disabilities and things were overlooked and that technology can help you so much … I knew it was important, I didn't realize quite how much you could really do with it"
1	"not so much changed. More so been enforced … I want to use technology, but like I said, kind of the only way that I really knew how was like slides and finding YouTube videos things. So, having this class, I know that, yes, I still want to do it. I really like it. But now I know more ways"
39	"I've always thought technology is very important to teach with because there's always new technology and kids are going to need to know how to use it"
14	"I always thought technology was the way to go … I love seeing them [students] being able to do things on the Chromebooks almost better than I can do anything … I love all the new t technologies coming out … I think I'm just excited to see what the future can bring and how we can integrate the current tools into the classrooms

The pre-survey asked students to rate their skill level on 19 educational technology skills. The skill levels were, this is completely new to me, I know a little about this, I've learned about this in other courses or on my own and am fairly comfortable using this, and I am an expert and can teach this to others. The post-survey asked students to rate the same 19 educational technology skills with the skill levels, I know a little about this, I am comfortable using this, and I am an expert and can teach this to others. Figure 4 shows the self-perceived skill level in the 19 measured skills at the beginning of the semester for 34 of 38 students. Four students did not submit a post-survey, so their data is not included.

Figure 4

Student Self-perceived Educational Technology Skills at the Beginning of the Semester



Additional Results

Application of Educational Technology Skills to Real-world Situations

While analyzing data, the researcher also identified themes outside the original purview of the study. One theme that emerged from data that was not directly tied to the research questions is that students felt that the educational technology skills they learned in the class had immediate applications to other classes and their field experiences, as well as their future classrooms. Data collected to demonstrate this theme included the post-survey open-ended questions, interview questions, and Philosophy of Educational Technology Integration Statements.

Several students responded to the optional open-ended question: do you have any other feedback or anything else you want to tell me about [class], with answers regarding the ability to apply their learning to other classes or real-world situations, as well as feeling more confident to do so, see Table 26. These responses suggest that students see a connection between the fluency skills learned in class to teaching and learning in future classes and their future classrooms.

Table 26

Responses to Second Open-ended Question

Student Number	Answer
5	"… Overall, everything in this class was really interesting and fun to apply to real-life situations"
6	"… This class is also very useful technology wise for a future teacher"
7	"I will definitely take the skills I learned in this course with me to my future teaching career and the rest of my college experience"
24	"it is so nice to have the confidence to integrate technology into my [future] classroom"

Students responded to four interview questions with responses related to using the technology tools or skills learned in [class] in real-world settings and/or other coursework. These responses were to interview question eight, is there anything else you would like to share with me regarding [class], interview question one, what educational technology skills do you believe you have learned in [class], interview question seven, what is the most important thing you have learned in [class], and interview question six, has your belief in your skills with teaching with technology since the beginning of [class]; why or why not, see Table 27. Student responses to these interview questions also suggest that students see a connection to fluency skills learned in class to teaching and learning in future classes and their future classrooms.

Table 27

Application of Tools and Skills Answers to Interview Questions 1, 6, 7, and 8

Student Number	Question Number	Answer
29	8	“the biggest thing that I got out of class … I think there might be a tool out there for that … It’s a mindset shift of oh, wait, there m might be an electronic resource out there that I can use to do this better”
1	1	“I definitely learned how to like podcasts a and like there's actual equipment and editing websites and things like that. I learned how to use it in my classroom … how to better use technology more than just like Slides … like learning more ways you can use technology in a classroom”
15	1	“probably more about how to use Google classroom. And in the field. … like what the teacher side looks like”
39	1	“the technology between the different classes. I feel like I've learned a lot more

		about Google Drive because I didn't really know that you could, like, organize it so much”
22	7	“basically that I have all of these tools at my disposal, not to just keep using the same thing … when we make our survey to send out to parents I can make it interactive”
4	6	“100% … I know about … a lot more things that are out there that I can use and how I can use them and how they're beneficial on the other side and not just, oh, I can use this thing. I know why it's good and how they [students] can use it, and how it benefits the student and not just me having to use it”
39	6	“I didn't think I'd be able to use all the different technology or at least like remember how to use it. But once you get it once or twice, you can kind of do it and teach it”

In their Philosophy of Educational Technology Integration Statements, several students commented on how educational technology tools and skills learned in class will be able to be applied in future field experiences and teaching. Quotes that supported this theme are included in Table 28.

Table 28

Student Comments in Philosophy of Educational Technology Integration Statements

Student Number	Comment
7	“… there is just so much you can do with it [technology] and it is a great way to not only use creativity and critical thinking skills as a teacher but also for the students”
10	“… technology can be such a powerful tool for students … the use of technology offers so many benefits that will help out students in the long run”

13	"… I think it is vital to integrate technology into the classroom, t there are so many different platforms that will help you teach, and the students learn"
16	"Integrating technology into the classroom sharpens student critical thinking and collaboration skills while also developing independence and digital literacy. … I especially identify with the idea of reimagining learning in the classroom rather than digitizing traditional learning. I am equipped to use Google, Microsoft, and Apple …"
26	"… technology can be implemented in a number of ways to I improve student learning and skills development… teachers uphold the responsibility of modeling proper use of technology and shaping students into internet-safe citizens"
30	"… I want to use … the AR [augmented reality] instructional strategy, having my students use their iPad to scan things around the room to see how the body works or what animals look like up c close"

Students Believe They Have Learned More Educational Technology Skills Than Those Listed in the Curriculum

Another theme developed from data not related to a research question is that participants believe they have learned more educational technology skills through Instructional and Assistive Technology in a Universally Designed Learning Environment than the educational technology skills listed in the curriculum or syllabus of the class. Data collected to demonstrate this theme included interview questions, Philosophy of Educational Technology Integration Statements, and post-survey open-ended questions..

When asked interview question one, what educational technology skills do you believe you have learned in [class], three student answers included skills and tools not listed in the syllabus or curriculum and when asked interview question seven, what is the most important thing you have learned in [class], three students replied with educational technology tools or skills not listed in the syllabus or curriculum, see Table 29. Student answers to interview questions one and seven indicated that students implicitly learned educational technology tools and skills not explicitly covered by the topics listed in the syllabus, however, students were not specific as to how these skills were learned.

