Preservice Teachers' Perceptions of Readiness for Teaching in a 1:1 Classroom

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PRESERVICE TEACHERS’ PERCEPTIONS OF READINESS FOR TEACHING IN A 1:1 CLASSROOM

by

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D DISSERTATION

Submitted in Partial Fulfillment of the Requirements for the Degree of

Doctorate of Education
Educational Leadership

The University of New Mexico
Albuquerque, New Mexico

December, 2019
Acknowledgements

I would like to acknowledge my committee chair Dr. Allison M. Borden. I could not contemplate making this journey without Dr. Borden at the helm. When asked about the qualities that make up a great teacher, I will always be able to speak about my personal experience as a student in Dr. Borden’s class, knowing that I was witnessing an extraordinary teacher at work. The dissertation journey is one that requires someone who believes in you to help you navigate the hurdles. I am so grateful for Dr. Borden’s encouragement, critical feedback, revisions, and kindness.

The dissertation journey is one that cannot be traveled without extensive support from others. To Dr. Woodrum, I offer my appreciation for the time spent not only reading multiple drafts of my dissertation and offering feedback, but also for the thoughtful lessons he prepared during my doctoral coursework. I became a more critical scholar as a result of Dr. Woodrum’s impact. I would also like to acknowledge Dr. Walker for providing me with feedback and information on the teacher candidacy program at UNM. These conversations allowed me to move forward at critical points in my journey. I also owe a debt of gratitude to Dr. Mora-Garcia whose insightful comments not only helped me improve my writing, but also provided me with an opportunity to reflect more deeply on the issues of equity that continue to impact the students of New Mexico.

My gratitude also extends to Sean Weiner whose support cannot be measured. My love and appreciation for Sean is unending. My children, Marissa, Noelle, Brittany, and Zach have provided years of encouragement to me and I am grateful for their love and patience. My parents, Carl and Karen Scott, have been a constant source of love and support my entire life. I am grateful to them for modeling perseverance and grit.
ABSTRACT

PRESERVICE TEACHERS’ PERCEPTIONS OF READINESS FOR TEACHING IN A 1:1 CLASSROOM

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With the emergence of digital technology as a primary means to communicate and learn, it is imperative that educators become proficient in utilizing 21st century digital tools and apps. However, research has shown that preservice teachers' levels of readiness for teaching in 1:1 classrooms are not sufficient. Preservice teachers need to increase their proficiency with technology, both hardware and software, in order to maximize student achievement and prepare their future students for a wide array of post-secondary options.

This study examined the perceptions that preservice teachers held regarding their readiness to step into 1:1 classrooms upon completion of their teacher candidacy program. The study was guided by these two questions: What professional digital competencies designed for a 1:1 classroom were being taught in the preservice teachers’ education courses? To what extent did preservice teachers feel prepared to begin their careers teaching in 1:1 classrooms?

Preservice teachers reported a wide range of responses when asked to reflect on their digital competencies and assess their levels of proficiency. When asked to assess their proficiency with hardware and educational software, the percentage of participants who agreed they were proficient ranged from 16% to 97%. However, a more complex
story emerged by conducting a cross-tabulation analysis between proficiency and readiness to teach. The cross-tabulation data revealed that preservice teachers’ levels of proficiency with hardware and educational software declined when readiness to teach was also considered. The level of hardware and educational software training preservice teachers received appeared to be highly dependent on the background of the faculty teaching their courses and their field study placement. Preservice teachers were less likely to receive training on integrating software apps into their lessons during their formal coursework, but were confident they would receive additional training in their school districts.

When asked about their readiness to teach, 73% of the participants responded they were prepared to select technologies to use in their 1:1 classrooms that enhanced what they taught, how they taught, and what students learned. In contrast, when each participant’s total score was calculated for the hardware and educational software questions, the percentage of participants who agreed they were proficient ranged from a low of 36.5% for hardware to 56.4% for educational software.

This study was a single exploratory case study, which focused on the elementary and secondary students enrolled in the teacher candidacy program at one university, during the course of one semester. The sample consisted of 63 preservice teachers who responded to an electronic survey. Three preservice teachers were interviewed to elicit additional contextual data.
# TABLE OF CONTENTS

**LIST OF FIGURES** ........................................................................................................ xi

**LIST OF TABLES** ........................................................................................................ xii

**CHAPTER ONE INTRODUCTION** ............................................................................... 1

Background ..................................................................................................................... 1

Statement of the Problem ............................................................................................... 3

Purpose of the Study ........................................................................................................ 4

Research Questions ........................................................................................................ 4

Theoretical Framework .................................................................................................... 4

Definition of Terms ......................................................................................................... 5

Delimitations ................................................................................................................... 5

Significance ...................................................................................................................... 5

Organization of the Literature Review ........................................................................... 6

**CHAPTER TWO LITERATURE REVIEW** ..................................................................... 8

Tools ................................................................................................................................. 8

  Early Tools .................................................................................................................. 8

  Early Educational Tools ............................................................................................. 9

  Digital Tools ................................................................................................................ 10

The Digital Divide .......................................................................................................... 15

1:1 Computer Initiatives ............................................................................................... 19

  Early Implementation ................................................................................................. 19

  Impact on Student Achievement .............................................................................. 20
Administration of the Questionnaire ................................................................. 63
Data Set Construction ....................................................................................... 65
Data Set Revision ............................................................................................. 67
Data Analyses .................................................................................................. 69
Phase II Qualitative ......................................................................................... 69
Data Collection ................................................................................................ 69
Interview Sample ............................................................................................. 70
Administration of the Interviews ..................................................................... 70
Data Analyses .................................................................................................. 70

CHAPTER FOUR FINDINGS ............................................................................. 71

Findings: Survey Research ............................................................................. 72
Sample ............................................................................................................. 72
Hardware Proficiency ...................................................................................... 72
  Descriptive Statistics .................................................................................... 73
Basic Software Proficiency ............................................................................ 75
  Descriptive Statistics .................................................................................... 75
Educational Software Proficiency ................................................................. 77
  Descriptive Statistics .................................................................................... 78
Modeling by Faculty ......................................................................................... 83
  Descriptive Statistics .................................................................................... 83
Contingency Table and Chi-Square Analyses ............................................. 85
  Hardware Proficiency .................................................................................... 86
  Basic Software Proficiency .......................................................................... 88
Educational Software Proficiency.................................................................89
Faculty Modeling ......................................................................................91
Assessing Social Media Proficiency............................................................92
Assessing Students’ Digital Readiness ..........................................................93
Assessing Digital Citizenship .....................................................................95
Performance of the Instrument: Questionnaire .........................................95
Findings: Interviews .....................................................................................96
Participants .................................................................................................96
Hardware Proficiency .................................................................................97
Findings ........................................................................................................98
Software Proficiency ...................................................................................99
Findings .........................................................................................................100
Faculty Modeling ........................................................................................101
Findings .........................................................................................................101
Readiness to Teach with Technology ............................................................101
Improving the Interviews .............................................................................104
Summary of Findings ...................................................................................105
Hardware .......................................................................................................106
Basic Software .............................................................................................107
Educational Software ..................................................................................108
Faculty Modeling ........................................................................................110
Readiness to Teach ......................................................................................111
Social Media .................................................................................................112
PRESERVICE TEACHERS’ PERCEPTIONS

Assessing Students’ Digital Readiness .................................................................112

Educational Trends .................................................................................................113

CHAPTER FIVE CONCLUSION .................................................................................114

Introduction ...........................................................................................................114

Summary of the Study .........................................................................................114

Overview of the Problem ....................................................................................114

Purpose Statement and Research Questions .....................................................114

Rationale for the Choice of Methods ..................................................................115

Going Beyond the Research Questions ...............................................................116

Limitations ............................................................................................................117

Future Research ..................................................................................................117

Policy Implications .............................................................................................118

Concluding Remarks .........................................................................................119

REFERENCES ........................................................................................................122

APPENDICES ..........................................................................................................140

Appendix A Electronic Questionnaire ...............................................................140

Appendix B Interview Questions .........................................................................150

Appendix C Interview Participant 1 ....................................................................151

Appendix D Codebook ..........................................................................................156
LIST OF FIGURES

Figure 1. Revised version of the TPACK image ..............................................................54

Figure 2. Preservice teachers’ responses when asked if they were proficient with social media .................................................................93

Figure 3. Preservice teachers’ strategies for assessing their students’ digital skills .......94
**LIST OF TABLES**

**Table 1.** 2000 National Technology Leadership Initiative Definition of Technology Tools, by Content Area .................................................................51

**Table 2.** Distribution of Preservice Teachers’ Responses to Five Items that Measure Hardware Proficiency (n = 63) ..........................................................................................................................73

**Table 3.** Percentage of Participants Who Agreed They Were Proficient Using Hardware in a 1:1 Classroom and Prepared to Select Technologies to Enhance What They Teach, How They Teach, and What Students Learn ........................................................................74

**Table 4.** Distribution of Preservice Teachers’ Responses to Four Items that Measure Basic Software Proficiency (n = 63) ..........................................................................................................................76

**Table 5.** Percentage Of Participants Who Agreed They Were Proficient Using Basic Software Applications And Who Agreed They Were Prepared To Select Technologies To Use That Enhance What They Teach, How They Teach, And What Students Learn (Readiness To Teach) ........................................................................................................77

**Table 6.** Distribution of Preservice Teachers’ Responses to 23 Items that Measure Educational Software Proficiency (n = 63) ..................................................................................................................78

**Table 7.** Distribution of Preservice Teachers’ Responses Regarding Their Ability to Assess Technology Apps .................................................................................................................................80

**Table 8.** Percentage of Participants Who Agreed They Were Proficient Using Educational Software Applications And Who Agreed They Were Prepared To Select Technologies To Use That Enhance What They Teach, How They Teach, And What Students Learn (Readiness To Teach) ........................................................................................................80
Table 9. Significant Decreases in Percentages Between Preservice Teachers’ Responses to Proficiency with Educational Software Apps Compared to a Cross-Tabulation of Preservice Teachers’ Proficiency with Educational Software Apps and their Readiness to Teach

Table 10. Distribution of Preservice Teachers’ Responses to 5 Items that Measure Appropriate Use of Technology by Education Faculty (n = 63)

Table 11. Percentage of Participants Who Agreed that their Education Professors Modeled an Appropriate Use of Technology for Teaching in 1:1 Classrooms and Who Agreed They Were Prepared to Select Technologies to Use That Enhance What They Teach, How They Teach, and What Students Learn

Table 12. Distribution of Participants’ Responses when Asked About Their Readiness to Teach, Proficiency Using Hardware, Proficiency Using Basic Software, Proficiency Using Educational Software, and Participants’ Perceptions of Appropriate Faculty Modeling of Technology

Table 13. Crosstabulation Between RTTrc and HARDWAREPROFrc

Table 14. Crosstabulation Between RTTrc and SOFTWAREBASICPROFrc

Table 15. Crosstabulation Between RTTrc and SOFTWAREEDUCPROFrc

Table 16. Crosstabulation Between RTTrc and MODELINGFACULTYrc
Chapter One Introduction

Our desire to communicate with others to acknowledge, entertain, inform, instruct, warn, or persuade, regardless of the tool, has been well-documented throughout history. In a recent exhibit in an internationally renowned museum, the sculptor juxtaposed a prehistoric stone tool and a cell phone (both crafted of greywacke, basalt, and argillite) to convey the similarity of items that symbolize both power and control. The museum notes offered this explanation for interpreting the artist’s work, “Sheehan’s sculptures provoke questions about contemporary rituals and interactions between man and machine” (Victoria & Albert Museum, 2016, p. 12).

Background

In the ancient past, when a stone tool would have been a highly-prized object for survival, we see the beginning of peoples’ relationship with tools. Whether tools were used for hunting game or grinding food, they were needed to survive. The ancient artifacts such as “stone tools, pottery sherds, metal sickles, iron slag, and grinding platforms” found in the archeological record were, over time, slowly replaced by other types of tools, those needed to support the growth of crops (Dobres, 2010, pp. 103-104).

In the waning decades of the 1800s, the image of a horse and wagon, moving slowly across a vast field, came to signify the final vestiges of the agricultural age. The tools used to support the agricultural age were utilitarian and sometimes hand-held, consisting of plows, tills, sticks, and wagons. The agricultural era dominated the period until the close of the 1700s; however, its status as a defining characteristic of society was replaced as we entered the industrial era.

The industrial age, characterized by large factories filled with people engaged in a
variety of repetitive tasks, signaled the next significant era. The industrial age also benefitted from tools that allowed mass production to occur. The Model T or Tin Lizzie, one of the first mass-produced vehicles to emerge, was possible only as a result of the new tools that undergirded the industrial age. The Tin Lizzie, like the computer, was originally produced at a cost that was beyond the means of the middle class (Bennett, 2008). Both items quickly reached economies of scale that allowed for cars and laptops to be affordable for a significant amount of the population.

As the recent global shift from an industrial to an information age has become more pronounced, modern tools have become digital and vastly more complex. New technology is “protean, unstable, and opaque,” and this suggests that educational pedagogy must adapt to ensure that students living in the information age are well prepared for their future pathways, however elusive those pathways may be (Mishra, 2009, p. 61).

As educators, we have an obligation to continuously reexamine our pedagogy. We are reminded of our responsibility by Rury (2013) who stated, “Because it [education] is inescapably linked to basic values about what children should learn and do, about human development, and even about the very purposes of life, it readily invites debate about methods and priorities” (p. 241).

Educators around the world are recognizing that to prepare K-12 students to become digitally literate and productive citizens will require student access to digital tools and apps, both inside and outside of school (Sahlberg, 2015; U.S. Department of Education, 2016). Educators also recognize that with the emergence of devices that may be in the hands of students in school or at home, pedagogical shifts must also occur that
allow teachers to continue to educate students for the era in which they live and work (Collins & Halverson, 2018; Kivunja, 2013; Mouza, Yang, Pan, Yilmaz Ozden, & Pollock, 2017). Therefore, pedagogical shifts from the institutions that prepare preservice teachers to enter classrooms are essential (Hughes, Liu, & Lim, 2016; Voogt, & Roblin, 2012).

**Statement of the Problem**

With the emergence of digital technology as a primary means to communicate and learn, it is imperative that educators become proficient in utilizing 21st century digital tools and apps. Preservice teachers’ ability to effectively use 1:1 digital tools and apps to prepare students to become digitally literate citizens has become essential (Chai, Tan, Deng, & Koh, 2017; Cuhadar, 2018; Gudmundsdottir & Hatlevik, 2018).

The International Society for Technology in Education (ISTE) published updated standards for teachers in 2017 that articulate the domains that teachers must reexamine as they integrate technology into every aspect of their pedagogy: learner, leader, citizen, collaborator, designer, facilitator, and analyst. For example, as a learner, “educators continually improve their practice by learning from and with others and exploring proven and promising practices that leverage technology to improve student learning” (ISTE Website, 2018). However, digital tools themselves are changing so rapidly and national and international expectations for preservice teachers’ technology education are elusive (Voogt & Roblin, 2012). This is resulting in many preservice teachers entering their first classrooms with insufficient educational technology training (Cuhadar, 2018; Heggart & Yoo, 2018; U.S. Department of Education, 2016).
Examining preservice teachers’ perceptions of readiness for teaching in 1:1 classrooms will help to identify the types of educational technology training new educators are receiving as they finalize their preparations for their first teaching assignment. In addition, analyzing preservice teachers’ perceptions may provide valuable insight to those responsible for teacher education (Chai, Tan, Deng, & Koh, 2017; Cuhadar, 2018).

**Purpose of the Study**

The purpose of this case study was to describe preservice teachers’ perceptions of readiness to teach in 1:1 classrooms at the conclusion of their teacher education programs.

**Research Questions**

I explored the following questions:

- What professional digital competencies designed for a 1:1 classroom are being taught in preservice teachers’ education courses?

- To what extent do preservice teachers feel prepared to begin their careers teaching in 1:1 classrooms?

**Theoretical Framework**

Educational researchers recognize that even if internet connectivity and access to devices are available, students will not receive equitable opportunities unless their teachers have a thorough and extensive understanding of how content, pedagogy, and technology interact (Koehler & Mishra, 2008; U.S. Department of Education, 2016). These three strands, identified in the Technology Pedagogy and Content Knowledge
(TPACK) framework in the next chapter, provide the basis for the theoretical framework of this study.

**Definition of Terms**

*Apps:* Software applications

*Educational Technology (EdTech):* the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources (Januszewski & Molenda, 2008).

*Digital Divide:* the gap that exists between those with access to a device, the internet, and equitable digital instruction, and those without access to a device, the internet, or equitable digital instruction.

*Digital Native:* a person “who has grown up with technology and does not know any other context” (Helsper & Eynon, 2009, p. 5).

*One-to-One (1:1) Classroom:* a classroom in which each student has access to his or her own computing and communication device (Islam & Grönlund, 2016).

*One-to-One Initiative:* a program in which all students in a district have access to a device.

**Delimitations**

The study is delimited to the preservice teachers enrolled in a teacher preparation program at the University of New Mexico.

**Significance**

The need for this study stems from the emergence of 1:1 initiatives in school districts across the globe (Heath, 2017; Whittier & Lara, 2006). Today many students have access to a digital tool and apps throughout their school day; however, they still face
a digital divide due to the lack of training that teachers have in effectively integrating instructional strategies with 1:1 devices (Dassa & Vaughn, 2018; Heath, 2017; U.S. Department of Education, 2016; Whittier & Lara, 2006).

Technology training in preservice teachers’ programs is not a new concept; however, the emergence of 1:1 devices for students, with a constantly increasing number of software applications or apps, has created a new classroom environment for teachers to manage. New teachers are unlikely to adopt new instructional strategies simply because they have technology in the classroom (Gherardi, 2017). New teachers are likely to deliver instruction that aligns to the modeling they received from their faculty; therefore, the professional digital competencies that preservice teachers are exposed to during their teacher preparation programs will have a significant impact on their future practice (Dassa & Vaughan, 2018; Gudmundsdottir & Hatlevik, 2018).

**Organization of the Literature Review**

In addition to reflecting on the relevance of tools that have impacted society over time, it was also important to review the history of the digital divide and the forces that interacted to create the digital divide. This literature review briefly touched on factors that have caused educational disparities to continue, as a result of limited access to digital tools, the internet, or equitable digital technology instruction.

Equally important was an examination of “one student to one device” initiatives, commonly referred to as 1:1 initiatives. The emergence of 1:1 initiatives, in which every student has access to a powerful device for learning, marked a new era. Furthermore, digital tools are no longer the purview of an adult population, focused on developing its young for their future responsibilities; rather, the advent of 1:1 digital technology has
placed a vast amount of power in the hands of our youngest students via software applications or “apps.” How educators integrate the 21st century digital devices and apps that are now available into their daily repertoires, and how they handle the drawbacks of technology inclusion, will impact our society.

An understanding of these topics combined with an examination of preservice teachers’ education provided insight to how educational technology has evolved. Finally, an in-depth study of preservice teachers’ perceptions of readiness for teaching in 1:1 classrooms delved more deeply into the professional digital competencies that preservice teachers developed in their coursework and fieldwork, and ultimately will integrate in their own classrooms.
Chapter Two Literature Review

To inform a study of preservice teachers’ perceptions, I organized the relevant research into sections: (1) tools; (2) the digital divide; (3) 1:1 computer initiatives; (4) digital technology drawbacks; (5) hardware; (6) software applications (apps); (7) preservice teachers’ education. After concluding the literature review, I summarized the research study, an analysis of preservice teachers’ perceptions regarding their readiness to teach in 1:1 classrooms.

Tools

**Early Tools.** Tools have a long, studied history. Archeologists have analyzed the usage of tools in both the human and non-human species. While animals have also used simple tools for the purposes of “producing an artefact that is then used, or to use one artefact to acquire another,” it is only humans who are able to make “composite tools (i.e., machines such as pulleys, windmills, automobiles) and tools used to make tools” (Aunger, 2010, p. 119). The bow and arrow is an example of a complex technological tool, used by all “contemporary human populations” (Aunger, 2010, p. 118). The bow and arrow has multiple parts (arrowhead, shaft, and fletchings) made of different materials. The individual parts, when used alone, are not effective in killing an animal; however, when the parts are constructed and used in a specific manner, the bow and arrow is powerful enough to bring down a large animal (Aunger, 2010).

Aunger (2010), studying the tool usage of both human and non-human species, posited that the “distinguishing feature of human technology” was the ability to “produce increasingly complex and varied artefacts” (p. 121). As we contemplate more recent
technological advances, and acknowledge the vast array of technology that is embedded in daily life, we are urged to ponder the impact of our “technological footprint” (p. 121).

**Early Educational Tools.** In 1890, Annie Willis, presumably an expert on blackboard “jottings,” wrote with confidence about the importance of using one’s blackboard to present information that was both informative and aesthetically pleasing. She provided her readers with several examples of models that could be written on the blackboard to help students understand new concepts: a tree to depict important dates in United States history; a border to highlight presidential terms; a relief drawing to highlight locations along the Hudson River; and finally, an “industrial map of America that made geography pleasant to one class” (Journal of Education, 1890, p. 6). Her comments appeared in the leading journal of her day and occupied space along with reflections on schoolroom methodology, physics prompts, and strategies for addressing discipline (remarkably similar to what is used today). Ms. Willis was using the technology of her time, blackboards, and was apparently considered an expert within this narrow field of educational tools.

Ms. Willis exemplifies the diligence that educators will often exhibit toward learning to use the tools of their trade. Many of today’s educators share Ms. Willis’s passion for mastering their craft, to include usage of their tools (Lei, 2009). Educational policy makers and curriculum specialists need to provide opportunities for relevant educational technology training that is embedded in all methodology coursework so that tomorrow’s teachers have opportunities to become master teachers (Kumar & Vigil, 2011; Minicozzi, 2018).
Archeologists study the remains of the materials, or technology, used in daily living to understand the past (Dobres, 2010). Future archeologists may approach their study of the archeological record in new ways. Examining both the material remains of objects used by humans in conjunction with the digital records that bear witness to their living conditions may yield a deeper understanding of how people lived. However fragile the process of analyzing the material remains of technology have been (i.e., unearthing items buried in the ground), analyzing the digital records of generations of those who lived during the information age may actually present a more challenging task for the archeologists of the future, due to the sheer volume of material that may be available.

**Digital Tools.** Even though the task is formidable, there are individuals who are creating what will be the digital archeological records of the future in a collaborative and transparent format. One example of a project that is being developed using digital tools to document the history of Native people is titled the “Indigenous Digital Archive.” The project is a collaboration between the New Mexico Museum of Indian Arts and Culture, the Indian Pueblo Cultural Center, and the State Library Tribal Libraries Program funded by grants. The stated purpose is to help people “explore the history of US government Indian boarding schools in the 19th and 20th centuries” (Indigenous Digital Archive, 2018). Visitors to the website not only have access to records that have been difficult to locate, there is also a mechanism that allows people to contribute in a variety of ways: add their personal stories, documents, or photos; offer counter-narratives; and share findings.

The digital tool has the potential to add accuracy, depth, and perspective to the archeological records that explored the history of the boarding schools that were opened
to educate young Native American children. The online process that allows for the expansion of the story by others is critical. Without contributions from students or families, the accounts represent only the viewpoints of those who were in power, painting a rosy, but misleading picture of the school as in the following account of the Superintendent in 1917.

The Superintendent of the Santa Fe Indian School began his 1917 report by extolling the health of the students. In rapid succession, he went on to favorably comment on each of the following: academic progress; building conditions; teacher morale; expenditures; vocational instruction; garden abundance; corn crop; and the Holstein cow purchase. He ended his report with a statement about systematic instruction (Santa Fe School Annual Report, 1917). Missing from his report was any commentary that reflected the controversial nature of the boarding school, or the viewpoints of students or families, many who believed cultural genocide was rampant.

Another example of the diversity and depth of the digital archeological records that are being created can be found in Chicago. The Museum of Contemporary Art Chicago recently featured an exhibit titled, “I Was Raised on the Internet.” In addition to the internet-themed art that was selected for inclusion in the museum exhibit, sixteen more artists were chosen to create online art using digital platforms to celebrate or warn viewers about the benefits or dangers of the internet. One of the artists chosen to participate in the museum’s online gallery was Jeremy Bailey. Bailey is featured because he founded an online accelerator startup, Lean Artist, to support aspiring artists who were interested in producing art that might be commercially viable, but more importantly, was
One of the Lean Artists supported by Bailey developed the following project to represent his misgivings about the ability of “Big Brother” to track internet communications, and to offer an option for those who want to connect without monitoring:

Clumzy is a playful electronic device that lets you send messages through a decentralized mesh network, alleviating any anxiety of “Big Brother” monitoring your communications. Designed to be squeezed like a stress ball (artist Jon Chambers modeled it after the negative space of his hand), it sends a color-encoded message based on the strength of the user’s grip. Those receiving the message feel a soft vibration that mimics an intimate touch. By not relying on text, Clumzy offers an alternative on the communication spectrum that encourages new, nonverbal conventions. (Contemporary Museum of Art Chicago, 2018, p. 3)

Another significant effort, international in scope, possible only through the use of digital tools, is the Comparative Constitutions project. The heart of the project is a comprehensive website, containing constitutions from 189 countries that can be read, searched, and easily compared by anyone with internet access. Each passage within the individual constitutions is tagged making it possible to search by more than 300 different topics. For example, a search for free education yielded 137 constitutions that contained these words (Comparative Constitution Project, 2018).

In addition to being able to search through constitutions, the project website also provides a chronological timeline of countries with data available on the earliest year a
constitution was created, the dates of amendments, and the date of the most recent revision to the constitution. The site enables people from all over the world to access the foundational documents of any country they are interested in analyzing. Excerpts can easily be downloaded for sharing passages with others.

The project is a collaboration between individuals from a wide range of organizations who contributed coding, translating, designing, and editing support. The project required a tremendous amount of collaboration and dialogue on the part of the participants. The project was possible only with digital tools that allowed documents to be shared and work to be completed by people living and working in many different parts of the world.

Blockchain is a digital tool that appears to be gaining momentum in both the public and educational sector. Tapscott and Tapscott (2017) argue that the blockchain, “not big data, MOOCs, virtual reality, or even artificial intelligence,” will be “the most important technology to change higher education” (p. 11). Tapscott and Tapscott offer a straightforward example of how the blockchain operates. Using the internet, users can easily forward and make copies of many different types of documents. In education, those documents might include lesson plans, syllabi, or class notes. However, there are some types of documents that need to be protected and should not be copied or printed (i.e., money, diplomas, or other educational certificates of completion). The blockchain technology allows people to “exchange things of value,” like money and diplomas, using an electronically secure and trustworthy process without assistance from the intermediaries who have traditionally helped people establish identities, transfer assets, and settle transactions (Tapscott & Tapscott, 2017, p. 12).
Why might this technology be useful to educational institutions preparing new teachers? If preservice students are able to attest to mastery, using blockchain technology, of specific content knowledge by “working with interactive, self-paced computer learning programs outside the classroom,” then faculty can focus class time on collaboration, discourse, and group work (Tapscott & Tapscott, 2017, p. 16). Blockchain is a digital tool that allows for collaboration and the exchange of things of value, from people all over the world, possible only as a result of the information age.

Numerous worldwide efforts are underway to capitalize on the power of technology to impact student learning through artificial intelligence. Although not commercially available yet, Carnegie Mellon researchers have developed smart glasses that allow teachers to gather real time data to assess students in a 1:1 classroom. The researchers recently queried a handful of K12 teachers to solicit input on what EdTech “superpower” the teachers would most like to have available in their classrooms. The teachers requested the ability to assess their students’ learning and monitor their behavior in real time, while the classroom was working on intelligent tutoring systems (ITSs) (Zalaznick, 2018).

As a result, Lumilo, an app which provides teachers with real-time continuous assessment data that floats above the students’ heads, was developed. The software is linked to the students’ devices and the smart glasses that the teacher dons. Once the smart glasses are on, the teacher is able to scan the room and view icons that represent the status of their students’ progress. They might see a question mark, the letters “zzz,” or a caution icon floating above the students’ heads, which all communicate to the teacher that an intervention is needed. Teachers can then respond to the students’ particular need,
maximizing their instructional support (Holstein, Hong, Tegene, McLaren, & Aleven, 2018). In addition to providing individual support, the software also allows teachers to immediately view class level analytics with the press of a finger. Although there is a myriad of creative and innovative minds involved in designing digital tools, the ability of educational institutions to provide equal access to all students of even the most basic educational resources and tools has been challenging, inconsistent, and inequitable.

**The Digital Divide**

The digital divide is a term that was initially used to define the gap between those who had access to the internet and a device, and those who did not (U.S. Department of Education, 2016). More recently, the term has come to denote the gap between students who have access to educational technology instruction and those who do not (U.S. Department of Education, 2016).

However, if we pause to look back on the history of public education, we are reminded of the enormous travesties that have been allowed to perpetuate our educational systems, long before the advent of the digital divide.

In the aftermath of WWII, the federal government took a leading role in education by providing funding and articulating policy that moved the educational debate onto the national stage (Rury, 2013). Public debate on education has remained at the forefront of our national conversations since the 1940s as educators, activists, and politicians have grappled with issues of curriculum, equity, access, and opportunity (Berkman & Plutzer, 2010; Preskill & Brookfield, 2009; Rury, 2013; Selden, 1999; Theoharis, 2009).

The long journey to obtain educational equality, at least on paper, was undertaken by many courageous people, fighting in court and in public spaces. The *Brown v. Board*
of Education decision in 1954 finally resulted in a ruling that afforded all children the right to public education; however, the battle to gain access and equality was not over (Kluger, 1976).

Even with their legal rights acquired, many children still experienced inequalities in their educational programs that exist to this day (Frankenberg, Ee, Ayscue, & Orfield, 2019; Kluger, 1976; Kozol, 1991; Ravitch, 2010). Along with uncertified teachers, decrepit school buildings, segregated schools, antiquated technology, and spotty or slow internet service, many students are now faced with a new area of inequity: the lack of teachers who possess the professional digital competencies to access the technology skills needed for the 21st classroom (U.S. Department of Education, 2016). The battle to obtain and then ensure that educational rights are provided to all is still ongoing; however, much of the continuing battle will be fought by citizens who believe that access to technology, the internet, and equitable digital instruction should be a given for all students.

In 2014, the National Assessment of Educational Progress (NAEP Technology and Engineering Literacy Report Card, 2018) assessment included a technology and engineering literacy assessment for 8th grade students. The assessment provided 8th grade students with an opportunity to use their technology and engineering skills to respond to a series of virtual scenario-based tasks. The percentage of 8th grade students who were proficient in 2014, by race/ethnicity, were as follows: Black 18%, Hispanic 28%, Pacific Islander 30%, American Indian/Alaska Native 42%, students reporting 2 or more races 45%, Asian/Pacific Islander 54%, Asian 56%, and White 56% (NAEP Technology & Engineering Literacy Assessment, 2014).
In 2018, the percentage of 8th grade students who were proficient, by race/ethnicity, were as follows: Black 23%, Hispanic 31%, Pacific Islander (not reported), American Indian/Alaska Native 29%, students reporting 2 or more races 53%, Asian/Pacific Islander 54%, Asian 66%, and White 59% (NAEP Technology and Engineering Literacy Report Card, 2018). The largest increase, 11 percentage points, was reported by students who identified as Asian/Pacific Islander. The sharpest decline, 13 percentage points, was reported by students who identified as American Indian/Alaska Native. The assessment results suggested that the achievement gap, for students other than those identifying as Asian, was just as pronounced within the realm of technology as it had been in math and reading. The need for 1:1 technology and instruction to support students of color remains a compelling issue (NAEP Technology and Engineering Literacy Report Card, 2018).

Tyack and Cuban (1995) contended that the debates over public education are crucial to developing and maintaining the discourse and foundations that support democracy. Retaining public education, discussing reforms, and promoting innovation represented the notion of an educational “trusteeship” that educators owed to students, and was essential to remaining a democratic country (1995, p. 142). Digital literacy is now addressed in public policy and promoted in many countries as being essential to a country’s economic welfare (Islam & Grönlund, 2016).

Merrow (2017) wrote passionately about his beliefs regarding school reform, arguing that not only must students be taught the traditional literacies, they must also be taught the “basics of speaking persuasively, listening carefully and critically, working collaboratively, and being reflective, all while mastering modern technology” (2017, p.
He argued that school reforms have been unsuccessful and subject to many diversions. One of his premises was that we must teach our students, many of whom are digital natives, to become digital citizens. He was impatient with the slow movement of reforms summarized by Tyack and Cuban (1995), suggesting that this slow pace caused the “addiction to reform” movement to become deeply entrenched (2017, p. 232).

Aoun (2017) espoused the teaching of three new literacies that he purported will be essential to harnessing the power of technology and human capabilities: technological, data, and human literacy. Aoun’s commentary was intriguing as he suggested that both the traditional and these new literacies or “humanics” will be critical in maintaining the ability of humans to thrive in a world of artificial intelligence (2017, p. 62).

Complicating the issue of digital equity is the tension between educators who believe that traditional instructional goals, emphasizing discrete content and specific skill acquisition, are non-negotiable when compared to the types of learning that technology affords to students, such as investigations and multimedia projects (Collins & Halverson, 2018). Others, like Prensky (2016), posited that the digital era has brought to the forefront the need for an educational overhaul, arguing that the four pillars of education (math, science, social studies, and English) should be replaced with four patterns of thought (i.e., effective thinking, effective relating, effective action, and effective accomplishing).

With the rise of 1:1 devices in classrooms across the nation, the conversation over what students should learn, and how technology should support students will continue. Inevitably, the continuation of curriculum conversations regarding the integration of technology will generate controversy as has been the case with the ongoing debates over
science curriculum first highlighted in the Scopes Monkey Trial of 1925. In 2010, Berkman and Plutzer argued, “the battle to control America’s science classrooms, then, is far from over,” (p. 226) suggesting that continued legal attempts, on the part of those who oppose evolution, will continue to surface. The authors also posited that with or without court battles, the ultimate influence on public high school biology students would be their biology teachers’ beliefs, training, and education. If technology integration also proves to be dependent on teachers’ beliefs, training, and education, the goals of individual teachers and their individual adoption of technology may overshadow the goals of society.

Ultimately, the discussions lead back to the purpose of education. If one accepts that promoting moral and informed citizens who can live and contribute to democratic citizenry is a purpose of education (Dewey, 1897; Mikulecky & Kirkley, 1998; Ravitch, 2010; Sehr, 1997; Soder, Goodlad, & McMannon, 2001), the emergence of 1:1 technology usage in education will continue to be an issue on the forefront of national policy, and thus is deserving of expanded research.

**1:1 Computer Initiatives**

**Early Implementation.** “1:1” is a term used in educational technology to signify providing a laptop or device to each student. The term is believed to have emerged as early as the 1990s in an Australian girls’ school (Johnstone, 2003). The school’s principal believed that his students would benefit from technology and convinced the parents of his fifth-grade class to purchase laptop computers for their daughters (Johnstone, 2003). From this beginning, other nations followed suit.
In the United States, based on the work in Australia, the Anytime Anywhere Learning initiative was created to provide students with a computer. Another initiative, the Teacher Leadership Project, was launched to provide teachers with technology training (Johnstone, 2003).

Both Microsoft and Toshiba sponsored programs for students in the 1990s (Johnstone, 2003). In 2002, the state of Maine began a program called the “Maine Learning Technology Initiative” which provided students and teachers with laptops, technical support, and training (Zheng, Arada, Niiya, & Warschauer, 2014, p. 280). Michigan, Texas, and Pennsylvania all rolled out similar programs after Maine.

Although one-to-one initiatives emerged as early as the 1990s, providing all students access to their own computer devices, both inside and outside of school, has not become ubiquitous throughout the United States. However, national policy, as articulated in the United States Educational Technology Plan, describes clear goals for 1:1 computer initiatives. Although research indicates that 1:1 devices positively impact student achievement, we have fallen short in providing both access to digital devices and instruction on digital applications (Harper & Milman, 2016; U.S. Department of Education, 2016).

**Impact on Student Achievement.** Harper and Milman (2016) conducted a literature review of empirical research studies on the topic of 1:1 devices, reviewing data from 2004 through 2014. They examined 400 articles before reducing their data set to just 48 articles that met their criteria for additional review. Harper and Milman (2016) emphatically made the point that they believe 1:1 devices will become more prevalent and thus, research is needed to identify the most effective strategies to utilize these tools.
In addition, Harper and Milman (2016) posited that 1:1 devices can positively impact student achievement across multiple content areas and grade levels. Students’ engagement and increased time on devices appear to be mechanisms for improving achievement (Harper & Milman, 2016).

Previous empirical studies indicated that 1:1 devices have the potential to benefit students in myriad ways (Tallvid, Lundin, Svensson, & Lindström, 2015; Zheng et al., 2014). Therefore, it is imperative that preservice teachers are exposed to pedagogy that addresses how 1:1 devices can be utilized to most effectively impact students’ learning. Pedagogy, specifically in relation to 1:1 classrooms, needs to be analyzed to better understand how digital devices and apps may enhance students’ learning.

Léger and Freiman (2016), examining the long-term benefits of 1:1 initiatives, posited that early laptop usage has long-term as well as short-term benefits for students: “These digital skills are technological resourcefulness, digital self-efficacy (empowerment), and open-mindedness toward technology” (p. 64). Although these digital skills are more difficult to measure, an awareness of their importance appears to be emerging in the national dialogue (Aoun, 2017; Merisotis, 2015). It is no longer sufficient for teachers to ensure that students have reading, math, and scientific skills; rather, a quality public education needs to effectively integrate technology if the highest goals of public education are to be met (Aoun, 2017; U.S. Department of Education, 2016).

Other researchers looking specifically at the impact of technology and learning-related outcomes concluded a review of “126 randomized evaluations and regression discontinuity designs” (J-PAL Evidence Review, 2019, p. 3). The authors identified two
areas, computer-assisted learning specifically in the area of math and technology-enabled behavioral interventions, as “two particularly promising areas” for future research (J-PAL Evidence Review, 2019, p. 20). The researchers also echoed a common theme in the EdTech literature: more research is needed to establish how best to integrate 1:1 technology into the educational setting.

In a literature review of 1:1 implementation programs from around the globe, the researchers studied usage patterns and the impact of 1:1 programs on students, teaching and learning, teachers, and communities (Islam & Grönlund, 2016). The review of 145 papers led the researchers to conclude that “using technology in the classroom can go either way; student results can improve or deteriorate. Only good pedagogy guarantees improvements” (Islam & Grönlund, 2016, p. 216).

**Net Generation.** Although some may argue that the term “digital native” refers to “the youngest generation who has grown up with technology and does not know any other context,” other researchers have a more nuanced definition: “someone who multi-tasks, has access to a range of new technologies, is confident in their use of technologies, uses the Internet as a first port of call for information and uses the Internet for learning as well as other activities” (Helsper & Eynon, 2009, p. 5). The term “digital native” is frequently interchanged with “net generation,” “google generation,” or “millennial” resulting in confusion regarding the term’s meaning (Helsper & Eynon, 2009, p. 1). For readers, it is important to note that the term does not have one definitive definition and its usage in describing a population may cause confusion rather than aid in providing clarity.

Although the Technological Pedagogical and Content Knowledge (TPACK) model presented a theoretical framework for analyzing the key components for teaching
in a digital age, the framework does not integrate the impact of a net-generation student, with a 1:1 device and access to unlimited apps, as a major component in the framework. Therefore, analyzing the impact of preservice teachers’ perceptions of readiness for teaching in 1:1 classrooms offered new perspectives on how technology should be integrated to best support students who have grown up with technology.

**1:1 Classrooms.** Various surveys have been developed to test a preservice teachers’ TPACK (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009), but the emergence of the 1:1 classroom, with each student now having access to his or her own internet device, has created significant new challenges and opportunities for educators (Dunleavy, Dexter, & Heinecke, 2007).

In observations of 1:1 classrooms, researchers have noted that students are often engaged in tasks that are not aligned with the learning objectives. For example, students may be multi-tasking during assignments that require the use of a device and preoccupied with combinations of the following: texting, updating social media, listening to music, watching videos, playing games, gathering information from non-scholarly sites, and skimming articles (Ditzler, Hong, & Strudler, 2016).

In a study of the Denver School for Science and Technology’s 1:1 initiative, researchers concluded that although laptops were instrumental in helping address the digital divide related to students’ access to devices and the internet, there were still complex challenges for educators to address: providing classroom management related to students’ device usage; selecting appropriate software in an environment where new apps are emerging at rates that defy categorization; developing systems to maintain laptops;
teaching students how to locate and utilize information that is credible, relevant, and appropriate for the tasks they are completing (Zucker & Hug, 2007).