Table 29

Other Educational Technology Tools and Skills, Interview Questions 1 and 7 Responses

Student Number	Question	Answer
4	1	“Before [class]? I don't even know half of the things that has even existed … [in high school] we didn't use Google except for a search engine. … So I think I've learned a lot because I just didn't know they were out there”
14	1	“now I understand more about how to use … Google Sites … I got more in depth. … I've also got more of an understanding of the more professional side when it comes to like Office. … But I'm learning … the new technologies being used in classrooms these days. … So I think just some of these skills are some of probably the most handy ones I've learned, because this is going to be such a good way to actually be able to show students what we might be going over and things like virtual field trips as well”
22	1	“I've learned that there's more Google products than I was aware of, like Google Meet. So just utilizing what I have instead of looking for outside sources, I have them right there to use”
15	7	“how much technology there is and how much you … will use it in class”
22	7	“ basically that I have all of these tools at my disposal not to just keep using the same thing”
29	7	“all the different ways that I can reach students and all the different ways that they

		can give me feedback and projects and ideas ”

In the post-survey open-ended questions and in their Philosophy of Technology Integration Statements, participants also mentioned technology tools and skills not listed in the course syllabus or curriculum. Participants gave examples of technology integration skills, listed examples of an understanding of the need for continuing professional development regarding technology tools and skills, and using technology to teach both effectively and innovatively, see Table 30.

Table 30

Other Educational Technology Tools and Skills, Post-survey and Philosophy of Technology Integration Statements

Student Number	Source	Quote
3	Post-survey	“I have learned so much about different ways I can integrate technology in my future classroom and feel much more comfortable with technology than I did before this semester. Even with things I already felt comfortable with, such as Docs and Slides, I have been able to further my knowledge even more in order to give my future students the best experience with technology in my classroom
8	Philosophy of Technology Integration Statement	“When I finally become a teacher I will be using technology every day in my teaching … technology is always changing. Since it always changing I will continue to advance … it is important to me to keep up to date on technology so my students can be the best they can be [with technology]”
20	Philosophy of Technology Integration Statement	“We have to integrate [technology] as well as do our best to innovate how we teach and what we teach. I will do my darndest to stay ahead of the ever growing tech curve that we see ourselves in and make great strides to

	maintain a classroom that fosters the creative nature of students and allow access to the best and finest tools and technology … We need to harness the power of tech and use that to teach in the most effective ways we can”

Summary

In summary, Research Question One, how do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program acquire educational technology skills to be used for future teaching, was informed by four themes. The first theme was that students’ acquisition of educational skills was tied to the instructional design of the course. The instructional design of the course affected students’ ability to gain educational skills by being half face-to-face and half online, by being consistent in format, by the instructor demonstrating skills and providing guiding practice, and by the course being laid out in the online learning management system in an organized, student centered manner. The second theme revealed that students believed that interacting with the educational technology through consistent hands-on practice was key to acquiring educational technology skills. The third theme was that students perceived that the educational technology competence of the instructor was tied to students’ acquisition of educational technology skills. The last theme that informed research question one was that the relationship between the instructor and the students impacted student ability to acquire educational technology skills for future teaching.

Research Question Two, how do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program perceive an application journal developed their educational technology skills to be used in future teaching, was informed by two themes. First, the application journal encouraged students to interact with educational technology tools and skills more in-depth and second, students perceived the application journal was more helpful in helping students, as a research tool and a way to remember the details about educational technology tools and skills, rather than a mechanism for acquiring educational technology skills for future teaching. The third research question, how do opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program regarding teaching with technology change during an educational technology class, was informed by the theme that opinions of students with regards to teaching with technology became more positive as the students' educational technology skills grew. The last research question, how do prior technology skills affect the opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program learning educational technology skills to be used for future teaching, was informed by the theme that students either started with the opinion that educational technology skills were important to teaching or changed their opinion to believe that educational technology skills were important to teaching after the opportunity to grow their educational technology skills, regardless of their self-perceived technology skills at the beginning of the semester.

Three other themes that emerged from the data that were not related to the research questions were that students felt that their perspective, mindset, and or abilities with regards to educational technology had changed over the semester, that the educational technology skills they learned had real-world applications in their future classes, their work in the field, and their future classrooms, and that students believed they had learned more skills than those specifically listed in the class curriculum or syllabus. These themes inform the profession of teacher education by assisting elementary, early childhood, and exceptional child educator programs in understanding how to structure the format of educational technology classes and how to aid students in learning educational technology skills to be used in future teaching. The next chapter provides suggestions for how to use this data to best prepare preservice educators to teach with technology.

Chapter Five: Discussion and Recommendations

Introduction

This fully qualitative case study used observations, interviews, student application journals, student Technology Integration Philosophy Statements, a Modified STEBI-B, and pre- and post-surveys to answer four research questions to discover how students in an elementary, early childhood, and exceptional child educator preparation program learn educational technology skills to be used in future teaching, how students perceive that an application journal helped them develop their educational technology skills, as well as whether the opinions of students learning educational technology skills regarding educational technology skills changed during an educational technology class and if prior technology skills affected the opinions of students in an educational technology class regarding technology for future teaching. The findings showed that multiple factors impacted students' learning of educational technology skills, including learning design of the technology course, hands-on learning of educational technology during the class, the competence of the instructor of the class with educational technology, and that the relationship between the instructor and students was important.

Students reported that the application journal was of more use as a tool for remembering educational tools and skills, while the application journal prompts and entries demonstrated that students had to interact more deeply with certain educational technology skills and tools through the journal. The Modified STEBI-B showed that students' opinions regarding teaching with technology changed in a positive manner during the class. Interview questions and the pre- and post-surveys of educational technology skills showed that students' prior technology skills either influenced students' opinions in positive ways or reinforced students' positive opinions regarding educational technology to be used in future teaching.

Interpretations of Results

Research Question 1

How do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program acquire educational technology skills to be used for future teaching?

Hybrid Instructional Design of the Educational Technology Class Impacts Learning

The two sections of Instructional and Assistive Technology in a Universally Designed Learning Environment in the study were designed in what the instructor called A-B format: the course was a two-day-a-week course, however, students attended face-to-face one day and were required to do online work for the second day, so that day one the A group students were face-to-face and the B group students had online work, while the second day the B group students had class face-to-face, while the A group students had online work. The AB format also allowed for smaller class sizes during the face-to-face portion of class. Seven of the eight interviewed students specifically mentioned the mix of face-to-face learning and online learning as key to learning educational technology skills, while observation notes showed that the instructor demonstrated technology skills then allowed time for students to practice with the technology skills while the instructor was available to give face-to-face assistance. Guided practice was followed by student independent practice on the same technology skills, through the asynchronous online work. This consistent flow of demonstration, guided practice, and independent practice allowed students to develop educational skills needed to use technology independently when teaching in their own classroom. Another way the instructional design impacted students' ability to acquire educational technology skills was the consistency of the online and face-to-face course formats, the connection of each face-to-face-class with prior and future learning, and that goals were made clear and connected to learning objectives, as described in the observation notes. Students commented on the consistency of the class format and the consistency of the course design in the online learning management system in the open-ended questions on the post-survey.