Neiterman and Zaza (2019) explored the perceptions of college students and instructors related to off-task technology use. Their study suggested that instructors often use one of three approaches when dealing with students who display off-task technology usage during class: “ignore or tolerate” the off-task actions of students; “embrace and utilize” the students’ focus on technology; “explain and minimize” the impact that technology has on students (Neiterman & Zaza, 2019, p. 7). While some K-12 school districts are investing in monitoring programs to collect data on sites that students visit, often in real time, this study revealed that post-secondary instructors, also grappling with off-task behavior by students, are approaching this issue with a very different lens due to concerns about privacy and constitutional rights.

Although 1:1 classrooms pose challenges, they also provide an opportunity for teachers to respond to students in creative and innovate ways. David Narter is an English teacher who became concerned about his written feedback to his student as he reflected on his practice. He realized that the written feedback he was routinely providing students focused on all the areas that needed improvement. Missing from his student critiques was any feedback that identified areas of strength and encouragement to continue developing ideas or arguments that supported the students’ essays. Narter decided to integrate 1:1 screen video tools to provide students with a more comprehensive review. His students began to submit their work electronically and Narter recorded an individual screencast with audio as his feedback. Narter (2018) reflected:

Through DV assessment, I am able to do far more than I ever have with
paper and pen. Unlike with standard red-ink edits, I am able to change a simple mistake in their writing in front of the student, change it back again, and note its appearances later in the same assignment. I’m able to open several of their documents at once to compare features and note their progress. I am able to refer back to standards rubrics and exemplar essays to suggest where things might have gone awry and provide clearer pathways to improvement (2018, p. 107).

This type of intensive feedback, individualized for each student, would not be possible without all students having access to the devices they need to research, write, submit, and review their instructors’ comments. Narter’s ability to provide a 1:1 digital video assessment to each of his 150 students attests to the power of 1:1 computing for positively impacting students’ writing.

An analysis of preservice teachers’ perceptions of readiness for teaching in a 1:1 classroom, which involves the monitoring and usage of apps on a daily basis, will add to our understanding of what constitutes the optimal learning conditions for preparing students for their future as productive citizens. Ultimately, an understanding of the educational tools that are now available will help “build a more nimble, informed, and continuously improving teaching force in America” (Webb, 2013, p.19). This study examined the professional digital competencies that teachers are acquiring as they complete their preservice programs, and will hopefully add to the body of literature that supports the intersection of technology and pedagogy in 1:1 classrooms.

**International Trends.** Australia recently funded a 1:1 initiative for one of its coeducational secondary schools through a federal grant. The secondary school was studied using a mixed methods approach to determine the perceptions of the students and
teachers regarding the 1:1 initiative. Two factors, collaboration with colleagues and access to a digital coach, were noted as the key components of a successful 1:1 initiative (Keane & Keane, 2017).

In Denmark, all students in grades 1 through 9 have access to their own device and research has suggested that there is a positive association between 1:1 devices and the acquisition of literacy skills (Andresen, 2017. However, teachers have to build their professional digital competencies to manage the new issues, such as multi-tasking and skimming, that have arisen as a result of 1:1 initiatives. As Andresen argued, “Teachers need to be able to manage 1:1 classrooms” (Andresen, 2017, p. 547). Andresen (2017) also espoused the viewpoint that those responsible for teacher preparation have a responsibility to build teacher capacity using technology.

Andresen challenged the notion that students, by virtue of being “digital natives,” will automatically become literate. Instead, he argued that research indicates that students must learn to “access and process educational material” in order to truly achieve digital literacy (2017 p. 547).

Swedish researchers (Tallvid, Lundin, Svensson, & Lindström, 2015) explored the use of personal computers by middle school students enrolled in two schools that adopted 1:1 initiatives. The authors concluded there was not a reciprocal correlation between sanctioned and unsanctioned laptop use by students, as other educators had suggested. Rather, the researchers determined that the number of students who used their laptops for sanctioned activities (word processing, information searching, preparing presentations, digital recordings, and music listening) increased each year, during the three year span of the study, while the percentage of students who used their laptops for
unsanctioned activities (chatting, playing games, off-task surfing, and downloading) remained at a similar level throughout the study (Tallvid et al., 2015).

Tallvid et al.’s study (2015) contained the terms “sanctioned” and “unsanctioned” in the title, suggesting that there were ethical or other disciplinary ideas that the study would explore. This was an interesting element of the research as it appeared to suggest that digital citizenship had emerged as a topic worthy of study. The steering group for these two schools determined early in the implementation process that the laptops would be provided to students without software filters or restrictions. The steering group articulated, “the filter should be in our mind—not inside the laptop” (p. 239). If teachers encountered issues with inappropriate student use, teachers were encouraged to “discuss the ethical questions more intensely in the class” (p. 239).

The results of the Swedish study, although promising, should not be considered generalizable at this juncture. The self-reported student data was problematic. The students were the first group in their municipality to be issued their own 1:1 laptops. Some students reported that they felt responsible for ensuring a successful implementation as other students, in later years, might benefit from the results (Tallvid et al., 2015).

The Swedish study, focusing on measuring usage rather than assessing positive academic outcomes, draws attention to the work of Cuban (2001) and Webster (2016), both of whom studied the assumptions of educators who made decisions related to technology. Cuban, writing in 2001, argued that educators often purchased hardware and software because it was “as much symbolic political gestures as they were attempts to actually acquire the right tool to get a job done well” (p. 158). Fifteen years later,
Webster posited that educators were still purchasing hardware and software for the wrong reasons.

Although educators who maintain responsibility for technology appear to view technology with optimism, their assumptions regarding technology are apt to fall into one of two categories: “educational goals and curriculum should drive technology,” and “keep up with technology or be left behind” (Webster, 2016, p. 29). More importantly, educators are most likely to maintain the “keep up with technology or be left behind” viewpoint because they view technology as inevitable (Webster, 2016, p. 29). Therefore, educators who understand that they are likely to demonstrate a propensity for this viewpoint will be better versed to take a step back and make thoughtful, reflective decisions related to technology resources and actual student needs.

School districts around the world are engaged in an examination of preservice teachers’ technology training to support the knowledge era. Research has shifted from an emphasis on whether 1:1 devices actually promote achievement to how 1:1 devices should be used to enhance teaching and learning (Keane & Keane, 2017).

**National Trends.** In 1996, the Department of Education issued its first national report on technology titled “Getting America’s Students Ready for the 21st Century: Meeting the Technology Literacy Challenge. A Report to the Nation on Technology and Education,” arguing that with “reading, writing, and arithmetic, technology has become the nation’s new basic” (U.S. Department of Education, 1996, p. 9). In addition to teacher training in technology, access to classroom computers, the internet, and software were also listed as essential elements for preparing students for life in the 21st century (U. S. Department of Education, 1996, p. 7). In 1996, 1:1 classrooms were rare and only 4
percent of schools reported having computers for students to share (5 students per 1 computer) (U.S. Department of Education, 1996).

The goal in 1996 was to ensure that all students in the United States had access to a classroom computer at a ratio of 5 students to each computer (U.S. Department of Education, 1996). In hindsight, the decision of policy makers to support a 5:1 ratio of students to computers may have inadvertently slowed down the progress of integrating technology into the classroom by setting a bar that was inadequate for effective technology utilization within classrooms.

In 2000, the Office of Educational Technology released its second national report addressing the state of education: e-Learning: Putting a World-Class Education at the Fingertips of All Children. The 2000 educational technology goals reflected the emergence of the internet and access to digital content as key elements of 21st century technology readiness (U.S. Department of Education, 2000). Teacher preparedness was again highlighted as a key element of a successful technology plan and explicit steps were outlined for teachers: “demonstrate a sound understanding of technology operations and concepts; plan and design effective learning environments and experiences supported by technology; implement curriculum plans that include methods and strategies for applying technology to maximize student learning; apply technology to facilitate a variety of effective assessment and evaluation strategies; use technology to enhance their productivity and professional practice; and demonstrate an understanding of the social, ethical, legal and human issues surrounding the use of technology in education” (U.S. Department of Education, 2000, p. 39). Teacher readiness was considered critical to the success of the technology plan.
Continuing its cycle, the Office of Educational Technology released its third national report in 2004 titled “Toward A New Golden Age in American Education—How the Internet, the Law and Today’s Students Are Revolutionizing Expectations.” In contrast to the report issued in 2000, the 2004 report emphasized the emergence of tech-savvy students entering schools that may not have adapted their instruction or trained their teachers for the new net generation (U.S. Department of Education, 2004).

In 2010, the National Education Technology Plan was named “Transforming American Education: Learning Powered by Technology.” The plan was divided into five sections (learning, assessment, teaching, infrastructure, and productivity) and harnessing the power of technology to provide individualized or personalized learning was emphasized (U.S. Department of Education, 2010). The plan included commentary on the need for teachers to consistently acquire advanced EdTech skills, an area that remains a focal point even 10 years later.

In 2016, the Office of Educational Technology released its report, “Future Ready Learning: Reimagining the Role of Technology in Education.” The report highlighted major recommendations that support the official goals of technology integration in public education. In particular, states are directed to use technology to ensure that students have continuous access to “learning ecosystems” (U.S. Department of Education, 2016, p. 22). A learning ecosystem, in which all students, wherever they reside have continuous access to an internet device and the internet was a lofty goal; however, the inclusion of 1:1 devices for students was a practical step that has promoted the national goal.

According to the 2016 National Technology Education Plan, schools should offer learning experiences that allow the United States to “remain globally competitive and
develop engaged citizens who can think critically, solve complex problems, collaborate, and communicate using multimedia” (p. 8). Does a rationale for 1:1 computer devices in schools align with the larger principles of public education that promote students’ pursuit of digitally literate and productive citizenry in a democratic society? Many would argue that the goals of public education are no longer obtainable without the use of technology (Aoun, 2017; Merrow, 2017; Ravitch, 2010).

Instead of waiting to issue another national report in 2021, the Department of Education announced in 2017 that the department would issue an annual report, rather than a report every five years, due to the rapid changes occurring in technology and education. The 2017 (U.S. Department of Education) plan was issued as an update of the 2016 plan; however, as of 2019, the annual plan for 2018 has not been made available.

**Local Trends.** In the state of New Mexico, the location of this study, one district chose to initiate a 1:1 laptop program in 2014. Santa Fe, New Mexico, home to the Santa Fe Public School District, provides educational services for approximately 13,000 students. Prior to 2014, the school district leadership proposed that the Board of Education adopt an $11 million technology note to support the first and second years of a $55 million five-year technology plan to increase equity and access to students by providing age-appropriate tools and instructional support. The Board supported the recommendation and voted to fund the initiative for the first and second year (Santa Fe Public Schools Board of Education, 2013).

In 2015, the board passed a resolution to ask the community to support the district’s technology plan, and moved to add the request for additional funding to the voter ballot in 2016. Voters were asked to support $33 million in additional funding to
cover the $55 million plan in full (Santa Fe Public Schools Board of Education, 2015).

The bond was supported by the community and by August of 2017, all Santa Fe middle and high school students were assigned a laptop for use at school and at home. In addition to the 1:1 laptop devices, classrooms were updated with new infrastructure, and equipment, to include Smartboards and document cameras. Professional development for teachers was also integrated into the technology plans, as well as the addition of digital learning coaches (DLCs) to the Information Technology department. Both initial training and on-going training were scheduled and funded.

The district believed the technology plan, to include the 1:1 initiative, would address the following goals: all students will possess the education and skills required to compete in the global marketplace; teachers will have the tools and training to prepare students to be collaborative world citizens; the community will benefit from more skilled young adults entering college and the workforce.

There are now more than 16,000 devices available in the district which means that the district has surpassed its 1:1 ratio goal. In grades kindergarten and first, iPads are available for each student. In grades two through six, there is a dedicated Chromebook cart for each classroom. In grades seven through twelve, each student is loaned a Chromebook to take home and use throughout the school year, although the district has not collected data on how many students have internet access at home.

The district hired 18 digital learning coaches, all of whom are qualified teachers, to continue to support educators. The role of the digital learning coach (DLC) has evolved as the technology department responds to the changing needs of the users. The responsibilities for the current year’s DLCs include the following: model technology
integration, provide staff development, assist in lesson creation, support digital
citizenship, and support and grow the use of digital resources.

The district recently acquired a license to pilot “CatchOn,” an app that helps identify utilization, trends, and best practices. One of the district’s middle schools is piloting a project, the “Rolling Study Hall,” to increase students’ access to the internet while being transported to and from school. The grant also provided funding for a tutor to ride the bus with students to offer support with homework (Lowe, 2018).

The district, in approaching the conclusion of five years of community provided EdTech funding, faced a daunting challenge: how would the district continue to fund its EdTech plan without a new source of revenue? District administrators, with the support of their local board of education, decided to again promote an educational technology note (ETN) bond, in a local election, which would provide another $55 million in taxpayer monies to support five more years of EdTech usage within the district.

The district realized that unless the ETN election was held in the spring of 2019, the district would face a gap in funding. Spurred on by a desire to maintain EdTech services, the district launched a publicity campaign, spending almost $200,000 to highlight the need for voter support of the 2019 ETN bond. The format of the election was non-traditional. Instead of voting in person on a specific day, the district sent mail-in ballots to all registered voters adding another layer of anxiety to those responsible for ensuring the continuation of EdTech services.

After the votes were counted, SFPS staff were elated to learn that almost 60% of voters had supported the bond and the district would be able to continue to provide EdTech services for another five years (Mullan, 2019).
For years, researchers have written about the funding obstacles that districts face in integrating educational technology throughout a district (Ireh, 2010). Without a thoughtful plan in place to purchase and maintain a robust educational technology environment, districts can quickly face a daunting set of challenges: How will replacement devices, needed every 3-5 years, be funded? Will there be adequate funding for technology specialists to maintain the devices and network? How will digital learning coaches, essential to training teachers to utilize technology, be funded?

Like Santa Fe Public Schools, in 2019 Albuquerque Public Schools (APS), the largest school district in the state of New Mexico, also reached out to their voters to request support for educational technology; however, the outcome was very different (Perea, 2019). The Albuquerque voters rejected the $200 million bond proposed by the school district and the state of educational technology enhancements in APS is, at least for the present, uncertain.

The recent differences in the outcome of these two New Mexico EdTech bonds underlie the challenges that school districts must overcome. APS, in failing to obtain voter support for their EdTech programs will need to identify other sources of funding or reduce their EdTech programs. Meanwhile, SFPS, after a successful mail-in voting campaign, was able to deliver another $55 million to the children of Santa Fe to continue their investment in EdTech (Mullan, 2019). This study on preservice teachers’ perceptions of readiness explored whether teacher candidates are ready to step into 1:1 districts and classrooms such as those described above. Are preservice teachers ready to integrate technology in a classroom in which all students have a device and do they understand the emerging controversies related to digital classrooms?
Digital Technology Drawbacks

Public opinion polls indicate that many adults, although they have concerns about digital technology, also report that their lives are very much dependent on technology, and overall, view technology access as a positive (Pew Research Center, 2018). In a 2018 Pew survey, respondents cited the following as benefits of digital technology: global connection with family and friends; wide-spread opportunities to create and innovate both in professional and personal endeavors; access to life-saving devices for one’s family and for elderly care; far-reaching capabilities to conduct business, make plans, buy, travel, or learn with ease (Pew Research Center, 2018).

Conversely, some of the respondents pointed out digital issues that have contributed to a decrease in quality of life activities: connections with others, through social media, are time consuming; security and surveillance are increasing at inappropriate rates and personal privacy is decreasing; social media sites encourage people to portray an image that is not grounded in real life; personal connections are superficial, while one’s ability to concentrate on a task for a sustained amount of time is impaired (Pew Research Center, 2018). These concerns are voiced in international, national, and local conversations by educational researchers.

International Trends. The spread of digital technology worldwide is eliciting concern from many researchers around the globe who are grappling with understanding the benefits and risks that digital technology affords, particularly in the area of internet usage. The Global Kids Online Research Synthesis Report for 2015–2016 summarized the work of many European countries united by the common goal of understanding both the benefits and risks of internet usage for students, and working to improve the internet
for kids (Byrne, Kardefelt-Winther, Livingstone, & Stoilova, 2016). The report highlighted the education and experiences that many European countries are providing to their children to help them develop the skills they need to navigate the online community.

Although the research compiled within the report suggests that the benefits of digital technology and internet use outweigh the risks, the authors also posited that policies should be adopted to ensure that children are being prepared and participating in the digital platforms in a manner that is age appropriate (Byrne et al., 2016). Teacher training was explicitly noted as being critical for this transition: “Improving school access, supported by teacher training, could further link internet use with education and information benefits, specifically by developing children’s digital skills, which have been shown in this report to include notable gaps in competence, especially among younger users” (Byrne et al., 2016, p. 63).

In another large study (n = 120,115) researchers (Przybylski & Weinstein, 2017) studied the screen time habits and mental health of teenagers in England concluding that “moderate use of digital technology is not intrinsically harmful and may be advantageous in a connected world” (p. 204). Their study set out to test a concept in the literature known as the “displacement hypothesis” in which increasing levels of exposure to screen time are linked to increasing levels of harm (with harm defined as a loss of interest in activities such as socializing, reading, and exercising) (Przybylski & Weinstein, 2017, p. 204).

Przybylski and Weinstein (2017) advanced a new phrase, dubbed the “digital Goldilocks hypothesis” to suggest that tech use in moderation causes no ill effects (p. 204). The authors concluded that technology use that was high, instead of moderate,
could have a small, but negative effect on teenagers and that the type and time frame of technology use were also contributing factors to whether technology use was viewed as beneficial or harmful. Overall, the study suggested that additional research was warranted to understand the nuances and impact of technology on students.

As preservice teachers prepare to enter classrooms where students may be exposed to screens, outside of school on a recreational basis for more than 18 hours per week (Ofcom, 2015), the need to understand how to best integrate technology into instruction remains critical.

**National Trends.** In a recent study of screen time, researchers (Twenge & Campbell, 2018) analyzed the screen viewing patterns, outside of school, of 40,000 children as reported by their primary caregivers. The authors concluded that “children and adolescents who spent more time using screen media were lower in psychological well-being than low users” (Twenge & Campbell, 2018, p. 279).

A major gap in the study conducted by Twenge & Campbell (2018) was the screen time usage patterns of children within the school day. If both school and home screen time patterns are analyzed, what impact does total screen usage have on children’s psychological well-being? This will be an area of research that needs additional focus as more school districts add 1:1 devices to their classrooms.

Other researchers (Walsh, Barnes, Cameron, Goldfield, Chaput, Gunnell, Ledoux, Zemek, & Tremblay, 2018) studied the impact of exercise, sleep, and recreational screen time for children and suggested there was an association between cognitive performance and movement guidelines. When children experienced 60 minutes of exercise per day, 9 to 11 hours of sleep per night, and 2 or fewer hours of recreational screen time per day
cognition was impacted (Walsh et al., 2018). This movement study, however, did not include the screen time that children were exposed to during the school day, an increasingly important data point as more students have access to 1:1 devices throughout their school day. This study, which noted the importance of minimizing children’s screen time, highlighted why additional research on total screen usage (recreational plus educational) is critical.

The American Academy of Pediatricians (AAP) currently provides recommendations for screen use for children 5 years of age and younger (Walsh et al., 2018), but the authors of this movement study suggested that it would be appropriate for the AAP to expand their recommendations for sleep, activity, and recreational screen time to include both preteens and teens. In light of the number of hours that some teens are spending on recreational screen time, it would be challenging for some parents to implement guidelines that limited usage to 2 or fewer hours per day. An increasing awareness of the amount of recreational and educational time that children are spending on screens is prompting parents, educators, and researchers to raise cautionary notes of concern.

In particular, the decisions by parents who work in the technology industry to limit their own children’s access to technology has recently garnered national attention (Bowles, 2018). The misgivings of these parents related to the impact of technology and the amount of time children spend in front of screens has resulted in a shift. These parents, many of them well-educated and affluent, are seeking schools that minimize or eliminate children’s access to devices, at least while in elementary school, citing the addictive nature of technology as a major issue (Bowles, 2018).
Other researchers are also highlighting legitimate concerns about the digitalization of America’s classrooms (Boninger, Molnar, & Murray, 2017). The routine collection, by for-profit companies, of enormous amounts of student data is a concern, in addition to the marketing strategies that are being employed by hundreds of companies anxious to increase their profits through an expanding array of digital tools (Boninger et al., 2017).

In 1998, the first Commercialism in Education Research Report was published to draw attention to the trends that were emerging between educational entities and the companies anxious to market digital tools to students and schools. The current 2017 report summarized the lack of protections that are in place, even after 20 years, to protect students, and the eagerness of companies to exploit a market that may yield handsome profits for many years to come (Boninger et al., 2017).

Although there have been attempts to protect student data through regulation, researchers (Boninger et al., 2017) contend that the loose federal guidelines that exist have not provided the protections that students deserve. In this year’s Commercialism in Education Research Report, subtitled “Asleep at the Switch: Schoolhouse Commercialism, Student Privacy, and the Failure of Policymaking,” the authors argued that school districts, prior to negotiating contracts with any technology company, should adopt data collection and privacy guidelines, in addition to transparent, independent, and validated reviews of algorithms for ensuring that students’ best interests are maintained (Boninger et al., 2017, p. 29).

The efficacy of technology that promises personalized instruction is also under debate (Enyedy, 2014). Enyedy (2014) posited that although technology has transformed
most sectors of the market place, the classroom is the one organization that has yet to benefit from the full potential of digital technology. Enyedy (2014) also argued that although computers in classrooms are routine, teaching practices have changed little. In addition, he espoused the viewpoint that administrators have responsibility for thoughtfully integrating technology: “Administrators must ensure that investments in technological infrastructure and software licensing are accompanied by substantive professional development for teachers in order to provide them with skills that have not historically been in the teacher’s toolbox” (p. 17). The call for administrators to become more knowledgeable about the efficacy and utilization of 1:1 technology is an emerging theme in the literature (Cole & Sauers, 2018; Håkansson Lindqvist, 2019; Penuel, 2006).

**Local Trends.** School districts throughout New Mexico are grappling with all of these issues: screen time, privacy guidelines, data collection, student engagement, and the efficacy of personalized learning. In addition, cybersecurity is also a concern. In the Gadsden school district this summer, a virus infected the district-wide email accounts, resulting in all email being unavailable for more than a week. The Superintendent released a statement clarifying that the district would not pay a ransomware request (D’Ammassa, 2019). The email accounts were rebuilt; however, email communication prior to March of 2019 was not recovered.

Research is drawing attention to both the positive and negative factors of life in a digital age. Recognizing that the emergence of the digital era is not without controversy requires researchers to examine both the benefits that students may reap as a result of educators’ thoughtful and strategic integration of technology, and the drawbacks.
Hardware

Although educators who maintain responsibility for technology appear to view technology with optimism, their assumptions regarding technology are apt to fall into one of two categories: “educational goals and curriculum should drive technology,” and “keep up with technology or be left behind” (Webster, 2016, p. 29). More importantly, educators are most likely to maintain the “keep up with technology or be left behind” viewpoint because they view technology as inevitable (Webster, 2016, p. 29). Therefore, educators who understand that they are likely to demonstrate a propensity for this viewpoint will be better versed to take a step back and make thoughtful, reflective decisions related to technology resources and actual student needs.

Thoughtful decision making related to technology expenditures is critical when one considers the initial cost of integrating technology into an organization, followed by the ongoing cost of maintaining robust systems.

School districts are using a variety of methods to pay for initial and on-going costs related to technology. Grants have been secured through micro-funding, local and state opportunities, and federal grants. Some states are providing funding for devices and connectivity while other states have relied on local communities to fund technology initiatives through bond elections. The FCC e-Rate program provides discounted rates for school districts accessing telecommunications services. Federal funding dispersed through Titles I through IV and the Individuals with Disabilities Education Act (IDEA) are also avenues for school districts to use to access resources that can be allocated to cover a host of technological needs, to include professional learning for educators (South, 2017). However, even with a variety of funding options available, school leaders still
worry about how long-term technology will be sustained. Along with cybersecurity, sufficient funding to ensure the continuity of technology continues to top the list of items that IT administrators voice concerns over managing (CoSN, 2019).

Nadjia Yousif is a technology advisor who provides mentoring services to financial organizations. Yousif recently delivered a TED talk with the following title, “Why you should treat the tech you use at work like a colleague” (TEDtalk, 2018, December). Yousif (2018) posited that companies that make significant investments in technology often overlook the training required for employees to maximize their technology usage. As a result, many projects are never completed or projects with minimal value to the company are delivered. Her solution is to help companies promote a new perspective regarding the relationships between people and tech. Instead of viewing tech as simply tools and software, people should adopt a new paradigm in which tech is treated as a colleague. If people are underutilizing tech, there should be conversations to better understand why one’s “colleague,” tech, is not helping people do their jobs in a more efficient manner.

In educational organizations preparing preservice teachers for 1:1 classrooms, would viewing digital tools as “colleagues” enhance the ability of new teachers to become more comfortable with digital tools? Would equating one’s digital tools to “colleagues” nurture an affinity by preservice teachers to use tools to maximize student learning? As we ponder technology’s impact, we may find that these types of questions seem less abstract and more reasonable to reflect upon.
Software

The burgeoning availability of software applications or “apps” has created new challenges for educators (Lee & Cherner, 2015). In a recent informal survey, I clicked on my “App Store” icon and searched for the term “education.” Almost 1000 apps were listed. As a preservice teacher preparing for the classroom, the ability to analyze the effectiveness of apps, and avoid inferior apps is a critical, but overwhelming task (Ditzler et al., 2016; Lee & Cherner, 2015).

Efforts to develop rubrics for teachers to use to assess software apps have been undertaken by multiple researchers. One rubric, developed by Lee & Cherner (2015), was organized around three categories or domains: instruction, design, and engagement. Their rubric was developed to allow teachers to analyze a number of specific dimensions in each domain. For example, “rigor, 21st century skills, connections to future learning, value of errors, feedback to teacher, and level of learning material” represent the areas that teachers would evaluate if focusing on the instructional features of a software app (Lee & Cherner, 2015, p. 37). Software assessment rubrics, however, have not become a routine topic in preservice programs.

The impact of software to identify and provide interventions for assessing multiple intelligences is also under study. Researchers (Garmen, Rodríguez, García-Redondo, & San-Pedro-Veledo, 2019), hoping to design and develop a software program to accurately measure students’ multiple intelligences using Gardner’s (1993) framework, summarized the results of their recent study. The authors concluded that the Tree of Intelligence digital tool they designed might hold merit as a software program that could assess students’ multiple intelligences and then provide online programming to address
any areas of concern in students’ profiles. The study was not generalizable, but the format of the research study suggested that software is being analyzed for its impact on content that includes bodily-kinesthetic, musical, interpersonal, and naturalistic ways of learning (Garmen et al., 2019).

Short video creation by teachers using software to teach content is another area garnering interest by educational researchers. Statistics related to the frequency that people view Youtube video, which is in the billions each day (Moussiades, Kazanidis, & Iliopoulou, 2019), attested to the popularity of images to engage viewers. To tap into this potential tool, researchers are studying the methodology that teachers might use to develop short videos that enhance student outcomes. The results are promising, but additional research is needed before teacher-created videos, using a research based methodology, will be readily available for use in preservice education (Moussiades et al., 2019).

**Preservice Teachers’ Education**

Preservice teachers’ education is most effective when the following supports are in place: “Coursework and clinical work that are interwoven and pointed at a common conception of good teaching; emphasis on understanding curriculum, learning, and assessment, as well as methods of teaching; and use of case methods, action research, and performance assessments to develop skills for reflecting on teaching in relation to learning” (Darling-Hammond, 2009, p. 206). Researchers have continued to study the extent to which pedagogy, content knowledge, technology, faculty modeling, opportunities for reflections, and field based experiences impact the type of instruction that preservice teachers deliver once they have their own classrooms (Brenner & Brill,
With the advent of technology, preservice teachers’ education took on added complexity. Now it is important to examine whether the pedagogical shifts that occurred as a result of the inclusion of technology have been sufficient to address the emergence of the 1:1 classroom. There are questions about preservice teachers’ abilities to connect technology, pedagogy, and content knowledge within the confines of a teacher prep program that offers insufficient time to master a very complex process (Mecoli, 2013). Therefore, the addition of another element, students with their own devices, creates yet another factor that increases the complexity for preservice students studying to become teachers.

**Pedagogical Shifts.** As we approached the final years of the 20th century, educational researchers were thinking about the impact of technology on education (Garner & Gillingham, 1998; Kinzer & Risko, 1998; Mikulecky & Kirkley, 1998). Educational case studies, presented in a multimedia format, but similar in structure to the case studies used in the medical and law professions were growing in use (Kinzer & Risko, 1998). The World Wide Web was viewed as an ideal forum to provide preservice teachers with opportunities to collaborate with other teachers around the world (Kinzer & Risko, 1998). In hindsight, the predictions of the researchers are interesting to read, both for the outcomes they accurately predicted and the estimates that have proved to be off target. Educational researchers who are now attempting to predict the future of educational technology may also find their predictions to be equally off target.

In contrast to the earlier predictions from Kinzer and Risko (1998), more current research indicated that case-based instruction was not the most effective strategy to build
Preservice teachers’ technological knowledge (Mecoli, 2013). Rather, preservice teachers should first be exposed to pedagogy, content, and technology and then be afforded opportunities to create lessons that use appropriate information and communication technology (ICT) to create lessons that are relevant and engaging (Mecoli, 2013).

Researchers have contended that teacher educators have a critical role in modeling effective strategies for utilizing technology in the classroom for preservice teachers; however, teacher educators reported that they do not always have the skill sets, devices, or support needed for integrating technology into their methods courses (Kalonde & Mousa, 2016). Furthermore, their study recently examined the factors that impact technology modeling by teacher educators and concluded that “content, ease of use, availability, experiences, students’ interests, and obstacles” were contributing factors when teacher educators designed their methodology courses (Kalonde & Mousa, 2016, p. 236). Strikingly, Kalonde and Mousa also posited that some teacher educators fear being unprepared to use technology “in the presence of knowledgeable students” (2016, p. 248). Master teachers, comfortable with their place in their classroom as the instructional expert, may have to wade into unfamiliar territory to meet the needs of their students who arrive possessing advanced digital literacy skills.

In February of 2000, the Department of Education announced a competition to award 80 grants to further the study of preparing preservice teachers to integrate technology into their teaching. More than $48 million was set aside to support the endeavor, Preparing Tomorrow’s Teachers to Use Technology Program (PT3) (U. S. Department of Education, 2000). The PT3 grants were designed to address the problem that only 20% of teachers reported feeling confident in integrating technology into their
classrooms.

Universities that applied for the grants focused on a variety of areas. The University of New Mexico (UNM) emphasized an initiative to support teachers with its application, “From Shared Vision to Shared Practice: Enabling Tomorrow’s Teachers.” The University of New Mexico articulated the following outcomes in its grant application:

A teacher preparation curriculum enriched with the integration of technology in both content and pedagogy; improved articulation between the university setting and field-placement classrooms; increased information technology proficiency among preservice teachers and methods and content area faculty; increased access to and sharing of field-based best practices in technology integration in critical areas such as multicultural education, science, and the teaching of special populations; new research documenting comprehensive systemic reform of the major elements of the extended teacher preparation process; and the capability to research and assess cutting-edge trends in higher education, business, industry, and government; and proactively include such innovations in the development of novice and in-service teachers. (U. S. Department of Education, 2000, p. 3)

The UNM grant study outcomes provided a wealth of information related to the integration of technology in preservice teacher education programs (Hall, Fisher, Musanti, Halquist, Magnuson, & Simmons-Klarer, 2002). The research study was designed as a collaboration between faculty members who taught preservice teacher methodology courses and graduate students. The graduate students were each assigned five faculty members to collaborate with them for the duration of the three-year grant
study. Inherent in the design of the study was the premise that although faculty “grounded their courses in constructivism and socio-political issues of learning,” absent from their repertoire were the “knowledge and skills necessary to connect these to computer-based learning activities” (Hall et al., 2002, p. 646). Hall et al. also emphasized that the practice of teaming graduate students with faculty members was helpful for a myriad of reasons to include “timely tutoring on software” (2002, p. 655).

The UNM study provided an opportunity for the graduate students to provide technical support for their faculty collaborators to use devices and integrate software apps into their methodology courses. The study also provided numerous options for all of the participants to meet in person and in small groups to reflect upon and discuss the progress of the initiative. At the conclusion of the study, the researchers identified six important insights:

Any process aimed at changing teaching practices must be sustained and supported over time; mentoring relationships between Tech Guides and faculty promote collaboration as a central piece in the co-development of classroom activities; relationships based on comfort foster collaboration and growth; small group conversations and continuous interaction positively impact the design of professional development; each faculty member's philosophy of education and teaching style must be respected in the process of integrating technology; incentives promote interest and motivation, but institutional pressures will contribute to lack of participation (Hall et al., 2002, pp. 648-649).

Did the lessons learned from the study become embedded in the UNM preservice
teacher preparation program or did a new vision of teacher preparation replace the insights garnered from the Sharing Visions study? An analysis of current preservice teachers’ perceptions of readiness for teaching in 1:1 classrooms yielded new insights in response to this question.

In the same time frame, Boston University also applied for and received a PT3 grant for a multi-year study. At the conclusion of the study, researchers noted that although preservice faculty were successful in integrating technology into their coursework, the initiative floundered after completion of the grant due to lack of funding and support (Whittier & Lara, 2006). The ability to sustain the changes that were noted by faculty during the grant period speak to the difficulty that is inherent in attempting to implement major pedagogical shifts in education.

In September of 2000, 17 national educational organizations came together to discuss technology integration within education, supported by a PT3 grant from the Department of Education (Bell, 2001). The alliance, formally called the National Technology Leadership Initiative (NTLI), included faculty from the following organizations that conduct teacher education: the Association for the Education of Teachers in Science (AETS), the Association of Mathematics Teacher Educators (AMTE), the College and University Faculty Assembly (CUFA) of the National Council for the Social Studies, the Conference on English Education (CEE) of the National Council of Teachers of English (NCTE), and the Society for Information Technology and Teacher Education (Bell, 2001).

This collaboration resulted in a substantial list, by content area, of the constraints that educators have encountered in attempting to integrate technology into preservice
education (Bell, 2001). One of the constraints noted in the report from 2000 was the limited number of computers available in classrooms. Major shifts in educational technology pedagogy may have been hampered in the early years of the 21st century due to the limitation of classroom devices. Without adequate classroom devices, research on 1:1 implementation was slowed (Bell, 2001).

In addition, some preservice teachers may have exited their programs with advanced skill sets for integrating technology into their classrooms, but ended up in schools with insufficient access to technology, thus slowing the pace of implementation (Bell, 2001; Fulton, Glenn, & Valdez, 2003).

The NTLI alliance also resulted in the development, by content area, of a list of items that define “technology.” The lists, shown below in Table 1, are revealing as they illustrate the difficulty in defining “technological tools,” and the rapid evolution of technology, based on the short list of software apps or tools that are listed, but are no longer used in education.
Table 1

2000 National Technology Leadership Initiative Definition of Technology Tools, by Content Area

<table>
<thead>
<tr>
<th>Mathematics Education</th>
<th>Science Education</th>
<th>Social Studies Education</th>
<th>English Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphing calculators, fraction calculators, and other handheld technologies</td>
<td>Digital microscopes</td>
<td>Electronic discussion groups in methods classes</td>
<td>Internet publishing</td>
</tr>
<tr>
<td>Spreadsheets</td>
<td>Simulation software (e.g., Starry Night Pro)</td>
<td>Digital resource centers with primary resources</td>
<td>Electronic journaling and discussion groups</td>
</tr>
<tr>
<td>Probeware (e.g., CBL)</td>
<td>Weather stations</td>
<td>Digital video cameras</td>
<td>E-mail</td>
</tr>
<tr>
<td>Dynamic geometry programs (e.g., Gometer’s Sketchpad)</td>
<td>Web sites with simulators and data collection</td>
<td>Handheld computing devices</td>
<td>Web sites</td>
</tr>
<tr>
<td>Probability and statistics software (e.g., Fathom)</td>
<td>Spreadsheets</td>
<td>Videoconferencing/electronic whiteboards</td>
<td>Electronic portfolios</td>
</tr>
<tr>
<td>Topic specific software (e.g., Green Globs)</td>
<td>Graphing calculators</td>
<td>Spreadsheets</td>
<td>Internet research</td>
</tr>
<tr>
<td>Computer algebra systems</td>
<td>Presentation software</td>
<td>Quantitative and qualitative statistical software packages</td>
<td>Applications for communication to self and others</td>
</tr>
</tbody>
</table>
At the beginning of the 21st century, preservice faculty were grappling with how to support preservice teachers’ efforts to improve student learning in an era of fast moving technological change (Cuban, 2001; Becker, 2000). Almost 20 years later, the challenge to prepare preservice teachers for the classrooms they will enter is ongoing.

Although the emergence of preservice teachers with a “technology pedigree” or advanced EdTech skills is becoming more commonplace, what has remained rare in education is the “phenomenon” of a preservice teacher providing mentoring support, in the area of technology, to veteran teachers (Fulton, Glenn, & Valdez, 2003). However, based on a recent study, this shift may be gaining momentum. Preservice teachers, after observing their faculty model technology strategies, provided in class technology support to veteran teachers with positive outcomes (Francom & Moon, 2018). Preservice teachers mentoring veteran teachers in the area of technology has a strong parallel to students, often labeled as the net generation arriving in classrooms with technology skills that outpace their teachers.

<table>
<thead>
<tr>
<th>Mathematics related websites</th>
<th>Internet2</th>
<th>Videoconferencing for cultural communication exchanges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications tools (e.g., e-mail, video-conferencing)</td>
<td>Presentation software</td>
<td>Text creation through word processing, graphics, and numerous other applications</td>
</tr>
<tr>
<td>Presentation tools</td>
<td>Word processing</td>
<td></td>
</tr>
<tr>
<td>Digital video</td>
<td></td>
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</tbody>
</table>
The number of 1:1 devices available to students has increased significantly within the last 10 years. In 2011, the percentage of children ages 3 to 18 using the internet was 61.8%. In 2015, the percentage of children ages 3 to 18 using the internet was 70.6% (National Center for Education Statistics, 2015). This attests to the need for educational organizations to examine the shifts that are necessary to adequately prepare students for the information age.

In 2006, the Technological Pedagogical and Content Knowledge (TPACK) Framework, expanded from the framework originally developed by Shulman (1986), was enhanced to highlight the integration of technology in educational methodology coursework (Koehler & Mishra, 2009). The framework expanded the critical elements of teaching from content and pedagogy to content, pedagogy, and technology. The framework suggested that the effectiveness of 21st century teachers would be dependent on all three of these critical elements being present in preservice teachers’ coursework, and eventually their daily practice.

Building a model to understand the intersections of content, pedagogy, and technology may be a conceptually straightforward task; however, teaching preservice teachers to implement the conceptual model in a series of lesson plans is a very complex task (Mecoli, 2013). Perhaps this explains the significant amount of research (Mouza et al., 2017) that has been dedicated to exploring the TPACK framework based on Shulman’s (1986) initial work.

The TPACK model, illustrated in Figure 1, consists of three areas of knowledge which, when analyzed based on their overlap, elicits reflection on how to structure lessons that will engage students. The center of the framework represents the perspective
that involves an educator analyzing content, pedagogy, and technology to create lessons that will promote high levels of student learning (Koehler & Mishra, 2009).

*Figure 1.* Revised version of the TPACK image. © Punya Mishra, 2018. Reproduced with permission.
The faculty members of teacher education programs have always had an important role to play in modeling the pedagogy that will most benefit preservice teachers (Dassa & Vaughan, 2018). The time required for faculty to feel comfortable modeling educational technology instruction is significant (Hall et al., 2002; Hughes, Liu, & Lim, 2016). Hughes et al. (2016) noted that faculty instructors, three years after the start of a 1:1 initiative, were still in the early stages of integration. Hill et al. (2002) argued that faculty teachers need five years to become a “technology-using teacher” attaining proficiency with technology embedded instructional practices (p. 656).

In addition, Hughes et al. (2016) examined the perceptions of preservice teachers from two time periods: 2004-2007 and 2008-2012. Preservice teachers were surveyed to assess their perceptions regarding their professors’ abilities to integrate technology in their course work. Preservice teachers reported significant differences in the educational technology modeling practices of their faculty members which, in turn, resulted in the preservice teachers completing their programs of study without a consistent technological base (Hughes et al., 2016).