Application Learning is Crucial to Learning Educational Technology Skills

The observation notes showed that the instructor was consistent every week in demonstrating specific educational technology tools or skill then giving students time for guided practice with the skill, while the instructor circulated through the room and answered questions, then assigned online work that had students practice with the tools or skills demonstrated and practiced in class. Five of the eight interviewed students specifically mentioned application learning as crucial to learning educational technology skills, and application learning was also mentioned by students in the open-ended questions in the post-survey. As suggested by Lavonen et al. (2006), student growth in educational technology skills depends on ongoing and consistent practice with the educational technology tools and skills they will need for future teaching and learning.

Educational Technology Competence of the Instructor Impacts Learning

Observation notes and student comments in the interviews and on the post-survey showed that the teacher educator of the two sections of Instructional and Assistive Technology in a Universally Designed Learning Environment in the study was competent in a variety of educational technology skills and tools and that competence positively impacted the growth of student skill with educational technology tools and skills covered in the class.

Class Culture Impacts Learning

Observation notes showed that students came to class early and stayed after class to task the instructor questions as well as asking questions during class. As mentioned in Chapter Four, during class discussions students were comfortable sharing their thoughts with the instructor, especially later in the semester. Class discussion included reflection and student comments became more positive later in the semester as their educational technology skills grew. In the interview questions and open-ended post-survey questions students specifically mentioned the enthusiasm of the instructor and how they felt engaged in the learning, which reflects the students' relationship with the instructor.

Research Question 2

How do students in a technology class in an elementary, early childhood, and exceptional child educator preparation program perceive that an application journal developed their skills to be used for future teaching?

Students Perceived the Application Journal as a Tool for Remembering Skills, not Learning Skills

Four out of 8 interviewed students stated that they felt that the application tool was more helpful as a resource to look back on during the future rather than a tool for learning educational technology skills. One interviewed student felt that they learned more from answering the prompts in the application journal, while the other three interviewed students felt that the application journal helped with specific skills, such as the Universal Design for Learning (UDL) guidelines, but that the application journal was less useful for learning many other skills. The UDL guidelines have very specific guidelines to follow while other educational technology tools and skills do not follow such a specific set of guidelines.

Students Went More In-depth with Skills Through Application Journal

The answers to journal prompts revealed, however, that the application journal caused students to interact with the educational technology tools and skills in the journal in a more in-depth manner as demonstrated by growth in skills from the pre- to post-surveys in comparison to the learning of skills enforced by the journal prompts.

Research Question 3

How do opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program regarding teaching with technology change during an educational technology class?

Students Opinions Regarding Teaching with Technology Changed as Students Became More Skilled with Technology Tools

The Modified STEBI-B linked self-efficacy with educational technology and opinions about educational technology. When broken down by class section, the scores on the first Modified STEBI-B for 2A were 6, 2B were 6.1, 3A were 5.77, and 3B were 4.13. For the second Modified STEBI-B the scores for 2A were 9.25, 2B were 9.80, 3A were 8.50, and 3B were 8.63. There was a 3.60 average gain in scores between the first and second Modified STEBI-B, when averaging the scores of all 38 students, while the average difference in scores between the first and second Modified STEBI-B varied for each class section. The average difference in scores for 2A was 3.25, 2B was 3.15, 3A was 3.02, and 3B was 4.5 This data suggested that opinions regarding educational technology changed in a positive direction for all students but how much opinions changed regarding educational technology was dependent on the section of class.

Growth in Perspective, Mindset, and or Abilities with Regards to Educational Technology

A theme that arose from the data that was not a response to any of the research questions was that 33 of 34 students that submitted the post-survey felt that they had a positive shift in mindset, perspective, and or abilities regarding educational technology during the semester. It is interesting to note that of the 17 of the 18 students that reported the most growth in educational technology skills only one student reported that they did not feel that they had a shift in perspective, mindset, or abilities with educational technology. The student with the most growth in abilities Student 24, with 48 points of growth, reported a shift in perspective, mindset, and ability while also reporting being "very confident" in their ability to incorporate UDL guidelines into their future teaching.

Research Question 4

How do prior technology skills affect the opinions of students in a technology class in an elementary, early childhood, and exceptional child educator preparation program learning educational technology skills to be used for future teaching?

Prior Technology Skills of Students Impacted Opinions of Students Regarding Educational Technology Who Showed Growth

Students with strong prior technology skills reported less opinion change than students with less strong technology skills. The students with less prior technology skills reported feeling more comfortable with technology and that they felt that they had gained experience with technology while the students with more prior technology skills reported that they had always felt that technology was important in teaching and learning. Tondeur et al. (2020) and Blackwell (2016) both reported preservice educator's attitudes towards technology being a determining factor in their willingness to integrate technology into teaching and learning as in service educators.

Three of eight interviewed students stated that their opinions regarding educational technology had changed in a positive way during the course of the semester while another four interviewed students stated that they always thought that teaching with educational technology was important so their opinions had not changed during the course of the semester. One interviewed student stated that their opinion had not changed and did not indicate that they thought teaching with educational technology was either important or unimportant, however, that student did show growth in educational technology skills. One interviewed student did not submit a post-survey so their prior technology skills were reported on the pre-survey but could not be compared to post-survey results to determine any growth in educational technology skills.

Other Findings

Students Reported that Educational Technology Skills will be Useful in Other Classes, Field Work, and Future Teaching

Another theme that arose from the data that was not directly in response to the research questions was that students felt that many of the educational technology skills they had learned in the course, Instructional and Assistive Technology in a Universally Designed Learning Environment, would be immediately applicable to upcoming classes and field experiences as well as useful for student teaching and teaching in their future classrooms. Students specifically mentioned UDL guidelines, Google Docs, Google Drive, Google Classroom, Google Forms, digital citizenship, podcasting, screencasting, video creation and editing tools, fair use/creative commons licensing, and virtual and augmented reality (VR/AR) tools as tools and skills that will be especially useful and or helpful. The Week 11 asynchronous online work required students to create a Google Sites e-portfolio that could be added to as students progressed through the educator preparation program then used in interviews for teaching jobs. Tondeur et al. (2020) discussed the need for authentic experiences in teacher preparation programs when integrating technology. The observation notes reported that students were given choice and voice in their assigned work, that the assigned work was as authentic to real-world situations as possible, and involved as authentic an audience as possible.