Researchers are engaged in attempts to formalize a set of technology competencies that could be used by teacher educators to support the development of EdTech curriculum for preservice teachers (Foulger, Graziano, Schmidt-Crawford & Slykhuis, 2017). Foulger et al. (2017) recently conducted a study using a three-pronged approach to develop a list of competencies that could be utilized by teacher educators to guide course design: crowdsourcing to identify relevant literature; a Delphi method to further refine the possible list of competencies; and an open request for feedback via public comment. The set of twelve competencies developed by Foulger et al. using this
collaborative strategy include the following:

Teacher educators will design instruction that utilizes content-specific technologies to enhance teaching and learning. Teacher educators will incorporate pedagogical approaches that prepare teacher candidates to effectively use technology. Teacher educators will support the development of the knowledge, skills, and attitudes of teacher candidates as related to teaching with technology in their content area. Teacher educators will use online tools to enhance teaching and learning. Teacher educators will use technology to differentiate instruction to meet diverse learning needs. Teacher educators will use appropriate technology tools for assessment. Teacher educators will use effective strategies for teaching online and/or blended/hybrid learning environments. Teacher educators will use technology to connect globally with a variety of regions and cultures. Teacher educators will address the legal, ethical, and socially-responsible use of technology in education. Teacher educators will engage in ongoing professional development and networking activities to improve the integration of technology in teaching. Teacher educators will engage in leadership and advocacy for using technology. Teacher educators will apply basic troubleshooting skills to resolve technology issues. (Foulger et al., 2017, pp. 432-433)

Although the current National Technology Plan is explicit in articulating the need for teacher educators to prepare preservice teachers for 21st century classrooms, it is too early to tell whether the competencies developed by Foulger et al. (2017) might be adopted as national standards (U.S. Department of Education, Office of Educational Technology, 2017).
Standalone vs. Integrated. Another critical shift that has appeared in the preservice teachers’ training literature is the emergence of a movement from a standalone educational technology requirement for all preservice teachers to a technology-infused methodology for integrating technology strategies into preservice teachers’ training programs of study (Foulger, Buss, Wetzel, & Lindsey, 2012).

Although preservice teachers at Arizona State University had indicated high levels of learning after completion of a standalone class to integrate technology into the classroom, the university still elected to move from its standalone educational technology course to a technology-infused methodology to better address the needs of preservice teachers who must integrate technology into their content (Foulger et al., 2012). The results of the study revealed that preservice teachers preferred to have “content and tools taught in tandem” because this method offered the preservice teachers more significant learning experiences (p. 56).

Even more recently, Francom and Moon (2018) analyzed the impact of a teacher preparation program that provided an opportunity for preservice teachers to gain experience in 1:1 classrooms, three days a week, as part of their coursework. The researchers suggested that embedding preservice teachers in 1:1 classrooms where technology was used extensively resulted in a higher level of professionalism and confidence being reported by the preservice teachers.

Other studies have noted that preservice teachers are receiving instruction on the development of lesson plans that include technology; however, they are not consistently being exposed to teaching models that allow them to experience effective integration of technology by their instructors (Foulger et al., 2017; Tondeur, Scherer, Siddiq, & Baran,
Additional research on the timing and the type of technology training best suited for preservice teachers is needed. This study of preservice teachers’ perceptions of readiness for teaching in 1:1 classrooms has added to the body of knowledge being developed around educational technology and pedagogy; however, there is much research that will be needed to support the integration of technology with ongoing instructional practices.

**Summary of the Literature Review**

Developing an understanding of preservice teachers’ perceptions regarding their readiness to teach in a 1:1 classroom revealed data that will help guide those responsible for teacher preparation. By examining preservice teachers’ perceptions of readiness for teaching in 1:1 classrooms, and involving the preservice teachers as co-researchers, we now better understand the instructional strategies that may be most beneficial for teaching in a digital age. Researchers continue to suggest that the experiences that preservice teachers receive in their initial teachers’ training will be an indicator of how they will deliver instruction in their own classrooms (Blackley & Walker, 2017; Dassa & Vaughn, 2018; Hughes, Liu, & Lim, 2016). Thus, examining preservice teachers’ perspectives was an important step if we want to understand how educational technology may be integrated in 1:1 classrooms and whether 1:1 programs are worthwhile endeavors for school districts to embark upon (Blackley & Walker, 2017).
Chapter Three Research Design

Purpose of the Study

The purpose of this case study was to describe UNM preservice teachers’ perceptions of readiness to teach in 1:1 classrooms as they approached the conclusion of their teacher education programs. At the start of my research, I was intrigued by commentary from Vogt (2007) in which he explained why the design of a research plan can necessitate gathering evidence that can “be handled in either quantitative or qualitative ways (p. 8). As a result, I decided to design my plan to integrate both quantitative and qualitative methods of data collection.

Research Questions

Through a study of preservice teachers’ perceptions of readiness for teaching in a 1:1 classroom, I examined the following questions:

- What professional digital competencies designed for a 1:1 classroom are being taught in preservice teachers’ education courses?
- To what extent do preservice teachers feel prepared to begin their careers teaching in 1:1 classrooms?

Research Paradigm

I used the social constructivist worldview as the research paradigm for this study. Social constructivism, with its emphasis on exploring the life and work setting of individuals, aligns with the research questions I explored (Creswell, 2013). In asking respondents to reflect on their perceptions, both in survey form and in individual interviews, I expected to see significant variability in the experiences that emerged. While some of the respondents viewed themselves as members of the net generation,
others felt uncertain when asked to describe their level of comfort with various devices and educational apps.

**Mode of Inquiry**

Combining both quantitative and qualitative approaches allowed a more detailed analysis of teachers’ perceptions to emerge as qualitative data rich in detail was available to accompany quantitative data (Maxwell, 2005). Since technology is changing at such a rapid pace, thus influencing the impact of the quantitative data that is primarily extracted from participants’ familiarity with recent apps, the inclusion of qualitative data provided insights that offered a deeper understanding of how preservice teachers perceive their readiness to teach in 1:1 classrooms (Creswell, 2013; Koehler & Mishra, 2009).

I chose the case study approach because I wanted to explore a “bounded system,” using quantitative and qualitative approaches to understand the perceptions of aspiring teachers who were on the cusp of moving into their first teaching assignments (Creswell, 2013, p. 277). I knew that my own experiences working in a 1:1 school district would impact my study so choosing the case study approach allowed my “interpretation” as a researcher to emerge throughout my study (Creswell, 2013, p. 279). In selecting the case study approach, I also reflected on the following factors identified by Creswell (2013) as essential to consider: clear boundaries, exploration of an issue, access to contextual material.

Although I was studying a case with clear boundaries (i.e., UNM preservice teachers) and focusing on one main issue, preservice teachers’ perceptions of readiness, my access to contextual material was limited. Generalizations that were suggested by my study would have been more pronounced had I collected and analyzed larger amounts of
contextual data. Although I gained insights from meeting with the UNM College of Education’s Department Chair, visiting preservice teachers’ courses, and studying the impact of a major grant that promoted Edtech use by UNM faculty, my exploratory study may have allowed me to describe the perceptions of preservice teachers more fully had I included a wider variety of contextual data.

Designing a research study that included a group interview (Creswell, 2013) may have allowed me to explore questions such as the following: “Do the major constructs reflect your experiences in the UNM program?” “Are there additional constructs that should have been included?” “Should the UNM teacher candidacy program include an online digital assessment component for students to self-assess their digital literacy?”

**Phase I Quantitative**

**Data collection.** The first phase of the study was a quantitative analysis of the factors contributing to a preservice teachers’ perception of readiness for teaching in a 1:1 classroom. One of the challenges to research in this area is the frequency of technological change. Promising new tools and apps are emerging at rates that may defy categorization or elude widespread familiarization. Therefore, I developed an instrument that combined elements from the following sources: the “Technological Pedagogical Content Knowledge” (TPACK) assessment instrument that was designed to measure the knowledge needed by preservice teachers to effectively integrate technology into their classrooms and the GoGuardian company’s “2018 Benchmark Report” that summarized the device usage habits of over five million K-12 students in the United States. GoGuardian is used extensively by districts that have purchased Chromebooks for their
students to monitor students’ browsing habits, and block, if necessary, students’ access to inappropriate sites.

The TPACK Questionnaire was designed to “measure preservice teachers’ self-assessment of their Technological Pedagogical Content Knowledge (TPACK) and related knowledge domains included in the framework” (Schmidt et al., 2009, p. 123). However, I adapted only five questions from that questionnaire for inclusion in my instrument. I revised the original five questions by adding the phrase, “in a 1:1 classroom” to each of the questions.

The 2018 Benchmark Report was useful in identifying the apps that are most frequently used by students. The report contended that the data that GoGuardian has collected and analyzed represented the “aggregated anonymous device usage” of more than five million students across the country (The 2018 Benchmark Report, 2018, p. 2). Although their statements were part of their marketing literature, the specific apps they identified were helpful to me in developing a list of commonly used apps.

For the purpose of this study, the instrument that I developed was titled “Preservice Teachers’ Perceptions Regarding their Readiness to Teach in 1:1 Classrooms” (PTPRRT) and contained 49 items measured by the following: multiple choice, short answer, dichotomous answers, or a four-point Likert-type scale.

This instrument has not been validated independently. I estimated Cronbach’s alpha reliability coefficient, a “correlational measure of the reliability or consistency of the items in a scale” to ensure that the items were measuring aspects of the same thing and that it was appropriate to add up items for an overall rating scale (Vogt, 2007, p. 90).
To address validity, I scheduled cognitive interviews with one preservice teacher and two information technology specialists to review a draft of the instrument. These individuals were not eligible to participate in the study.

**Sample.** The students enrolled in the preservice teacher program at the University of New Mexico were invited to take part in the study. My intent was to make the questionnaire available to all students from UNM who were enrolled in the elementary or secondary preservice teacher program. Based on the small size of the target population (213), I invited all elementary and secondary preservice teachers, regardless of their content area focus, to participate.

**Administration of the questionnaire.** The questionnaire was web based and I sent the link to the questionnaire hosted by SurveyMonkey to the UNM email accounts of all preservice students enrolled in the certification program. After approval from the UNM Institutional Review Board (IRB), I requested the email addresses of all preservice teachers from the data assessment team at UNM.

I contacted the preservice teachers’ department head at the university, Dr. Walker (who is also a member of my committee) by email to discuss my research study. Dr. Walker identified the courses that preservice teachers must take as part of their final preparation to teach. I contacted the UNM faculty who taught the following courses to obtain permission for an in-class visit where I explained my research and encouraged participation: EDUC 403 Using Assessment: K-8 Learning Environments III; EDUC 464 Student Teaching Seminar Secondary.

An informed consent form was the first item that the participants viewed after accessing the questionnaire. Participants were not able to proceed with the questionnaire
unless they agreed to the terms of the study as outlined in the consent form. I sent the potential participants a second email reminder one week after distribution of the first request. If there was still no response, I sent one final email reminder.

Each section of the questionnaire contained questions related to apps that are commonly used in classrooms across the nation. I surmised that preservice teachers’ familiarity with the names of specific apps might influence their self-rating when asked about their overall familiarity with a specific category of software.

Therefore, one of the challenges of my questionnaire was leniency bias, or the belief that one’s skill sets are more advanced than they really might be if tested (Maderick, Zhang, Hartley, & Marchand, 2016). Researchers have suggested that familiarity with the narrow spectrum of using digital technology for recreational use does not equate with readiness to use 1:1 devices in a classroom (Lei, 2009; Maderick et al., 2016). To partially address this issue, I grouped similar apps in categories to aid in assisting respondents in identifying programs.

Another challenge that I needed to address was the issue of low response rates. I offered a $5 gift card incentive to participants who completed the initial questionnaire. I also sent reminder emails to all potential respondents.

I administered the questionnaire twice during the spring semester of 2019. In my first data request, I asked for the “UNM email addresses of all preservice teachers enrolled at UNM in an elementary or secondary program for the 2018-2019 school year, who are also in their 4th or senior year of study.” I received a spreadsheet listing 122 seniors who appeared to meet the criteria. After sending out the questionnaire in
February, I was dismayed at the low response rate, 7%, and reevaluated my research design.

I decided to expand the target population and in my second data request, I requested the UNM email addresses of all preservice teachers enrolled at UNM in an elementary or secondary program for the 2018-2019 school year. I received a spreadsheet with two categories of students: students (freshmen, sophomore, junior, and senior) who were coded as pre-elementary or pre-secondary education students and students (freshmen, sophomore, junior, and senior) who were coded as elementary or secondary education students. After reviewing the data in my second request, I realized that when I sent out the first link, it did not go to the intended population, i.e., preservice teachers enrolled in an elementary or secondary education program.

In April, I distributed my questionnaire only to the 213 students who were coded as being enrolled in the elementary or secondary education program at UNM. The response rate for this second round was 30%.

**Data set construction.** The questionnaire began with a consent question followed by general demographic questions and included 49 items: 1 scale question (year of birth); 5 nominal questions (consent, final year, first teaching job, status, and gender); 2 questions requiring a short answer; and 41 ordinal questions (strongly disagreed, disagreed, agreed, strongly agreed). The questionnaire is included in Appendix A.

The 41 ordinal items were divided into four major constructs: hardware proficiency (5 items); basic software proficiency (4 items); educational software proficiency (26 items); faculty modeling (5 items). In addition to the items that were
grouped within the four major constructs, I also included an item that measured aspiring teachers’ perceptions of their readiness to teach in a 1:1 classroom (1 item).

The five hardware proficiency questions addressed preservice teachers’ levels of proficiency with the following devices: SmartBoard, document camera, iPad, Chromebook, and laptops.

The basic software category consisted of four questions related to the respondents’ proficiency or familiarity with email, documents, spreadsheets, and presentation software apps. The educational software category consisted of 26 questions related to the respondents’ proficiency or familiarity with more recent software apps, specifically designed for educational purposes.

The instructors’ modeling category consisted of five questions related to the faculty instructors’ abilities to use technology as an integral part of teaching to model best practices for preservice teachers. The need for faculty to use technology “for instruction,” rather than to “prepare for instruction” has been emphasized in the educational technology literature (Cuban, 2001, p. 126).

Enskat, Hunt, and Hooker (2017) examined the technology integration of instructors who are considered “Baby Boomers,” and students who are defined as “Millennials.” They contend that millennials (who constituted the majority of my participants) have expectations about their professors’ utilization of teaching strategies that include proficiency with technology as a given. Thus, it was important that I analyzed questions related to modeling to determine if technology integration was a widespread practice in preservice teachers’ training.
The questionnaire included two questions designed to elicit individualized responses to aid in understanding teachers’ perceptions: “How will you assess your future students’ technology readiness?” and “How will you teach digital citizenship?” I included these questions to explore whether preservice teachers were being exposed to literature in their coursework that addressed many of the emerging concerns within the realm of digital literacy.

**Data set revision.** After exporting 46 variables from SurveyMonkey to SPSS 25 (the consent question and the two short answer questions were excluded), I created new variables. I computed Variable 47, “Hardware Proficiency,” by adding each participant’s answers to the five hardware proficiency questions. I computed Variable 48, “Software Basic Proficiency,” by adding each participant’s answers to the four basic software proficiency questions. I computed Variable 49, “Software Educational Proficiency,” by adding each participant’s answers to 23 educational software proficiency questions. I computed Variable 50, “Modeling by Faculty,” by adding each participant’s answers to the five questions related to their professors’ modeling of technology for 1:1 classrooms.

To create Variable 51, “AGErc,” I subtracted the participant’s year of birth from 2019 to compute their age.

Variable 52, “Readiness to Teach recoded” was created after I made a decision to assign a “1” to any participant who responded with a “strongly agree” or “agree” answer and a “0” to any participant who responded with a “strongly disagree” or “disagree” answer to the readiness to teach item in the questionnaire.

I made a decision to create Variable 53, “HARDWAREPROFrc” where I assigned a “1” to any participant who had a score of at least 15 out of 20 in Variable 47.
To clarify, Variable 47 represented each participant’s total score when adding all of the hardware proficiency items. If a participant’s score from Variable 47 was less than 15, I assigned a “0.” For example, if a participant answered “strongly agree,” which was assigned a value of four, for all five items within the hardware proficiency construct, his or her score would be 20 and assigned a “1.” A person who answered “agree,” which was assigned a value of three, for all five items within the hardware proficiency construct would have a score of 15 and also be assigned a “1.”

I made a decision to create Variable 54, “SOFTWAREBASICPROFrc” where I assigned a “1” to any participant who had a score of at least 12 out of 16 in Variable 48. To clarify, Variable 48 represented each participant’s total score when adding all of the basic software proficiency items. If a participant’s score from Variable 48 was less than 12, I assigned a “0.” For example, if a participant answered “strongly agree,” which was assigned a value of four, for all four items within the basic software proficiency construct, his or her score would be 16 and assigned a “1.” A person who answered “agree,” which was assigned a value of three, for all four items within the basic software proficiency construct would have a score of 12 and also be assigned a “1.”

I made a decision to create Variable 55, “SOFTWAREEDUCPROFrc” where I assigned a “1” to any participant who had a score of at least 69 out of 92 in Variable 49. To clarify, Variable 49 represented each participant’s total score when adding all of the educational software proficiency items. If a participant’s score from Variable 49 was less than 69, I assigned a “0.” For example, if a participant answered “strongly agree,” which was assigned a value of four, for all 23 items within the educational software proficiency construct, his or her score would be 92 and assigned a “1.” A person who answered
“agree,” which was assigned a value of three, for all 23 items within the educational software proficiency construct would have a score of 69 and also be assigned a “1.”

I made a decision to create Variable 56, “MODELINGFACULTYrc” where I assigned a “1” to any participant who had a score of at least 15 out of 20 in Variable 50. To clarify, Variable 50 represented each participant’s total score when adding all of the faculty modeling items. If a participant’s score from Variable 50 was less than 15, I assigned a “0.” For example, if a participant answered “strongly agree,” which was assigned a value of four, for all five items within the faculty modeling construct, his or her score would be 20 and assigned a “1.” A person who answered “agree,” which was assigned a value of three, for all five items within the faculty modeling construct would have a score of 15 and also be assigned a “1.”

**Data analyses.** I calculated descriptive statistics for all variables, including range, mean, quartiles, minimum, maximum, standard deviation, frequencies, percentages, and proportions. I also estimated the Chi-square statistic and correlations.

Although the majority of the questionnaire items addressed the participants’ proficiency or familiarity with utilizing apps in a 1:1 classroom setting, there were also questions related to the participants’ familiarity with basic software, hardware, social media, and faculty modeling. Two of the survey questions, assessing students’ digital readiness and teaching students’ digital citizenship, elicited short answer responses and were analyzed and coded according to themes.

**Phase II Qualitative**

**Data collection.** The second phase of the study consisted of a qualitative analysis to explore the perceptions of preservice teachers when asked to reflect on the following:
exposure to hardware and software instruction during their teacher candidacy program; the role of teachers in promoting their students’ digital literacy; the professional digital competencies of faculty; and predictions about the future of educational technology.

I conducted semi-structured interviews via telephone as the primary approach for collecting qualitative data from those who volunteered to take part in an interview.

**Interview sample.** All of the participants had an opportunity to indicate whether they wanted to participate in the individual interviews. At the conclusion of the initial questionnaire titled “Preservice Teachers’ Perceptions of Readiness for Teaching in 1:1 Classrooms,” they had an opportunity to link to a second questionnaire asking them for their email (to deliver their $5 gift card) and about their willingness to participate in a 30-minute interview. The total number of participants who expressed a willingness to be interviewed was 15. I then sent these 15 individuals an email invitation to participate in a phone interview. Three preservice teachers accepted the invitation and I scheduled individual interviews with them.

**Administration of the interviews.** I audio recorded the interviews and then used speech to text software for the transcription. I verified the accuracy of the transcription by comparing the audio recording to the transcription.

**Data analyses.** I analyzed the interview transcripts, coded conceptual categories, wrote memos while thinking critically about the data, and refined the conceptual categories. I coded participants’ interview transcripts according to organizational and substantive categories with an attempt to link the responses to the four major constructs of the study: hardware proficiency, basic software proficiency, educational software proficiency, and faculty modeling.
Chapter Four Findings

The purpose of this exploratory study was to enhance our understanding of the factors that promote preservice teachers’ perceptions of readiness to teach in 1:1 classrooms. An analysis of these factors should allow educators to make pedagogical shifts in preservice teachers’ programs to better prepare new teachers for the 21st century classrooms they will help create: places of learning that provide equitable and relevant experiences for all.

This study was guided by the following questions:

- What professional digital competencies designed for a 1:1 classroom are being taught in preservice teachers’ education courses?
- To what extent do preservice teachers feel prepared to begin their careers teaching in 1:1 classrooms?