Students Believe They Have Learned More Educational Technology Skills Than Those Listed in the Curriculum

The third theme developed from the data that was not related to a research question was that students in Instructional and Assistive Technology in a Universally Designed Learning Environment believed that they learned more educational technology skills that the skills specifically listed in the curriculum or the syllabus. Students noted in interview questions, post-survey open-ended questions, and Philosophy of Educational Technology Integration Statements that they had learned many Google Workplace for Education skills beyond those specifically covered in class or assignments as well as skills such as virtual filed trips. Students also reported that they had learned educational technology skills beyond specific tools such as patience when using technology, the need to always have a backup plan when teaching with technology, and the need for continual learning about educational technology tools and skills.

Implications

Teacher Educator Digital Competence is Important

As discussed in Chapter Two, the digital competence of the teacher educator teaching an educational technology course impacts the student learning of educational technology skills. Bai and Ertmer (2008) stated that teacher educators play an important role in “transforming classrooms through the use of technology” (p. 93) and Foulger et al. (2017) stated that a crucial part of preservice educators learning to teach with technology is the “influence of the teacher educator” (p. 417). The competence of the instructor teaching the two sections of Instructional and Assistive Technology in a Universally Designed Learning Environment had a positive impact on students in the class learning educational technology tools and skills. In Chapter Two, the researcher discussed how rapidly educational technology is evolving. Sutton and DeSantis (2017) proposed that using a technology adoption model will allow teacher educators to “take advantage of the capabilities of recently emerged technologies” (p. 227).

Technological Pedagogical and Content Knowledge (TPACK)

TPACK is important for preservice educators which means that preservice educators need digital fluency skills as a baseline for learning TP, TCK, and TPACK throughout their EPP curriculum. The TPACK framework introduced by Koehler and Mishra (2009) was discussed in Chapter Two. Koehler and Mishra also stated that technology “integration efforts should be creatively designed” (p. 62). The instructional design of the two sections of Instructional and Assistive Technology in a Universally

Designed Learning Environment studied for this research had an impact on student acquisition of educational technology skills. The AB format, one day of face-to-face class and one day of online class, allowed for smaller class sizes, more collaboration among students, and richer class discussion and participation. The AB format also allowed the instructor to spend more time demonstrating technology skills and tools and provided more time for guided practice, as well as giving the students more opportunity to practice, and go more in-depth with, educational technology tools and skills on their own during the online portion of the class.

Growth in Mindset and Technology Abilities Beyond the Syllabus/Curriculum

Students consistently commented on how their mindsets regarding technology had grown and how they had learned many technology skills beyond what was specifically listed in the curriculum and or syllabus. During the interviews many of the students mentioned that their mindset had grown regarding teaching with technology. In the post-survey, interviews, and Philosophy of Educational Technology Integration Statements, many students noted that they now understood that they would need to continually learn about educational technology to be able to better teach their students with and about technology. Students also mentioned learning how to seek out information about educational technology skills and how to better help themselves understand educational technology skills and tools. Mishra and Koehler (2006) stated that there is not a specific educational technology tool that works for every teaching and learning context so preservice teachers need to understand a variety of technology tools. Ideland (2021) described a desirable teacher as flexible and emphasized that teachers need to be able to respond to rapidly changing technology.

Regional State University's Innovation and Technology Center

Regional State University has an Innovation and Technology Center that is part of the College of Education, Health, and Human Studies and was utilized often by the instructor and students in the two sections of Instructional and Assistive Technology in a Universally Designed Learning Environment in the study. The face-to-face portions of the class were taught in the Center and technology housed in the Center was used for teaching 3D printing, virtual and augmented reality (VR/AR), video creation and editing, podcasting, screencasting, and coding. The Center's Coordinator, who has a Master's Degree in Educational Technology, was brought in by the instructor to be a guest speaker on Google Workplace for Education and digital citizenship, and the Coordinator also facilitated the use of many of the Center's resources by the instructor and students. Having an innovation and technology space within the college, as well as a staff member with educational technology expertise, made it possible for the instructor and students to interact with emerging technologies in a consistent manner. The Center and its resources are leveraged for learning some of the specific skills mentioned in the pre-and post-surveys: screencasting, podcasting, video editing, digital citizenship, VR/AR, and coding. Sutton and DeSantis (2017) suggested that educational technology skills are best learned when supported by experiential learning and the resources and staff of the Innovation and Technology Center provide a platform for experiential learning with educational technology.

Stakeholder Input into Educational Technology Skills Taught

As discussed in Chapter Two, Buss et al. (2015) emphasized that stakeholder input into educational technology skills taught in educator preparation programs (EPPs) is important to ensure that preservice educators are prepared to teach with technology. Regional State University's College of Education, Health, and Human Services Innovation Technology Center sends out an educational technology use survey to regional schools on a two-year cycle. The data from this survey, including feedback from respondents on two open-ended questions regarding how Regional State University's EPP should be preparing preservice educators to teach with and effectively integrate educational technology, is incorporated into the syllabus of Instructional and Assistive Technology in a Universally Designed Learning Environment. By including stakeholder input into educational technology skills being taught, modeled, and integrated into EPP courses, EPPs ensure that preservice educators are prepared to teach with technology in field experiences, student teaching, and their first year of teaching and beyond.

Recommendations

Teacher educators must be willing to use a technology education model and consider changes to established teaching methods to integrate technology. Teacher educators must also be willing to take part in continual professional development to stay competent with educational technology. Leadership of Educator Preparation Programs (EPPs) must encourage teacher educators to attend professional development on technology, as well as support teacher educators that participate in technology professional development. Bai and Ertmer (2008) asserted that the beliefs of teacher educators regarding the use of technology in teaching and learning affect preservice educators' beliefs about teaching and learning and technology use. Foulger et al. (2017) expressed that the involvement and influence of teacher educators is crucial to preparing preservice educators to teach and learn with technology. Foulger et al. further stated that many teacher educators lack competence with technology skills needed to effectively integrate educational technology into preservice educator's coursework. Borthwick and Hansen (2017) expressed the idea that teacher educators need professional development on educational technology skills needed for teaching and learning, so that teacher educators are sufficiently digitally competent to design and implement educational technology into teaching and learning in methods courses and other educator preparation coursework.

According to Mishra and Koehler (2006), technology integration must be taught in a consistent fashion throughout educator preparation programs. Foulger et al. (2017) stated that a standalone technology course may benefit students by providing baseline digital fluency skills that can be used in future classes and field experiences; it is also crucial that the teaching of technology skills and tools be integrated in all educator preparation courses, including content courses. One of the four principles for preparing preservice educators to teach with technology is "ensure preservice educators experience educational technologies program wide" (Stokes-Beverly & Simoy, 2016, p. 9). This means that technology integration should be included in content courses, even when those courses are taught by faculty outside schools or colleges of education, which also means any faculty teaching content courses will need continual professional development on educational technology tools and skills to be digitally competent.

ISTE Standards for Educators 2017 Standard 2.4.b states that educators should "use new digital resources and diagnose and troubleshoot technology issues." This means that students need to understand how to have a growth mindset regarding educational technology as well as how to troubleshoot basic technology issues. Therefore, growth mindset regarding educational technology and digital fluency skills need to be taught as part of technology integration in educator preparation program curriculum.

The instructional design of any standalone technology course must be carefully considered. The AB format of the two sections of Instructional and Assistive Technology in a Universally Designed Learning Environment allowed the instructor to have smaller classes, while also creating more time for technology demonstrations and guided practice with technology. As learning technology tools and skills requires a hands-on approach, the AB format allows more time for students to interact with technology, as well as go more in-depth with technology. Further, an application journal can assist students with thoughtful and meaningful reflection on how to integrate technology tools in future teaching. Most students reported the journal as helpful as a tool for remembering all the tools, while the journal prompts showed deeper learning through thoughtful responses.

Recommendations for Future Research

For the future, other studies should include middle, secondary, and K-12 education programs, as well as elementary, early childhood, and exceptional child education programs, so results of the study are able to be generalized to more education programs. It would also be beneficial to study class sections of the same class not by the same instructor to see if qualitative data changes, based on the instructor. Further, it would be beneficial to collect comparison data on a standalone technology course being taught early in an educator preparation program, then followed by technology integration taught as part of the curriculum of following education courses versus technology integration taught as part of curriculum in every course without a standalone technology course.

It would also be beneficial to continue the current study in a longitudinal study to follow students through the rest of their education courses, field experiences, student teaching, and first year of teaching. Collecting data on the same students who implemented the technology skills learned in Instructional and Assistive Technology in a Universally Designed Learning Environment would inform the curriculum of the class as well as show if students continue to grow in educational technology skills and use the skills learned in Instructional and Assistive Technology in a Universally Designed Learning Environment in future teaching.

The reliability and validity of the instrument used to measure student self-efficacy and opinions of educational technology, the Modified STEBI-B, has been tested for reliability and validity for science and math but it has not been tested for reliability and validity with the verbiage changed to reflect statements about technology. Future studies could include a test of the validity and reliability of the Modified STEBI-B used for technology or use a different instrument to measure self-efficacy and opinions of technology.

A recommendation for future studies would be to use an instrument to measure whether students reported self-perceived skills were reflected in data that does not rely on student self-perception. Another recommendation would be to measure whether attendance affected student ability to learn educational technology skills, especially in a fully face-to-face class.

Conclusion

The purpose of this case study was to examine two sections of the course, Instructional and Assistive Technology in a Universally Designed Learning Environment, taught by the same instructor, as part of an elementary, early childhood, and exceptional child educator preparation program to determine how students in the class acquired educational technology skills to be used in future teaching. Data collected showed that students acquired educational skills through hands-on learning and that the digital competence of the teacher educator who taught the class was important to the acquisition of educational technology skills.

Educational technology skills are a crucial piece of learning how to be an effective educator in the 21st century. Educator preparation programs need to understand how to best integrate educational technology learning into their curriculum to best prepare preservice educators to teach with technology in a safe, legal, responsible, and effective manner. By ensuring that teacher educators are receiving educational technology professional development and using creative instructional design, educator preparation programs can ensure that preservice educators are fully prepared to effectively integrate educational technology into their future classrooms.

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Appendix A: Modified STEBI-B Statements

SA=Strongly Agree A=Agree UN=Undecided D=Disagree SD=Strongly Disagree

1. I will continually find better ways to teach with technology. SA A UN D SD
2. Even if I try very hard, I will not teach with technology as well as I will without technology. SA A UN D SD
3. I know the steps necessary to be prepared to teach with technology effectively. SA A UN D SD
4. I understand educational technology concepts well enough to be effective in teaching early childhood, elementary, or exceptional child students. SA A UN D SD
5. Students' achievement with educational technology is directly related to their teacher's effectiveness in teaching with educational technology. SA A UN D SD
6. I will typically be able to answer students' educational technology questions. SA A UN D SD
7. I wonder if I will have the necessary skills to teach with educational technology. SA A UN D SD
8. When teaching with educational technology, I will usually welcome student questions about educational technology. SA A UN D SD

Appendix B: Interview Questions

1. What educational technology skills do you believe you have learned in [class]?

2. How do you believe you learned those skills?

3. Which type of learning did you feel was most helpful: in class, on Zoom, online assignments, or another type of learning?

4. Do you feel that the application journal helped you learn educational technology skills? Why or why not?

5. Have your opinions about teaching with technology changed since the beginning of [class]? Why or why not?

6. Has your belief in your skills with teaching with technology changed since the beginning of [class]? Why or why not?

7. What is the most important thing you have learned in [class]?

8. Is there anything else you would like to share with me about [class]?

Appendix C: Application Journal Prompts

1. Based on the article you read, describe two ways Bitmoji can be used in the classroom? Explain how each of these uses is beneficial for student learning.
2. If someone asked you what UDL is, what would you say? Write one paragraph (that is at least 4-5 sentences) using your own words to describe your answer.
3. Explain how you think digital technology can play a role in UDL.
4. For each of the following UDL guidelines related to Perception, identify and explain how a specific accessibility feature aligns with that guideline.

   1.1- Offer ways of customizing the display of information

   1.2- Offer alternatives for auditory information

   1.3- Offer alternatives for visual information
5. Describe a specific example of how a <u>teacher</u> could use screencasting for teaching a mathematics concept.
6. Describe a specific example of how a <u>student</u> could use screencasting as a form of student action and expression.
7. Explain why parent/guardian surveys are important...what are the potential implications of using them in your classroom?
8. Identify and describe an example of how you might use Google Forms for assessment?
9. Identify and describe an example of how Google Forms could be used for student learning and creating?
10. Think about and identify 3 related issues or challenges that children, teens, young adults or adults might face in regard to the digital world?