Based on the literature review and my experience as a school leader, I anticipated that:

- Preservice teachers may have limited experience working with hardware in 1:1 classrooms;
- Preservice teachers may indicate high levels of proficiency with basic apps (i.e., documents, spreadsheets, email, and presentations);
- Preservice teachers may lack familiarity with educational apps;
- Preservice teachers may have limited or varied exposure to faculty modeling of strategies for 1:1 classrooms.
- Preservice teachers may indicate high levels of proficiency with social media apps;
- Preservice teachers may have limited experience in assessing their students’ digital readiness.

**Findings: Survey Research**

**Sample.** The participants invited to take part in the survey consisted of all of the elementary and secondary education students enrolled in UNM’s teacher preparation program (n = 213). Both undergraduate and graduate students participated in the survey. Out of the total possible number of participants eligible to take part in the survey, 30% (63 participants) elected to take the survey with seven participants indicating they were graduate students and 55 students listing their status as undergraduate students. The average age of participants was 27 years. Although the participants ranged in age from 20 to 57 years old, 73% of the participants were in their 20s; 14% in their 30s; 10% in their 40s; and 3% in their 50s. The vast majority (90.5%) of the participants were female, 7.9% were male, and one person did not indicate a gender preference although the option of “other” was available.

Participants were asked about their expected date for entering a classroom and their final year enrolled in a preservice program. Of the 63 survey participants, 76.2% indicated they were in their final year of coursework. Although the majority of the 213 students enrolled in UNM’s teacher preparation program were seniors (92%), the participants reported a range of expected dates for beginning their first teaching assignment, from the summer of 2019 to the spring of 2020.

**Hardware proficiency.** Preservice teachers were asked to reflect on their exposure to hardware and the devices used most often in 1:1 classrooms. Participants were asked to indicate their levels of agreement with statements about using different
types of hardware in preparation for teaching in 1:1 classrooms. They were asked to
comment on their proficiency with five hardware devices: SmartBoards, Document
Cameras, iPads, Chromebooks, and Laptops. The questionnaire is available in Appendix
A.

*Descriptive Statistics.* Given that the five items that index the hardware concept
were ordinal variables, I calculated the percentage of participants who strongly disagreed,
disagreed, agreed, and strongly agreed when asked if they were proficient using hardware
with students in a 1:1 classroom. Table 2 summarizes the responses of participants when
asked if they were proficient using five different devices often present in a 1:1 classroom.

Table 2

*Distribution of Preservice Teachers’ Responses to Five Items that Measure Hardware
Proficiency (n = 63)*

<table>
<thead>
<tr>
<th>Type of Hardware</th>
<th>Strongly Disagreed</th>
<th>Disagreed</th>
<th>Agreed</th>
<th>Strongly Agreed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document Camera</td>
<td>9.5%</td>
<td>28.6%</td>
<td>28.6%</td>
<td>33.3%</td>
</tr>
<tr>
<td>SmartBoard</td>
<td>11.1%</td>
<td>22.2%</td>
<td>46%</td>
<td>20.6%</td>
</tr>
<tr>
<td>Chromebooks</td>
<td>3.2%</td>
<td>30.2%</td>
<td>31.7%</td>
<td>34.9%</td>
</tr>
<tr>
<td>Laptops</td>
<td>1.6%</td>
<td>15.9%</td>
<td>30.2%</td>
<td>52.4%</td>
</tr>
<tr>
<td>iPads</td>
<td>4.8%</td>
<td>9.5%</td>
<td>42.9%</td>
<td>41.3%</td>
</tr>
</tbody>
</table>

Preservice teachers agreed they were most proficient using iPads with students in
a 1:1 classroom (84.2%) followed closely by laptops (82.6%). Participants’ agreement
about their proficiency with Chromebooks, Smart Boards, and document cameras was
lower.

Some of the UNM preservice teachers may have completed their field experiences
in the Albuquerque Public Schools where Promethean Boards may be used more
extensively. The questionnaire’s lack of clarity in identifying the different types of smart boards that are currently available may have impacted response rates to the question related to smart boards. Although the term “Smart Board” began as a specific company name, it evolved into a generic term for describing interactive white boards.

When examining the relationship between hardware proficiency, by device, and readiness to teach, a more complex story was evident. I conducted a cross-tabulation analysis between hardware proficiency responses by device and readiness to teach responses. Table 3 summarizes the percentage of participants who agreed they were proficient using hardware with students in a 1:1 classroom and who agreed they were prepared to select technologies to enhance what they teach, how they teach, and what students learn (coded as the Readiness to Teach variable).

Table 3

Percentage of Participants Who Agreed They Were Proficient Using Hardware With Students in a 1:1 Classroom and Prepared to Select Technologies to Enhance What They Teach, How They Teach, and What Students Learn

<table>
<thead>
<tr>
<th>Type of Device</th>
<th>Percentage Proficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>SmartBoard</td>
<td>57%</td>
</tr>
<tr>
<td>Document Camera</td>
<td>54%</td>
</tr>
<tr>
<td>iPads</td>
<td>62%</td>
</tr>
<tr>
<td>Chromebooks</td>
<td>52%</td>
</tr>
<tr>
<td>Laptops</td>
<td>65%</td>
</tr>
</tbody>
</table>

The percentage of preservice teachers who stated that they were proficient with specific hardware and prepared to select technologies to enhance what they teach, how they teach, and what students learn was lower in all five hardware categories when
compared to their responses in Table 2. In addition, the decrease that was most notable occurred with iPads. Although 84.2% of preservice teachers responded that they were proficient using iPads with students in 1:1 classrooms, when their responses were cross-tabulated with their readiness to teach using technology responses, the affirmative response rate decreased by 21.2 percentage points. The data suggested that even if some preservice teachers felt confident in their ability to use hardware devices, they did not consistently feel confident in their abilities to select and use hardware technology to best support students’ learning (Chai et al., 2017).

This finding related to hardware usage suggests that preservice teachers would need support in learning to effectively use hardware devices in 1:1 classrooms to maximize student learning (Cuhadar, 2018).

**Basic software proficiency.** Preservice teachers were next surveyed about their levels of proficiency with basic apps (i.e., documents, spreadsheets, email, and presentations). I expected preservice teachers to report high levels of proficiency with basic applications.

**Descriptive statistics.** Given that the four items that measured the basic software construct were ordinal variables, I calculated the percentage of participants who strongly disagreed, disagreed, agreed, and strongly agreed when asked if they were proficient using these four basic apps.

An analysis of these data (presented in Table 4) revealed that the individual basic software items resulted in self-assessed proficiency percentages between 84.2% and 100%.
Table 4

_Distribution of Preservice Teachers’ Responses to Four Items that Measure Basic Software Proficiency (n = 63)_

<table>
<thead>
<tr>
<th>Type of Software App</th>
<th>Strongly Disagreed</th>
<th>Disagreed</th>
<th>Agreed</th>
<th>Strongly Agreed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation App</td>
<td>0%</td>
<td>0%</td>
<td>31.7%</td>
<td>68.3%</td>
</tr>
<tr>
<td>Spreadsheet App</td>
<td>1.6%</td>
<td>14.3%</td>
<td>41.3%</td>
<td>42.9%</td>
</tr>
<tr>
<td>Documents App</td>
<td>0%</td>
<td>0%</td>
<td>23.8%</td>
<td>76.2%</td>
</tr>
<tr>
<td>Email App</td>
<td>0%</td>
<td>0%</td>
<td>14.3%</td>
<td>85.7%</td>
</tr>
</tbody>
</table>

The data related to basic software usage suggested that almost all preservice teachers surveyed considered themselves proficient to utilize basic software applications; however, additional analysis was necessary.

When examining the relationship between basic software proficiency and readiness to teach, the data revealed insights about the preservice teachers’ readiness to teach in a 1:1 classroom. I conducted a cross-tabulation analysis between each type of basic software usage and readiness to teach. Table 5 summarizes the percentage of participants who agreed they were proficient using basic software and who agreed they were prepared to select technologies to use that enhance what they teach, how they teach, and what students learn (Readiness to Teach).
The percentage of preservice teachers who stated that they were proficient with basic software apps and prepared to select technologies to use that enhance what they teach, how they teach, and what students learn was lower in all four basic software categories when compared to their responses in Table 4. The data revealed that even when preservice teachers felt very confident in their own ability to use basic software, they did not consistently feel confident in their abilities to select and use technology to best support students’ learning.

This finding suggested that preservice teachers, even those who report high levels of proficiency with basic software, would need support in learning to effectively use basic software in 1:1 classrooms to maximize student learning (Heggart & Yoo, 2018; Lei, 2009).

**Educational software proficiency.** In this study, preservice teachers were asked to respond to questions asking them about their proficiency levels with educational apps. The educational apps mentioned in the survey were organized into broad categories that provided participants with insight into the purpose of the app.
Descriptive statistics. Given that the 23 items that measured the educational software construct were ordinal variables, I calculated the percentage of participants who strongly disagreed, disagreed, agreed, and strongly agreed when asked if they were proficient using these 23 apps in a 1:1 classroom. In Table 6 are listed the responses of preservice teachers when asked to rate their level of proficiency with a series of educational apps that have been recently utilized in classrooms across the nation.

Table 6

Distribution of Preservice Teachers' Responses to 23 Items that Measure Educational Software Proficiency (n = 63)

<table>
<thead>
<tr>
<th>Type of Software</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filtering App</td>
<td>30.2%</td>
<td>54.0%</td>
<td>7.9%</td>
<td>7.9%</td>
</tr>
<tr>
<td>Science App</td>
<td>25.4%</td>
<td>50.8%</td>
<td>20.6%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Language App</td>
<td>20.6%</td>
<td>47.6%</td>
<td>19%</td>
<td>12.7%</td>
</tr>
<tr>
<td>Monitoring App</td>
<td>27.0%</td>
<td>33.3%</td>
<td>30.2%</td>
<td>7.9%</td>
</tr>
<tr>
<td>Assessment App</td>
<td>22.2%</td>
<td>39.7%</td>
<td>22.2%</td>
<td>15.9%</td>
</tr>
<tr>
<td>Typing App</td>
<td>20.6%</td>
<td>39.7%</td>
<td>19%</td>
<td>20.6%</td>
</tr>
<tr>
<td>Collaboration App</td>
<td>19.0%</td>
<td>38.1%</td>
<td>25.4%</td>
<td>17.5%</td>
</tr>
<tr>
<td>Study Aid App</td>
<td>15.9%</td>
<td>39.7%</td>
<td>27%</td>
<td>17.5%</td>
</tr>
<tr>
<td>Grading App</td>
<td>27.0%</td>
<td>27.0%</td>
<td>20.6%</td>
<td>25.4%</td>
</tr>
<tr>
<td>Creativity App</td>
<td>17.5%</td>
<td>33.3%</td>
<td>34.9%</td>
<td>14.3%</td>
</tr>
<tr>
<td>Data Analysis App</td>
<td>17.5%</td>
<td>33.3%</td>
<td>31.7%</td>
<td>17.5%</td>
</tr>
<tr>
<td>Lesson Plan App</td>
<td>12.7%</td>
<td>28.6%</td>
<td>39.7%</td>
<td>19%</td>
</tr>
<tr>
<td>Teaching Aid App</td>
<td>9.5%</td>
<td>30.2%</td>
<td>38.1%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Editing App</td>
<td>6.3%</td>
<td>30.2%</td>
<td>33.3%</td>
<td>30.2%</td>
</tr>
<tr>
<td>Class Mgt App</td>
<td>7.9%</td>
<td>25.4%</td>
<td>38.1%</td>
<td>28.6%</td>
</tr>
<tr>
<td>Graphing Calc App</td>
<td>11.1%</td>
<td>22.2%</td>
<td>30.2%</td>
<td>36.5%</td>
</tr>
<tr>
<td>Math App</td>
<td>11.1%</td>
<td>19.0%</td>
<td>39.7%</td>
<td>30.2%</td>
</tr>
<tr>
<td>Survey App</td>
<td>6.3%</td>
<td>20.6%</td>
<td>36.5%</td>
<td>36.5%</td>
</tr>
<tr>
<td>News App</td>
<td>7.9%</td>
<td>15.9%</td>
<td>49.2%</td>
<td>27%</td>
</tr>
<tr>
<td>Game App</td>
<td>4.8%</td>
<td>17.5%</td>
<td>49.2%</td>
<td>28.6%</td>
</tr>
<tr>
<td>Quiz App</td>
<td>3.2%</td>
<td>15.9%</td>
<td>36.5%</td>
<td>44.4%</td>
</tr>
<tr>
<td>Storage App</td>
<td>3.2%</td>
<td>7.9%</td>
<td>39.7%</td>
<td>49.2%</td>
</tr>
</tbody>
</table>
There is a great deal of variation in self-reported proficiency levels with educational software applications, from a minimum of 15.8% who agreed they were proficient using filter bypass apps in a 1:1 classroom such as Psiphon and Ultrasurf to a maximum of 96.8% who agreed they were proficient using video apps in a 1:1 classroom. Preservice teachers also noted lower levels of proficiency with science apps at 23.8% as compared to math apps at 69.9%.

Only 15.8% of preservice teachers responded that they agreed they were proficient using filter bypass apps in a 1:1 classroom. The need for educators to reconceptualize classroom management to include both readily observable and online student behaviors has become increasingly important (Andresen, 2017).

When asked to rate their agreement with the statement, “I am proficient in assessing educational technology apps for use in my 1:1 classroom,” it is important to note that 84.1% of preservice teachers reported they agreed or strongly agreed with this statement as shown in Table 7. However, looking back at Table 6, we can see that out of the 23 app items that participants entered responses, only two apps, Storage Apps and Video Apps, were over 84.1%. This figure of 84.1% may reflect the leniency bias that researchers have identified when surveying respondents about their levels of proficiency with technology (Lei, 2009; Maderick et al., 2016).
Table 7

*Distribution of Preservice Teachers’ Responses Regarding Their Ability to Assess Technology Apps*

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>3</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Disagree</td>
<td>7</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Agree</td>
<td>30</td>
<td>47.6</td>
<td>47.6</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>23</td>
<td>36.5</td>
<td>36.5</td>
</tr>
<tr>
<td>Total</td>
<td>63</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

I conducted a cross-tabulation analysis between responses for each type of educational software and the readiness to teach variable. Table 8 summarizes the percentage of respondents who agreed that they were proficient using educational software in a 1:1 classroom and who agreed that they were prepared to select technologies to use that enhance what they teach, how they teach, and what students learn (Readiness to Teach).

Table 8

*Percentage of Participants Who Agreed They Were Proficient Using Educational Software Applications In a 1:1 Classroom And Who Agreed They Were Prepared To Select Technologies To Use That Enhance What They Teach, How They Teach, And What Students Learn (Readiness To Teach)*

<table>
<thead>
<tr>
<th>Type of Educational Software</th>
<th>Percentage Proficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filtering App</td>
<td>16%</td>
</tr>
<tr>
<td>Science App</td>
<td>22%</td>
</tr>
<tr>
<td>Language App</td>
<td>30%</td>
</tr>
<tr>
<td>Monitoring App</td>
<td>33%</td>
</tr>
<tr>
<td>Assessment App</td>
<td>37%</td>
</tr>
<tr>
<td>App</td>
<td>Percentage</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Typing App</td>
<td>35%</td>
</tr>
<tr>
<td>Collaboration App</td>
<td>40%</td>
</tr>
<tr>
<td>Study Aid App</td>
<td>41%</td>
</tr>
<tr>
<td>Grading App</td>
<td>43%</td>
</tr>
<tr>
<td>Creativity App</td>
<td>44%</td>
</tr>
<tr>
<td>Data Analysis App</td>
<td>41%</td>
</tr>
<tr>
<td>Lesson Plan App</td>
<td>54%</td>
</tr>
<tr>
<td>Teaching Aid App</td>
<td>48%</td>
</tr>
<tr>
<td>Editing App</td>
<td>56%</td>
</tr>
<tr>
<td>Class Management App</td>
<td>59%</td>
</tr>
<tr>
<td>Graphing Calculator App</td>
<td>56%</td>
</tr>
<tr>
<td>Math App</td>
<td>52%</td>
</tr>
<tr>
<td>Survey App</td>
<td>62%</td>
</tr>
<tr>
<td>News App</td>
<td>63%</td>
</tr>
<tr>
<td>Game App</td>
<td>62%</td>
</tr>
<tr>
<td>Quiz App</td>
<td>70%</td>
</tr>
<tr>
<td>Storage App</td>
<td>70%</td>
</tr>
<tr>
<td>Video App</td>
<td>71%</td>
</tr>
</tbody>
</table>

The percentage of preservice teachers who agreed that they were proficient using educational software apps in a 1:1 classroom and prepared to select technologies to use that enhance what they teach, how they teach, and what students learn decreased in all 23 software categories, with the exception of the filtering app, when compared to their responses in Table 6.

Listed in Table 9 are the apps that had notable decreases when preservice teachers were initially asked whether they were proficient using educational software apps in a 1:1 classroom compared to a cross-tabulation between those who agreed that they were proficient using educational software in a 1:1 classroom and the preservice teachers’ beliefs regarding their readiness to select technologies to use that enhance what they teach, how they teach, and what students learn.
Table 9

*Notable Decreases in Percentages Between Preservice Teachers’ Responses to Proficiency with Educational Software Apps Compared to a Cross-Tabulation of Preservice Teachers’ Proficiency with Educational Software and their Readiness to Teach*

<table>
<thead>
<tr>
<th>Type of Educational Software</th>
<th>Percentage Point Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Aid App</td>
<td>12.3</td>
</tr>
<tr>
<td>Graphing Calculator App</td>
<td>10.7</td>
</tr>
<tr>
<td>Math App</td>
<td>17.9</td>
</tr>
<tr>
<td>Survey App</td>
<td>11.0</td>
</tr>
<tr>
<td>News App</td>
<td>13.2</td>
</tr>
<tr>
<td>Game App</td>
<td>15.8</td>
</tr>
<tr>
<td>Quiz App</td>
<td>10.9</td>
</tr>
<tr>
<td>Storage App</td>
<td>18.9</td>
</tr>
<tr>
<td>Video App</td>
<td>25.8</td>
</tr>
</tbody>
</table>

The percentage of respondents who agreed they were proficient using video apps in a 1:1 classroom was 98.6%; however, only 71% of respondents stated they were proficient using video apps in a 1:1 classroom AND prepared to select technologies to use that enhance what they teach, how they teach, and what students learn, a decrease of 25.8 percentage points.

The data suggested that even when some preservice teachers felt confident in their own ability to use educational software, they did not consistently feel confident in their abilities to select and use technology to best support students’ learning. These findings related to educational software usage suggest that preservice teachers would need support in learning to effectively use educational software in 1:1 classrooms to maximize student learning (Ditzler et al., 2016; Lee & Cherner, 2015).
Modeling by faculty. Preservice teachers were also asked to comment on the appropriateness of the technology modeling they observed in their math, literacy, science, social studies, and technology coursework.

Descriptive statistics. Given that the five items that measured faculty modeling were ordinal variables, I calculated the percentage of participants who strongly disagreed, disagreed, agreed, and strongly agreed when asked if their professors appropriately modeled technology usage for 1:1 classrooms in their teaching. Table 10 lists the distribution of participants’ responses when asked if their education faculty appropriately modeled technology use as preparation for teaching in 1:1 classrooms, by content area.

Table 10

<table>
<thead>
<tr>
<th>Content Area</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math</td>
<td>15.9%</td>
<td>34.9%</td>
<td>30.2%</td>
<td>19.0%</td>
</tr>
<tr>
<td>Literacy</td>
<td>7.9%</td>
<td>39.7%</td>
<td>39.7%</td>
<td>12.7%</td>
</tr>
<tr>
<td>Science</td>
<td>9.5%</td>
<td>33.3%</td>
<td>36.5%</td>
<td>19.0%</td>
</tr>
<tr>
<td>Social Studies</td>
<td>12.7%</td>
<td>23.8%</td>
<td>41.3%</td>
<td>17.5%</td>
</tr>
<tr>
<td>Technology</td>
<td>9.5%</td>
<td>14.3%</td>
<td>46.0%</td>
<td>30.2%</td>
</tr>
</tbody>
</table>

Although 69.9% of preservice teachers (see Table 6) agreed they were proficient using math apps in a 1:1 classroom, we see in Table 10 that only 49.2% of preservice teachers agreed that their mathematics education professors appropriately modeled technology usage for 1:1 classrooms in their teaching. Preservice teachers may have received training on math apps during their field experiences, which could have influenced their responses and the degree of self-efficacy they reported with math apps.
Interestingly, only 23.8% of preservice teachers (see Table 6) agreed they were proficient using science apps in a 1:1 classroom, but 55.5% agreed that their science professors appropriately modeled technology usage for 1:1 classrooms in their teaching.