11. Identify one potential teaching challenge or concern related to integrating digital citizenship lessons into your classroom.
12. Explain a possible solution for overcoming the challenge stated above.
13. Research tips and tricks for using Google Classroom...Google search for articles, websites, listen to a podcast, videos, look at a blog, etc. Explain two new things you learned in addition to the basics learned in the tasks.
14. Summary on how fair use works in relation to teacher instruction.
15. Describe a specific lesson or project in which students could create an audio podcast.
16. Identify skills that students are developing by engaging in audio/podcast creation.
17. Identify and describe which UDL guidelines align with students using audio media/podcasts for learning or communicating.
18. Record a video that includes responses to the following three prompts:

    Describe one way that video recording/editing can be used for teacher instruction... (go beyond screencasting or using video streaming - YouTube as examples).

    Describe one way that video recording/creation can be used for student learning, meaning the students are the ones recording videos (go beyond screencasting since we have already discussed this use in the classroom)

    How does the use of video recording for teaching or learning align with UDL Guidelines...reference one or more specific guidelines in your answer?
19. Blog, article title, summary, response
20. Identify a 3-D manipulative that would be useful in the classroom.

Identify a website where the 3D Model prototype is located

Write a justification to support the 3D printing

Explain how students would use the 3D-printed model-manipulative for learning in relation to a lesson/unit of study

Explain the benefits to students of using this model/manipulative

Identify any limitations to using this model/manipulative

Appendix D: Pre-survey Questions

For each of the following technologies or related concepts, identify your level of knowledge/experience by clicking the appropriate circle.

This is completely new to me

I know a little about this

I've learned about this in other courses or on my own, and am fairly comfortable with this

I am an expert and can teach others about this topic

Universal Design for Learning (UDL) Framework

Accessibilities Features on iPad/Chromebook

Using/Organizing a Google Drive

Creating/Using Google Docs

Hyperdocs

Creating Google Forms

Creating Google Slides

Creating a Google Site

Using a Google Classroom

Creating and Using Spreadsheets- Google Sheets or Excel

Google Chrome Extensions

QR Codes

Screencasting/Screenrecording

Podcasting

Video and/or Audio Editing

Digital Citizenship

Media Licensing (Copyright, Fair Use, OER-Creative Commons)

Virtual/Augmented Reality (VR and AR)

Coding and/or Computer Programming

Appendix E: Post-survey Questions

For each of the following technologies or related concepts, identify your level of knowledge/experience by clicking the appropriate circle.

I know a little about this

I am comfortable using this

I am an expert and can teach others about this topic

Universal Design for Learning (UDL) Framework

Accessibilities Features on iPad/Chromebook

Using/Organizing a Google Drive

Creating/Using Google Docs

Hyperdocs

Creating Google Forms

Creating Google Slides

Creating a Google Site

Using a Google Classroom

Creating and Using Spreadsheets- Google Sheets or Excel

Google Chrome Extensions

QR Codes

Screencasting/Screenrecording

Podcasting

Video and/or Audio Editing

Digital Citizenship

Media Licensing (Copyright, Fair Use, OER-Creative Commons)

Virtual/Augmented Reality (VR and AR)

Coding and/or Computer Programming

With regards to instructional and assistive technology, explain how your perspective, mindset, and/or abilities have changed over the course of the semester.

Do you have any other feedback or anything else you want to tell me about [class] (e.g. format, your experiences, topics, etc.)? This question is optional.

Appendix F: Philosophy of Educational Technology Integration Statement Prompts

Your Philosophy Statement should include beliefs that reflect best practices and the most current literature regarding the education of individuals while incorporating technology in your teaching...think about all of the things we learned about in this class (reference your Google Sites if needed)

Writing: This is a formal writing assignment. Use correct grammar, punctuation, and use academic language to express your thoughts. **The following three sections should be a minimum of 10 sentences each**. This can also be a part of your teaching portfolio and added to your Google Site.

STRUCTURE: Break down your philosophy into three different sections -- **use the following three headings**:

- **Beliefs about teachers teaching using instructional technology?** Focus on the teacher aspect and the connections between technology and teaching. Include in your response, aspects related to instruction, but also other uses in the educational setting in which a teacher might utilize technology. Reference and include appropriate aspects of UDL in your response and provide specific examples of how UDL can be connected to the use of technology for teacher instruction.
- **Beliefs about student learning and assessment using and integrating technology?** Focus on the student aspect and the connections between utilizing technology and student learning. Include how technology can be used for learning in a variety of ways. Reference and include appropriate

aspects of UDL in your response and provide specific examples of how UDL can be connected to the use of technology for student learning.

- **How I integrate technology into my classroom teaching and learning to meet the needs of all learners?** This is about you and your personal approach to integrating technology in the classroom. Focus on your current beliefs about integrating technology into your future classroom. Include in your response specific examples of how you will use technology to meet the needs of all learners. I'm looking for application here. Discuss some of the technology resources, tools, platforms, devices, or frameworks that you learned about in this class or other classes, and apply it to your future instruction.

HELPFUL HINTS:

This philosophy statement should explain your beliefs about technology in teaching and learning and include a description of what you consider to be most important about using technology in your teaching, as well as how students learn using technology and how technology and UDL are connected. Include how you see yourself in your teaching role as it relates to technology integration. This philosophy will likely change and evolve as you gain experience working with technology in your teaching and are in new and different situations.

You have been a student for a long time, and you've been in all types of classes, so you have opinions about teaching and learning and what works and doesn't work. Think about the great teachers you've had and what made them so effective, what they did that inspired you. Now think about everything you learned this semester about using technology in your teaching.

Another useful tip is to think about what you don't like in a teacher. Reflecting on what you don't like can give you insights about what you do like, and that can help you to define your own teaching philosophy and goals.

Appendix G: [Class] Syllabus

(1**)** Course Number: XXXXX

(2) Course Title: Assistive and Instructional Technology in a Universally Designed Learning Environment

(3) Catalog Description: This course is designed for teacher candidates to investigate and implement the effective integration of technology into the P-12 curriculum.