There was a noticeable difference between the technology modeling and the modeling in the core content areas by faculty. Preservice teachers agreed that 76.2% of their technology professors appropriately modeled technology usage for 1:1 classrooms in their teaching as compared to percentages between a low of 49.2% for math faculty and a high of 58.8% for social studies faculty.

I conducted a cross-tabulation analysis between responses for each of the faculty modeling variables and the readiness to teach variable. The results of the cross-tabulation are listed in Table 11.

Table 11

<table>
<thead>
<tr>
<th>Content Area</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math Modeling</td>
<td>44%</td>
</tr>
<tr>
<td>Literacy Modeling</td>
<td>46%</td>
</tr>
<tr>
<td>Science Modeling</td>
<td>46%</td>
</tr>
<tr>
<td>Social Studies Modeling</td>
<td>53%</td>
</tr>
<tr>
<td>Technology Modeling</td>
<td>63%</td>
</tr>
</tbody>
</table>

The percentage of preservice teachers who stated that their professors appropriately modeled technology use in a 1:1 classroom and who stated they were prepared to select technologies to use that enhance what they teach, how they teach, and
what students learn decreased in all 5 categories when compared to their responses in Table 10. The largest percentage point decrease was in the area of technology modeling. Respondents indicated that 76.2% of their technology professors appropriately modeled technology usage in 1:1 classrooms in their teaching; however, when examining the cross-tabulation of technology modeling and readiness to teach, only 63% of the preservice teachers stated they were in agreement with both statements, a decline of 13.2 percentage points.

These findings suggest that aspiring teachers need additional modeling by their faculty of technology in their content area coursework to effectively use technology in 1:1 classrooms (Dassa & Vaughn, 2018; Urbani et al., 2017). Faculty members may also need on-going exposure to the educational apps that are used most frequently in 1:1 elementary and secondary classrooms (Kalonde & Mousa, 2016).

Contingency table and exploratory chi-square analyses. After collecting the preservice teachers’ responses, I decided to create five new variables that would allow me to conduct contingency table and exploratory Chi-square analyses. The variables I created represented the major concept and constructs of the study: preservice teachers’ self-assessments regarding their readiness to teach using technology (RTTrc), preservice teachers’ self-assessments regarding their readiness to use all five hardware devices to teach (HARDWAREPROFrc), preservice teachers’ self-assessments regarding their readiness to use four basic software apps (SOFTWAREBASICPROFrc), preservice teachers’ self-assessments regarding their readiness to use 23 educational software apps to teach (SOFTWAREEDUCPROFrc), and preservice teachers’ perceptions regarding their faculty modeling of technology throughout their coursework.
Table 12

<table>
<thead>
<tr>
<th>Construct</th>
<th>Frequency Disagree</th>
<th>Percent Disagree</th>
<th>Frequency Agree</th>
<th>Percent Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readiness to Teach</td>
<td>17</td>
<td>27.0%</td>
<td>46</td>
<td>73.0%</td>
</tr>
<tr>
<td>Hardware Proficiency</td>
<td>27</td>
<td>42.9%</td>
<td>35</td>
<td>55.6%</td>
</tr>
<tr>
<td>Software Basic Proficiency</td>
<td>1</td>
<td>1.6%</td>
<td>62</td>
<td>98.4%</td>
</tr>
<tr>
<td>Software Educational Proficiency</td>
<td>40</td>
<td>63.5%</td>
<td>23</td>
<td>36.5%</td>
</tr>
<tr>
<td>Modeling by Faculty</td>
<td>37</td>
<td>58.7%</td>
<td>24</td>
<td>38.1%</td>
</tr>
</tbody>
</table>

**Hardware proficiency.** The variable “HARDWAREPROFrc,” which I defined to mean a preservice teacher’s belief in his or her ability to use hardware (five devices) in a 1:1 classroom, was the sum of each participant’s answers to the five hardware proficiency items recoded “proficient” or “not proficient” using the process outlined in the previous chapter. While 55.6% of participants (35 preservice teachers) met the minimum criterion for hardware proficiency, 42.9% (27 preservice teachers) did not.

A review of the hardware data revealed that although the individual hardware items yielded proficiency percentages between 61.9% and 85.4% as highlighted in Table 2, when all five items were combined for each participant, the participants’ perceptions of their overall hardware proficiency levels were lower, calculated as 55.6%.
In Table 13, I conducted a contingency table analysis to examine the relationship between the composite categorical variable “HARDWAREPROFrc” and the readiness to teach categorical variable “RTTrc.” It is important to note that if there is no relationship between the preservice teachers’ HARDWAREPROFrc score and their RTTrc score, the difference between the observed and the expected counts would be minimal. In this table, we can see that there are four sets of observed and expected data, separated in value by 6.6.

Table 13

Crosstabulation Between RTTrc and HARDWAREPROFrc

<table>
<thead>
<tr>
<th>RTTrc * HARDWAREPROFrc Crosstabulation</th>
<th>HARDWAREPROFrc</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>RTTrc Disagree</td>
<td>Count</td>
<td>14</td>
</tr>
<tr>
<td>Expected Count</td>
<td></td>
<td>7.4</td>
</tr>
<tr>
<td>RTTrc Agree</td>
<td>Count</td>
<td>13</td>
</tr>
<tr>
<td>Expected Count</td>
<td></td>
<td>19.6</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>27</td>
</tr>
<tr>
<td>Expected Count</td>
<td></td>
<td>27</td>
</tr>
</tbody>
</table>

In attempting to examine whether there is a relationship between preservice teachers’ readiness to teach and their hardware proficiency, it is critical to test the null hypothesis, which in this study was “there is no relationship between preservice teachers’ perceptions of readiness for teaching in 1:1 classrooms and their proficiency with hardware devices.”

For the data in Table 13, I estimated the Chi Square statistic to test the relationship between preservice teachers’ readiness to teach and their hardware proficiency resulting in a Chi-Square value of 14.346. The p-value was less than .05,
which suggested, based on this sample, there was a significant relationship between preservice teachers’ readiness to teach and their proficiency with hardware devices ($x^2 = 14.346, p < .001$).

**Basic software proficiency.** The variable “SOFTWAREBASICPROFrc,” which I defined to mean a preservice teacher’s belief in his or her ability to proficiently use basic software in a 1:1 classroom, was the sum of each participant’s answers to the four basic software proficiency items recoded using the process outlined in the previous chapter. While 98.4% of participants (62 preservice teachers) met the minimum criterion for basic software proficiency, only 1.6% (1 preservice teacher) did not.

A review of the basic software data revealed that not only did the individual basic software items yield very high proficiency percentages as listed in Table 4, when all four items were combined for each participant, the participants’ perceptions of their basic software proficiency levels remained very high, at 98.4%.

In Table 14, I conducted a contingency table analysis to examine the relationship between the composite categorical variable “SOFTWAREBASICPROFrc” and the readiness to teach categorical variable “RTTrc.” It is important to note that if there is no relationship between the preservice teachers’ SOFTWAREBASICPROFrc score and their RTTrc score, the difference between the observed and the expected counts would be minimal. In this table, we can see that there are four sets of observed and expected data, separated in value by only .7.
In attempting to examine whether there is a relationship between preservice teachers’ readiness to teach and their basic software proficiency, it is critical to test the null hypothesis, which in this study was “there is no relationship between preservice teachers’ perceptions of readiness for teaching in 1:1 classrooms and their proficiency with basic software.”

For the data in Table 14, I estimated the Chi Square statistics to test the relationship between preservice teachers’ readiness to teach and their basic software proficiency resulting in a Chi-Square value of 2.750. The p-value was greater than .05 which suggested, for this sample, there was no significant relationship between preservice teachers’ readiness to teach and their proficiency with basic software ($x^2 = 2.750, p = .097$).

**Educational software proficiency.** The variable “SOFTWAREEDUCPROFrc,” which I defined to mean a preservice teacher’s belief in his or her ability to proficiently use educational software in a 1:1 classroom, was the sum of each participant’s answers to 23 educational software proficiency items recoded using the process outlined in the

---

### Table 14

<table>
<thead>
<tr>
<th>RTTrc * SOFTWAREBASICPROFrc Crosstabulation</th>
<th>SOFTWAREBASICPROFrc</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>RTTrc Disagree</td>
<td>Count</td>
<td>1</td>
</tr>
<tr>
<td>Expected Count</td>
<td>0.3</td>
<td>16.7</td>
</tr>
<tr>
<td>RTTrc Agree</td>
<td>Count</td>
<td>0</td>
</tr>
<tr>
<td>Expected Count</td>
<td>0.7</td>
<td>45.3</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>1</td>
</tr>
<tr>
<td>Expected Count</td>
<td>1</td>
<td>62</td>
</tr>
</tbody>
</table>
previous chapter. While 36.5% of participants (23 preservice teachers) met the minimum criterion for educational software proficiency, 63.5% (40 preservice teachers) did not meet the criterion for proficiency.

In Table 15, I conducted a contingency table analysis to examine the relationship between the composite categorical variable “SOFTWAREEDUCPROFrc” and the readiness to teach categorical variable “RTTrc.” It is important to note that if there is no relationship between the preservice teachers’ SOFTWAREEDUCPROFrc score and their RTTrc score, the difference between the observed and the expected counts would be minimal. In this table, we can see that there are four sets of observed and expected data, separated in value by 5.2.

Table 15

*Crosstabulation Between RTTrc and SOFTWAREEDUCPROFrc*

<table>
<thead>
<tr>
<th>RTTrc</th>
<th>SOFTWAREEDUCPROFrc</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>RTTrc</td>
<td>Count</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Expected Count</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10.8</td>
<td>6.2</td>
</tr>
<tr>
<td>Agree</td>
<td>Count</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Expected Count</td>
<td></td>
</tr>
<tr>
<td></td>
<td>29.2</td>
<td>16.8</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Expected Count</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>23</td>
</tr>
</tbody>
</table>

In attempting to examine whether there is a relationship between preservice teachers’ readiness to teach and their educational software proficiency, it is critical to test the null hypothesis, which in this study was “there is no relationship between preservice teachers’ perceptions of readiness for teaching in 1:1 classrooms and their proficiency with educational software.”
For the data in Table 15, I estimated the Chi Square statistics to test the relationship between preservice teachers’ readiness to teach and their educational software proficiency resulting in a Chi-Square value of 9.421. The p-value was less than .05 which suggested, for this sample, there was a significant relationship between preservice teachers’ readiness to teach and their proficiency with educational software ($x^2 = 9.421$, $p = .002$).

**Faculty modeling.** The variable “MODELINGFACULTYrc,” which I defined to mean a preservice teacher’s belief in the appropriateness of his or her education professors’ modeling of technology for 1:1 classrooms, was the sum of each participants’ answers to the five faculty modeling items recoded using the process outlined in the previous chapter. While 38.1% of participants (24 preservice teachers) indicated that their professors’ technology modeling met the criterion for appropriateness, 58.7% (37 preservice teachers) stated that their professors’ technology modeling did not meet the criterion for appropriateness.

In Table 16, I conducted a contingency table analysis to examine the relationship between the composite categorical variable “MODELINGFACULTYrc” and the readiness to teach categorical variable “RTTrc.” It is important to note that if there is no relationship between the preservice teachers’ MODELINGFACULTYPROFrc score and their RTTrc score, the difference between the observed and the expected counts would be minimal. In this table, we can see that there are four sets of observed and expected data, separated in value by 6.7.
Table 16

*Crosstabulation Between RTTroc and MODELINGFACULTY rc*

<table>
<thead>
<tr>
<th>RTTroc * MODELINGFACULTYrc Crosstabulation</th>
<th>MODELINGFACULTYrc</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>RTTroc Disagree</td>
<td>Count</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Expected Count</td>
<td>10.3</td>
</tr>
<tr>
<td>RTTroc Agree</td>
<td>Count</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Expected Count</td>
<td>26.7</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Expected Count</td>
<td>37</td>
</tr>
</tbody>
</table>

In attempting to examine whether there is a relationship between preservice teachers’ readiness to teach and the appropriateness of their professors’ technology modeling, it is critical to test the null hypothesis, which in this study was “there is no relationship between preservice teachers’ perceptions of readiness for teaching in 1:1 classrooms and the appropriateness of their professors’ modeling.”

For the data in Table 16, I estimated the Chi Square statistics to test the relationship between preservice teachers’ readiness to teach and the appropriateness of their professors’ technology modeling resulting in a Chi-Square value of 15.287. The p-value was less than .05, which suggested, in this sample, there was a significant relationship between preservice teachers’ readiness to teach and the appropriateness of the professors’ technology modeling proficiency with hardware devices ($\chi^2 = 15.287, p < .001$).

**Assessing social media proficiency.** Another of the items I studied was the perception of preservice teachers regarding social media. Preservice teachers were asked whether they were “proficient using social media apps” (Facebook, Twitter, SnapChat,
Instagram). The percentage of preservice teachers who agreed or strongly agreed they were proficient with social media apps was 88.9%.

Social media familiarity was expected to be high within the preservice teaching cohort and the survey data supported this premise as depicted in Figure 2 (Lei, 2009).

Figure 2. Preservice teachers’ responses when asked if they were proficient with social media.

**Assessing students’ digital readiness.** Preservice teachers may have limited experience in assessing their students’ digital readiness. To explore this topic, one of the items I included on the survey was: How will you assess your future students’ technology readiness? I first analyzed the preservice teachers’ responses to identify common terminology that appeared in their responses that would support the coding of the responses. Following the review of the data, I established the following broad categories to code the data: assess students’ digital skills; assess products students created using
digital skills; discuss technology with students; observe students using technology; survey students about their technology skills; teach students digital skills; uncertain answers (i.e., I don’t know); vague answers; wait for students to ask for help.

In Figure 3, I highlighted the preservice teachers’ recommendations for assessing their students’ digital readiness.

![Preservice Teachers' Strategies for Assessing Students' Digital Skills](image)

*Figure 3.* Preservice teachers’ strategies for assessing their students’ digital skills.

The term “assess” was used most often in the preservice teachers’ responses. Some of the participants stated they would assess a particular skill (i.e., keyboarding), while others referenced a digital activity or product that they would ask their students to complete (i.e., a paper or a presentation).

The participants did not identify a particular assessment tool nor did they provide information on what the assessment might contain. The results of this data analysis suggest that continued research in identifying the digital literacy skills that preservice teachers should possess, before beginning their first teaching assignment, remains
elusive, but imperative (Byrne, Kardefelt-Winther, & Livingstone, 2016). If preservice teachers are going to need to assess the digital literacy skills of their students, they need training on both a tool and methodology for completing this assessment.

**Assessing digital citizenship.** I asked preservice teachers to respond to this question: How will you teach digital citizenship to your students? Although all 63 participants were asked this question, almost 40% (39.7%) stated they did not know or left the answer box blank. Of the 60.3% that did respond, their answers ranged from descriptions of how they would teach their students’ digital citizenship (20 responses) to the types of content they would teach (15 responses). One respondent referenced the ISTE Standards while 3 respondents included the phrase “media literacy” in their answers. The findings suggest that digital citizenship is a topic that warrants additional coverage in preservice programs (Andresen, 2017).

**Performance of the instrument.** The instrument I developed for this study has not been validated independently. I estimated Cronbach’s alpha reliability coefficient, a “correlational measure of the reliability or consistency of the items in a scale” to ensure that the four constructs (i.e., hardware proficiency, basic software proficiency, educational software proficiency, and faculty modeling) were measuring aspects of the same thing and that it was appropriate to add up items for an overall rating scale (Vogt, 2007, p. 90). The Cronbach’s alpha reliability coefficient for each of the constructs was the following: Hardware Proficiency .793; Basic Software Proficiency .686; Educational software proficiency .938; Faculty Modeling .868.

The performance of the instrument may have been improved if the length had been reduced. Although individual items were clustered, the number of responses that
each participant was asked to respond to may have been too great. Survey fatigue may have been a factor in some of the participants’ responses.

The inclusion of a gift card option at the end of the instrument seemed practical at the onset of the study; however, there were problems in accessing the second survey if a participant used his or her phone. This may have resulted in fewer cards being distributed as a result of participants having to add a more cumbersome step to access the gift card.

The terminology in the instrument created several areas of confusion. For example, the question “I am proficient using a SmartBoard with students in a 1:1 classroom” should have stated “I am proficient using an interactive white board with students in a 1:1 classroom.” In addition, instead of beginning each item with “I am proficient using …,” the instrument would have been strengthened by beginning each item with “What is your level of proficiency?”

Findings: Interviews

Participants. At the conclusion of the questionnaire, participants were provided with information on how to link to a second questionnaire that would enable them to enter their email address for delivery of their $5 incentive card and to indicate whether they were interested in participating in a 30-minute interview. Although 63 respondents completed the questionnaire, only 33 used the link to enter information for the $5 incentive and the interview request. Access to the link using a smart phone rather than a laptop may have been more cumbersome resulting in a decrease in completion rates of the second questionnaire. Of the 33 participants who completed the second questionnaire, 15 provided their email addresses and indicated they were interested in participating in the interview.
The 15 preservice teachers interested in the interview then received a second email from me listing various options for scheduling the interview (3 different days with 11 different time slots). After sending out the email invitation with the various options, I received replies from three participants (2 seniors and 1 junior who I will refer to by the pseudonyms Natalia, Reina, and Brooke). I confirmed the date and time of their interview and completed the fifteen-question interviews on May 15.

Findings are presented in the next section and are grouped by the major constructs of this study: hardware, software, and faculty modeling. Readiness to teach is also included as a focus area. The interview questions are available in Appendix B. A coded transcript of Natalia’s interview is also included as Appendix C.

**Hardware proficiency.** Natalia, Reina, and Brooke all made mention of discussions related to hardware in their technology courses, but they did not confirm that hardware (i.e., interactive white boards or SmartBoards, document cameras, iPads, Chromebooks, or laptops) devices were an explicit topic of study in their methodology coursework. Natalia stated, “The most effective instruction I’ve had in technology has been in my student teaching. We talked about technology in my methods classes, but they haven’t really been useful.” Reina noted with dismay that instruction on hardware was nonexistent. Brooke reflected that “I don’t know how to organically include hardware into a lesson. I don’t know how to make flipcharts or anything. It’s very bad.” Brooke learned to use a document camera and to turn on a SmartBoard, but she was apprehensive about resolving other hardware issues. Reina expressed frustration at not being prepared to use the devices that might be available in her future classroom.

Natalia, Reina, and Brooke were asked to elaborate on the types of technology...
issues that they would be most likely to seek assistance in resolving. Natalia was confident that if the hardware devices were working properly, she would not have any problems with using the classroom devices. However, if there were problems with “something not working, or if a plug is not in the right spot,” Natalia was uncertain whether she could resolve the issue. Reina was of the opinion that she would be able to fix anything that was mechanical, but if there were problems with the software, she would need to contact the IT department. Brooke relayed that she would most likely need assistance calibrating the promethean boards as she “noticed that is a problem in my student teaching class.” She also expressed her belief that she might need support with the Wi-Fi connections or downloading programs.

When asked about hardware use in her first classroom, Natalia was quite confident stating that she was prepared to use a promethean board and laptop in her lessons because she had used these devices in her student teaching. Although Reina mentioned using hardware to access digital microscopes and project images up on the screen, Reina did not display the level of confidence that Natalia projected. Brooke was anxious to create flipcharts similar to what her mentor teacher had modeled during her student teaching work. Brooke was also confident that she would utilize her document camera for read alouds.

**Findings.** The comments of the participants suggest that there is an expectation that mentors or an IT department person will be available for support in resolving issues related to hardware devices. The participants did not appear overly concerned about their lack of expertise in trouble shooting hardware devices as they assumed that technical
support would be readily available. The participants acknowledged their lack of exposure to training with classroom devices (Chai et al., 2017; Cuhadar, 2018).

**Software proficiency.** When asked about software integration, Natalia, Reina, and Brooke all noted that discussions regarding software occurred, specifically in their technology class. Natalia clarified that the class had never downloaded software to review software from either a student’s or teacher’s perspective. Reina referred to a website titled “Wicks,” which may have been a reference to Wikipedia, when asked to discuss software apps. Reina also noted that she had looked up websites that she might use in her future classroom while completing assignments. Brooke noted that at the conclusion of her class, she had a long list of “super awesome tools,” but she did not know how to use them.