(4) Prerequisites: Admission to Teacher Education Program

(5) Co-requisites: n/a

(6) Credit Hours: 03

(7) Semester: Fall 2021

(8) Class Meeting Time(s):

XXXXX-01: A-Tuesdays 12:30pm-1:45pm in [Building/Room]

XXXXX-01: B-Thursdays 12:30pm-1:45pm in [Building/Room]

XXXXX-02: A-Tuesdays 11:00-12:15pm in [Building/Room]

XXXXX-02: B-Thursdays 11:00-12:15pm in [Building/Room]

Format: Face-to-face and mixed. The class will be divided into two groups. One group will meet face-to-face in class on Tuesdays, and the other group will meet face-to-face in class on Thursdays. Groupings will be communicated prior to the first day of class.

During class time on the day in which a group is not meeting face to face, students will complete online assignments and work on course projects.

(9) Instructor: Dr. XXXXX

(10) Instructor Contact Information:

Email: XXXXX

Office Phone: XXXXX

Office Location: XXXXX

Office Hours: Tuesdays 2pm-5pm by appointment

(11) Concerns: Questions, comments or request regarding this course should be taken to the instructor. Unanswered questions or unresolved issues about this class can be directed to Dr. XXXXX, chair of the department at XXXXX.

(12) Objectives of the Course:

The teacher candidates will:

1. utilize and demonstrate current instructional technology resources by creating a universally designed learning environment for all students. (DESE 4C2)(2017 ISTE Standards for Educators 1c and 5)
2. demonstrate knowledge and implementation of assistive technology to support students' functional capabilities and academic achievement. (DESE 3C2)(2017 ISTE Standards for Educators 5)
3. promote and model digital citizenship by recognizing the rights, responsibilities, and opportunities of living, learning, and working in a

digital world and acting/modeling ways that are safe, legal, and ethical. (DESE 8C3)(2017 ISTE Standards for Educators 3)

4. engage in professional development and life-long learning. (DESE 8C2)(2017 ISTE Standards for Educators 1)
5. be able to locate national and state standards and create aligned learning experiences while integrating technology. (DESE 3C1)
6. demonstrate current instructional resources to foster collaborative learning. (2017 ISTE Standards for Educators 4c)
7. apply appropriate use of technology to effectively communicate and collaborate with families. (DESE 6C4)(2017 ISTE Standards for Educators 4d)
8. create learning opportunities that challenge students to use a design process and computational thinking to innovate and solve problems. (DESE 4C2)(2017 ISTE Standards for Educators 6c and 6d)

(13) Course Learning Outcomes:

1. Create an instructional activity integrating multimedia technologies that includes multiple means of engagement, representation and expression.
2. Demonstrate mastery of current P-12 educational technology tools (Apple Teacher Certification and Level 1 Google Certified Educator Certification)

3. Collaborate to demonstrate a mastery of digital citizenship elements (Small group collaborative project involving the elements of digital citizenship)

(14) **Course-specific Required Materials:**

There is not a textbook for this class. Other reading/resource materials will be provided and shared in class.

Technology Requirements: Education majors must have a technology device for their course work such as a laptop or tablet, but not exclusively iPads. Cell phones are not an acceptable device. The device must meet specifications needed for education courses, and the details of these specifications can be found on the XXXX Center website at this link: XXXX.

(15) Course Content:

Main Topics	# of Hours
Universal Design for Learning	10
Assistive Technology	5
Communication	5
Collaborative learning/tools	5
Engage in Professional Growth	5

Digital Citizenship	5
Instructional technology resources	10
TOTAL	45 Hours

Tentative Weekly Schedule:

Week	Topics	Tentative Outputs	Course Objectives Alignment
1	Syllabus Ed Tech Intro; Innovative Mindset, 4C's, Tech Certifications Google Accounts/Google Drive/Chrome	Course Google Drive Set-up Apple Teacher Learning Center sign up	4, 5, 6,
2	Bitmoji/Avatars, Google Slides, Google Docs, UDL Framework	Google Slides/Bitmoji Room Google Doc Application Log	1, 6
3	Application of UDL Assistive Tech/Accessibility Features	Collaborative Google Doc Chart Accessibility Feature Inquiry	1, 2, 6
4	Assistive Tech/Accessibility Features Continued/Screencasting	Screencast Check for Understanding	1, 2, 3
5	Communication with families – Google Forms/Sheets	Collaborative Jamboard Google Forms Parent Survey	1, 3, 4, 6, 7, 8

6	Communication/Learning Management Systems (LMS) - Google Classroom Organization/Digital Newsletter	Google Classroom Creation Digital Newsletter	1, 4, 6, 7, 8
7	Digital Citizenship (DC)	DC Curricular Resources Assignment	1, 4, 6, 7, 8
8	DC Continued/Audio Listening and Recording/Podcasting in the classroom	**Apple Certification Due** Check for Understanding II	1, 3
9	Audio/Podcasting creation/editing; Media Licensing	Collaborative audio presentation/podcast about a DC issue in PK-12 education	1, 3, 6, 7
10	Video use and creation in the classroom; Video Creation/Editing – iMovie intro/review	Video-based Scavenger Hunt Lesson Plan integrating student video recording	1, 3, 5, 8
11	Google Sites Professional Learning Networks (PLNs)/PD Resources	Google Site Digital Portfolio	1, 4, 7
12	Google Certification Test Prep and review; Voucher and Test Sign-up	**Google Educator Level I** **Certification Exam**	1, 3, 4, 6, 7
13	Virtual Reality (VR)/Augmented Reality (AR); 3D Printing Models/Manipulatives	**Google Educator Level I** **Certification Exam**	1, 5
14	XXXX Center Resources; Learning using coding/computational thinking	Coding/tools exploration and integrated curriculum assignment	1, 5, 6, 8

15	SAMR Model Integration/ISTE Standards; Digital Interactive Posters/Presentation	Interactive Presentation Poster	1, 5, 6
FINAL	FINAL paper – Due during the course final exam day/time.	Philosophy of Educational Technology Integration Statement	1, 2, 3, 6

(16) **Grading Scale and Policies:**

Evaluation Criteria	**Percentage**
Projects/Presentations	30
Assignments	30
Tests	20
In-Class Participation	20

Late Assignments:

Assignments are considered late if they are submitted past the posted due date/time. A deduction of 25% will be taken based on the earned points. Late assignments will not be accepted after one week past the due date. In extenuating circumstances, an extension may be granted if you contact Dr. XXXX in advance prior to the due date with supporting reasoning/documentation.

*Technology can be challenging and inconsistent. Do not wait until the last possible moment to complete course assignments. Give yourself plenty of time to work with the technology and to complete your assignments to ensure that you meet assignment deadlines. When submitting links to documents or other products, double-check all links to ensure that they work and are actively linked.

Feedback/Grades for assignments will be provided via Canvas within one week of submission.

Grading Scale

100-90% = A

89.9-80% = B

79.9-70% = C

69.9%-60% = D

59.9% and below = F

*Students must earn a C or better in this course

(17) **Final Exam Schedule:**

- XXXXXX-01: Tuesday, December 14, 2021 12:00pm-2:00pm
- XXXXXX-02: Thursday, December 16, 2021 10:00pm-12:00pm

This will be an online final paper. The format of the final is a written format. The prompts will be provided in class and on Canvas during

Week 15. Paper submissions may then be submitted to the Canvas course drop box at any point during the final exam day/time.

(18) **Classroom Guideline for Minimizing the Risk of COVID-19**

Practice social distancing (six feet of spacing), wear facial coverings, and follow proper prevention hygiene, such as washing your hands frequently and using alcohol-based (at least 60% alcohol) hand sanitizer when soap and water are not available.

- The wearing of a face covering is a University safety requirement under the current conditions as well as a XXXX County Emergency Order pursuant to *RSMo 192.300*. We hope that through modeling and a positive and encouraging environment, all will do their part. If a student refuses to wear a face covering, it will be handled in the same manner as if they refused to comply with a course requirement or adhere to the Code of Student Conduct. An instructor may ask a student to leave a class and an employee may ask a person to leave a meeting or event if they do not wish to comply with the Face Coverings and Social Distance Guidelines.
- In the event that a student does not comply with this guidance and does not leave the space, faculty/staff will send the student's name and email address or [student] ID to deanofstudents@XXX.edu. If a student refuses to leave a classroom or other University facility upon request, and/or becomes disruptive, the Department of Public Safety can be contacted for assistance.

If you are not able to wear face coverings due to health or ADA concerns, contact the office of Accessibility Services at ds@XXX.edu or XXXX for information on how to obtain an exemption. Affected individuals should also consult with their physicians before wearing a face covering.

- Avoid sharing electronic devices, books, pens, and other learning aids unless thoroughly cleaned between users.
- Students are encouraged to clean and disinfect before and after class, any contact surfaces such as chairs, desks, and equipment utilized for the class. Students will follow the protocol established for this classroom.
- Appropriate signage will be displayed in the classroom or adjacent areas on protocols to follow that protect our community members during classes. Please become familiar with this information and follow it in our shared community.
- The seating in the classroom may be positioned to maintain social distancing or signs may be posted with seating direction. Do not move seating or signs unless instructed to do so by your instructor.
- Social Distancing minimizes risk. When in buildings, hallways and entering or exiting buildings or classrooms, maintain at least six feet of social distancing space and avoid gathering in groups.
- The final exam will be online, and instructions are provided in the final exam section of the syllabus.

(19) **Academic Honesty** – Regional State University expects all students, faculty and staff to operate in an honest and ethical manner. Academic dishonesty is a very serious offense because it undermines the value of your education and the education of others.

Students who engage in academic dishonesty face significant penalties. Forms of academic dishonesty include, but are not limited to, plagiarism, cheating, contract cheating, misrepresentation, and other actions you take. Some of these are defined below:

- Plagiarism means passing off someone else's work as your own, whether it is intentional or unintentional.
- Cheating includes copying from another person or source of information to meet the requirements of a task.
- Contract cheating is paying someone else or a company to do your work.
- Misrepresentation means you are posing as someone else or someone else is posing as you to complete a task.
- Collusion means working with one or more people to cheat. If you help someone cheat or plagiarize you will face the same penalties.

For more information, visit the Regional State University Code of Conduct http://www.XXX.edu/regionalstateuniversity/code-of-conduct.html or the Faculty Handbook Section (D) on Academic Honesty http://www.XXX.edu/facultysenate/handbook/5d.html

(20) **Accessibility –** Regional State University and Accessibility Services are committed to making every reasonable educational accommodation for students who identify as people with disabilities. Many services and accommodations which aid a student's educational experience are available for students with various disabilities. Students are responsible for contacting Accessibility Services to register and access accommodations. Accommodations are implemented on a case by case basis. For more information, visit http://www.XXX.edu/ds/ or contact Accessibility Services at XXXX.

(21) **Civility –** Your university experience is purposely designed to introduce you to new ideas, help you think effectively, develop good communication skills, evaluate information successfully, distinguish among values and make sound judgements. Doing this well requires respectful and courteous discussion among and between students and the instructor. Together, we must create a space where we acknowledge and respect others have different experiences, perspectives and points of view. Disagreements are likely. Mutual respect for one another and a willingness to listen are important. Remember, you are responsible for your behavior and actions. There is a no tolerance policy on bullying or harassment of any kind. Additional information on student conduct may be found at:

http://www.XXX.edu/pdf/stuconduct-code-conduct.pdf?ver=1.0 and

https://www.XXX.edu/pdf/Conduct-Faculty-Resource-Guide.pdf

(22) **Mandatory Reporting** – I will keep information you share with me confidential to the best of my ability, but as a professor I am legally required to share information about sexual misconduct and crimes I learn about to make our campus and community safe for everyone.

(23) **Student Success** – This course uses XXXX, Regional State University's student success network, to improve communication between students, faculty and staff on campus. You'll get emails through XXXX with information about resources or concerns. Please read these emails—they are sent to help you succeed! You can access XXXX through your portal or directly at XXXX.XXX.edu to see any academic alerts, ask for help and to access resources to support your success at Regional State University.

Vitae

Jana L. Gerard

Colleges and Universities

1989-1993: Bachelor of Science in Criminal Justice from Xavier University; 2016-2017: Master of Arts in Education, Educational Technology Emphasis from Lindenwood University; 2019-present: pursuing Doctorate of Education in Instructional Leadership (expected graduation date in May of 2022) from Lindenwood University

Teaching and Educational Employment History

2019-present: Coordinator, EDvolution Center at Southeast Missouri State University

2017-2019: Learning Specialist, IDEA Studio at Lindenwood University

2015-2017: Instructional Technology Specialist, Bryan Middle School, Francis Howell School District

2015-2017: English Language Arts and Information Literacy Instructor at Bryan Middle School, Francis Howell School District

2013-2015: Library Media Specialist, Francis Howell School District

Educational Technology Certifications

Apple Teacher & Apple Teacher Swift Playgrounds

Level 1 & 2 Google Certified Educator

Google Certified Trainer

Microsoft Certified Educator

Microsoft Innovative Educator

Microsoft Technology Associate- Mobility & Device Fundamentals