In describing her use of software apps in her first classroom, Natalia acknowledged that the only programs she planned to use would be those given to her so she would know what was expected of her. While Reina was uncertain about the software apps that might be available for use, Brooke immediately noted that she would use ClassDojo as this was an app that her mentor teacher used with great success for communicating with families. Brooke also noted that she would need to complete extensive research on appropriate software apps for her classroom.

I asked Natalia, Reina, and Brooke whether they had reviewed educational software in their preservice programs. Natalia confirmed that although there had been limited discussion about educational software, she had not actually reviewed software. Reina reported a similar experience. Brooke began by stating she had reviewed software to “a slight extent”; however, after elaborating, it was clear that she had not downloaded
any trial software to evaluate as part of her coursework. Brooke, an elementary education student, also stated that “none of her other professors have talked about technology in the classroom,” with the exception of her MSAT professor.

Natalia, Reina, and Brooke confirmed that their coursework did not include opportunities for designing specific lessons that focused on 1:1 classrooms. Reina mentioned using overhead projectors or PowerPoints, but did not recall an assignment that specifically required technology. Brooke requested clarification on the phrase “1:1 classroom,” stating, “I’m not sure what that means.”

The participants were also asked about software designed for interventions. Natalia responded to this question by stating that she did not yet have any training on selecting programs, but she stated that “if” she had a student needing interventions, she would ask for assistance. It was interesting to note that she qualified her response with “if” rather than acknowledging the fact that in almost any school one might teach in New Mexico, there will be students who need interventions. Reina did not have experience with assessing software, other than the interactive programs Reina had purchased for use at home within the family setting. Brooke identified three types of interventions that require technology, but was not able to expand further than these three options responding, “I don’t know if I know any other ones.”

**Findings.** The comments of the three participants suggested that software familiarization and review were not topics covered in depth in their preservice courses (Ditzler et al., 2016; Lee & Cherner, 2015). One of the participants expressed confidence that she could learn to navigate any program that was used by her district to support
students. The participants had limited knowledge of the types of software that might be most beneficial for students needing interventions.

**Faculty modeling.** I asked Natalia, Reina, and Brooke about the types of technology issues that education faculty needed assistance to resolve. Natalia responded that her education faculty had “all been pretty proficient in the technology available in the classrooms.” If they had technology issues, the smart board was usually the device that would not work. Issues were often solved by contacting the technology assistant. Reina mentioned software issues, problems with the speakers, and access to email accounts as the areas that educational faculty were most likely to need assistance with resolving. Brooke summarized the process used by her educational faculty in the following manner, “they would take a little while to see if they could figure it out and then they would ask the class if any of us knew and if that didn’t work, they would call the tech support for the building.”

**Findings.** The comments of the three participants suggested that faculty were, for the most part, proficient with using the technology in their classrooms, although varying levels of proficiency were observed (Hughes et al., 2016). If assistance was needed, faculty members would either request assistance from a student or from the IT department providing technical support in the building.

**Readiness to teach with technology.** When I asked about the responsibility for teaching preservice teachers about digital citizenship, Natalia suggested that although preservice teachers could get assistance with teaching digital citizenship in their student teaching assignments, the preferred method would “be the university teachers because that way preservice teachers have at least an idea of what to expect with digital
citizenship and all that before they enter their student teaching.” Reina also placed the onus on university faculty for teaching preservice teachers about digital citizenship stating, “we are going to school to learn, supposedly to learn how to be a teacher. It should be all included within the class works and we should be actually having classes that, you know, focused on what we will actually be doing in the classroom, not just, you know, what general classes are like.” Brooke was indecisive and put forth a more hesitant response that the technology professors should be responsible.

I asked Natalia, Reina, and Brooke to define a term that appears in the technology literature, “digital native.” Natalia stated that the term defined “somebody who has grown up and been around technology for most of their lives.” Natalia further elaborated on her response stating that she was not sure that she would define herself as a digital native; however, her students would fit into this category because “they have had access to computers and phones and tablets for all of their lives.” Reina may not have heard the expression “digital native” as a reference to people with life-long access to technology as Reina interpreted the phrase to mean a type of programming language rather than a reference to a person’s digital exposure. Brooke suggested that having technology since birth qualified a person as a digital native stating, “kids that grew up in an era that already had technology” met the definition.

When I asked about the importance of social media proficiency, Natalia, Reina, and Brooke had different perspectives to share. Natalia explained that a basic understanding of social media was important because students would most likely have this knowledge and teachers should have an awareness of what interests their students. Reina focused on the controversial aspects of social media commenting that “any little
tidbit can come back after you and you know anybody can possibly see that information and use it against you.” Brooke was quick to confirm her belief in the importance of social media proficiency as one of the many skills that teachers should possess. She asserted that “it’s going to be in kids’ lives whether we want it or not,” and was concerned that educators have the skills to help guide and protect students. Brooke elaborated by stating, “I think it’s super important. If you are proficient, you can help kids navigate it or keep them safe.”

When I asked the participants how they remain current with educational trends, Natalia shared that in her opinion, Pinterest “has a lot of the new cool things in education. So that’s the biggest where I see the most trends in education.” Reina replied that most of her knowledge of educational trends was coming from internet searches. Reina also clarified that many websites were problematic, stating, “most of them are garbage. You’ve got to weed through everything.” Brooke listed professional development, teacher Youtube videos, and teacher bloggers as sources for keeping up to date with educational trends.

I asked all three participants if they would be prepared to begin teaching in a 1:1 classroom for their first teaching assignment. Natalia was confident. She shared that she felt prepared now, but by the time she graduated in December, she would be more prepared. Even if Natalia was invited to teach “right now,” she would be prepared. Reina also stated that she was “already” ready because she had general experience teaching others. Reina expressed a desire to see state mandated requirements for lesson plans and other procedures, to include technology expectations, be adopted to minimize confusion for new teachers. Only Brooke stated that she was unprepared to teach in a 1:1 classroom
at the conclusion of her preservice program explaining, “No, I didn’t even know what it was before this interview.”

To conclude the interview, I asked all three participants what changes might occur in educational technology within the next 10 years. Natalia shared a common viewpoint that it would be difficult to predict the changes that technology will elicit in even the short period of 10 years. She did suggest that the amount of materials that would be available online would increase, while paper assignments would decrease. Reina expressed her belief that most educational settings would be “basically computer-based” and teachers would just sit back and answer individual questions. Reina also remarked, “Technology is going to change out like crazy. You know most teachers are going to wind up being out of a job.” Reina also expressed frustration with the compliance issues that teachers face and the difficulty that the state experiences in trying to hire qualified teachers for all of the open positions. Brooke, although she earlier noted that she was unqualified to teach in a 1:1 classroom, was clear about her belief that technology would become more integrated and integral to the teaching profession. She expressed excitement about the “cool stuff” that would be available for use in the classroom exclaiming, “It will become even more crucial and important and people will be more comfortable teaching it and talking about it.”

**Improving the interviews.** The interview questions allowed me to elicit information that helped me better understand how to improve the questionnaire as well as understand the possible reasons behind the questionnaire findings. I believe the interviews would have garnered additional qualitative data had I been able to conduct the interviews in person. I found that it took several minutes, at the start of each interview, to
relax and read the questions in a natural way. I believe the participants may also have been more relaxed had we met in person.

Although the number of participants who expressed interest in the interview was 15, I was only able to conduct three interviews. The timing of the interview request may have contributed to the low response rate as I sent the request to students close to the end of the spring semester, a hectic time of year for anyone involved in education.

**Summary of Findings**

The purpose of this exploratory case study was to enhance our understanding of the factors that promote preservice teachers’ perceptions of readiness to teach in 1:1 classrooms. An analysis of these factors should allow college educators to make pedagogical shifts in preservice teachers’ programs to better prepare new teachers for 21st century classrooms.

Although the results of my study appeared to corroborate the literature and confirm my initial observations, there were two areas, readiness to teach and proficiency in assessing educational technology, that were surprising.

There were 63 preservice teachers who participated in the study. Although 73% or 46 preservice teachers reported they were ready to teach in 1:1 classrooms, their responses to the items within the four constructs (hardware proficiency, basic software proficiency, educational software proficiency, and faculty modeling) included a low of 36.5% for educational software proficiency, 38.1% for appropriate faculty modeling, and 55.6% for hardware proficiency. Basic software proficiency was the only area that preservice teachers were in almost total agreement regarding their level of proficiency (98.4%).
When I asked preservice teachers whether they were proficient assessing educational technology apps for use in a 1:1 classroom, 84.1% agreed they were proficient, perhaps reflecting the leniency bias noted by researchers (Lei, 2009; Maderick et al., 2016). The comparison of 84% of preservice teachers reporting they are proficient assessing educational technology apps compared to the 36.5% figure that was calculated as the sum of preservice teachers’ proficiency with educational software merits additional research.

**Hardware.** The first outcome I anticipated was that preservice teachers might have limited experience working with hardware in 1:1 classrooms. The survey data I analyzed indicated that when asked about individual devices (i.e., Document Cameras, SmartBoards, Chromebooks, Laptops, and iPads), preservice teachers reported varying degrees of proficiency, from 61.9% for document cameras to 84.2% for iPads. When I examined the sum of their hardware proficiency scores, just over half or 55.6% reported they were proficient with hardware.

However, when examining the relationship between their hardware proficiency responses, by device, and readiness to teach, a more complex story emerged. After conducting a cross-tabulation analysis between hardware proficiency responses, by device, and readiness to teach responses, I noted that hardware proficiency responses decreased in all five categories.

I estimated the Chi Square statistics to test the relationship between total hardware proficiency responses and the readiness to teach responses. The test resulted in a Chi-Square value of 14.346. The p-value was less than .05, which suggested, for this sample,
there was a significant relationship between preservice teachers’ readiness to teach and their proficiency with hardware devices ($x^2 = 14.346, p < .001$).

The data and supporting literature suggested that even if some preservice teachers felt confident in their ability to use hardware devices, they did not consistently feel confident in their abilities to select and use hardware technology to best support students’ learning (Chai et al., 2017). This finding related to hardware usage suggested that preservice teachers would need support learning to effectively use hardware devices in 1:1 classrooms to maximize student learning (Cuhadar, 2018).

The comments of the three preservice teachers I interviewed suggested that there is an expectation that mentors or an IT department person will be available for support in resolving issues related to hardware devices. The participants did not appear overly concerned about their lack of expertise in trouble shooting hardware devices as they assumed that technical support would be readily available. The participants acknowledged their lack of exposure to training with classroom devices.

**Basic software.** The second outcome I anticipated was that preservice teachers might indicate high levels of proficiency with basic software apps (i.e., documents, spreadsheets, email, and presentations). The survey data I analyzed indicated that when asked about basic software apps (i.e., documents, spreadsheets, email, and presentations), preservice teachers reported high degrees of proficiency, from 84.2% for spreadsheets to 100% for documents, email, and presentations. When I examined the sum of their basic software proficiency scores, 98.4% reported they were proficient with basic software. This bodes well as using technology to prepare for teaching is a prerequisite to teaching with technology.
However, when examining the relationship between their basic software proficiency responses, by type, and readiness to teach, additional insights emerged. After conducting a cross-tabulation analysis between basic software proficiency responses, by type, and readiness to teach responses, I noted that basic software proficiency responses decreased in all four categories.

I estimated the Chi Square statistics to test the relationship between total basic software proficiency responses and the readiness to teach responses. The test resulted in a Chi-Square value of 2.750. The p-value was greater than .05 which suggested, based on this sample, there was no significant relationship between preservice teachers’ readiness to teach and their proficiency with basic software ($x^2 = 2.750, p = .097$).

The data and supporting literature revealed that even when preservice teachers felt very confident in their own ability to use basic software, they did not consistently feel confident in their abilities to select and use technology to best support students’ learning. These findings suggested that preservice teachers, even those who reported high levels of proficiency with basic software, would need support learning to effectively use basic software in 1:1 classrooms to maximize student learning (Heggart & Yoo, 2018).

**Educational software.** The third outcome I anticipated was that preservice teachers might lack familiarity with educational apps. The survey data I analyzed indicated that when asked about educational software, preservice teachers reported significantly different levels of proficiency, from 15.8% for filtering apps to 96.8% for video apps. When I examined the sum of their educational software proficiency scores, just over one third or 36.5% reported they were proficient with educational software apps.
When examining the relationship between their educational software proficiency responses, by app, and readiness to teach, a clearer story was evident. After conducting a cross-tabulation analysis between educational software proficiency responses, by app, and readiness to teach responses, I noted that educational software proficiency responses decreased in all 23 categories, with the exception of the filtering app.

I estimated the Chi Square statistics to test the relationship between total educational software proficiency responses and the readiness to teach response resulting in a Chi-Square value of 9.421. The p-value was less than .05 which suggested, based on this sample, there was a significant relationship between preservice teachers’ readiness to teach and their proficiency with educational software ($\chi^2 = 9.421$, $p = .002$).

The data and literature suggested that even when some preservice teachers felt confident in their own ability to use educational software, they did not consistently feel confident in their abilities to select and use technology to best support students’ learning. These findings related to educational software usage suggest that preservice teachers would need support learning to effectively use educational software in 1:1 classrooms to maximize student learning (Ditzler et al., 2016; Lee & Cherner, 2015).

In an era in which educational apps are emerging at rates that defy close scrutiny, educational institutions may need to develop processes for reviewing and recommending software, to include a method to ensure that an independent review of the algorithms that drive the software programs has been conducted. The preservice teachers I interviewed expressed limited exposure to software for educational purposes. They had not reviewed software in their coursework, nor did they report experience looking at software for interventions or for students with disabilities.
The literature and my own experience as a school leader suggested that preservice teachers might lack familiarity with educational apps. The interviews supported this premise. The comments of the three participants suggested that software familiarization and review were not topics covered in their preservice courses. One of the participants expressed confidence that she could learn to navigate any program that was used by her district to support students. The participants had limited knowledge of the types of software that might be most beneficial for students needing interventions.

**Faculty modeling.** The fourth outcome I anticipated was that preservice teachers might have limited or varied exposure to faculty modeling of strategies for 1:1 classrooms. The survey data I analyzed indicated that when asked about the appropriateness of the faculty modeling they observed, preservice teachers reported a range of levels, from 49.2% for appropriate modeling in math coursework to 76.2% for appropriate modeling in technology coursework. When I examined the sum of their faculty modeling scores, 38.1% reported appropriate modeling by their education faculty.

However, when examining the relationship between their faculty modeling responses and their readiness to teach responses, a more detailed picture emerged. After conducting a cross-tabulation analysis between faculty modeling responses and readiness to teach responses, I noted that faculty modeling responses decreased in all five categories.

I estimated the Chi Square statistics to test the relationship between total modeling faculty responses and the readiness to teach response resulting in a Chi-Square value 15.287. The p-value was less than .05 which suggested, based on this sample, there was a significant relationship between preservice teachers’ readiness to teach and the
appropriateness of the professors’ technology modeling proficiency with hardware devices (χ² = 15.287, p < .001).

The supporting literature and these findings suggest that aspiring teachers need additional modeling of technology in their content area coursework, by their faculty, to effectively use technology in 1:1 classrooms (Dassa & Vaughn, 2018; Urbani et al., 2017). Faculty members may also need ongoing exposure to the educational apps that are used most frequently in 1:1 elementary and secondary classrooms (Kalonde & Mousa, 2016).

Both the literature and my own experience as a school leader suggested that there might be inconsistencies in the ability of faculty educators to model strategies and resolve technology issues. Preservice teachers in this study reported varying levels of agreement with the ability of their content area faculty to model the appropriate use of technology for a 1:1 classroom. Just as principals may struggle to model and recommend specific software for use in classrooms due to their lack of opportunity to practice these strategies, so, too, may faculty at universities struggle with modeling techniques for use in 1:1 classrooms. However, the preservice teachers I interviewed reported that their education professors demonstrated proficiency with the technology in their coursework. If a professor was unable to resolve an issue, the professor would contact the IT department for assistance.

Readiness to teach. Although there appear to be gaps in the technological knowledge base of aspiring teachers enrolled at UNM at the time of this study, 73% of the preservice teachers surveyed seemed to share an optimism about their readiness to teach as they prepare to enter their first classrooms. Two of the three preservice teachers
interviewed reported they were confident about their readiness to teach in a 1:1 classroom, echoing the perceptions of the survey participants.

Social media. I also anticipated that preservice teachers might indicate high levels of proficiency with social media apps. The survey data supported this observation as 88.9% of preservice teachers reported they were proficient with social media apps.

However, when examining the relationship between their social media responses and their readiness to teach responses, a more detailed picture emerged. After conducting a cross-tabulation analysis between social media responses and readiness to teach responses, I noted that the percentage of respondents who were proficient with social media and ready to teach decreased from 88.9% to 67.7%.

I estimated the Chi Square statistics to test the relationship between social media responses and the readiness to teach response resulting in a Chi-Square value of 4.135. The p-value was greater than .05 which suggested there was no relationship between preservice teachers’ readiness to teach and the social media proficiency of preservice teachers ($x^2 = 4.135, p > .05$).

Assessing students’ digital readiness. The results of the supporting literature and this study suggested that if preservice teachers are going to assess the digital literacy skills of their students, they need training on both a tool and methodology for completing this assessment (Byrne et al., 2016). How do we define digital literacy? Is there a guiding set of tasks that could help educators develop skill sets in their students or will digital literacy remain elusive as new software and hardware enter the market? Research is needed to further define what the phrase digital literacy represents when applied to students and learning outcomes.
Educational trends. When asked about keeping informed about educational trends, the interview participants did not mention journals, books, or research studies; rather, Pinterest, Youtube videos, teacher bloggers, and the internet were cited as sources to consult for educational trends. These comments suggest that one of the goals of media literacy, creating content, may be emerging more rapidly than expected. If new preservice teachers are investigating the content produced by their peers through sites that are popular, but not officially peer-reviewed or supported by research, the spread of misleading information could be problematic, especially if it relates to instructional strategies.
Chapter Five Conclusion

Introduction

The integration of tools to communicate and to impact lives will continue to provoke dialogue and research, especially in education. Educators are responsible for investigating how digital tools can be utilized to enhance student achievement and prepare students for a world in which the nature of work is unknown, but the inclusion of technology is essential (Aoun, 2017; Collins & Halverson, 2018; Darling-Hammond, 2009; Merrow, 2017).

Summary of the Study

Overview of the problem. Although many of the preservice teachers who will enter America’s classrooms in the upcoming years may have grown up with technology, they do not necessarily have the digital skills to impact their students’ learning outcomes in the most effective manner possible (Kumar & Vigil, 2011; Minicozzi, 2018). Institutions of higher education, considered by many to be the critical bridge preparing students to advance from compulsory education to workplace readiness, are faced with a daunting challenge. Preservice teachers must be prepared for the 21st century classrooms they will enter; however, the technological tools now available for use in 1:1 classrooms are evolving so quickly that the systems in place to prepare teacher candidates may be insufficient (Andresen, 2017; Kalonde & Mousa, 2016).

Purpose statement and research questions. This research study examined the professional digital competencies being taught in preservice coursework at the University of New Mexico and the perceptions of preservice teachers, enrolled in both elementary and secondary teacher candidate programs, regarding their readiness to teach in 1:1
classrooms. The purpose of this exploratory study was to promote positive student outcomes by identifying current practices for preparing new teachers to enter their first 1:1 classroom with the prerequisite skills needed for using technology. The study was guided by these questions.

- What professional digital competencies designed for a 1:1 classroom are being taught in preservice teachers’ education courses?
- To what extent do preservice teachers feel prepared to begin their careers teaching in 1:1 classrooms?

**Rationale for the choice of methods.** I decided to combine quantitative and qualitative research approaches to gain a deeper understanding of preservice teachers’ perceptions of readiness for teaching in a 1:1 classroom. The integration of technology into the realm of education is multi-faceted so an approach using both quantitative and qualitative methodology seemed appropriate. To examine my research questions, I explored how preservice teachers planned to use technology to enhance what they teach, how they teach, and what students learn. I focused my survey research on four major constructs in an attempt to narrow a very wide field of study to hardware proficiency, basic software proficiency, educational software proficiency, and faculty modeling. I also included interviews to probe how preservice teachers interpreted questions related to assessing digital citizenship, remaining current with educational trends, and predicting future changes in educational technology, in addition to the software and hardware proficiency questions.

In selecting the case study method, I wanted to explore a bounded system, specifically the University of New Mexico’s teacher preparation program, and I was
interested in a methodology that allowed for the researcher’s interpretations to be included (Creswell, 2013). I have spent several years as a principal in a district that launched a 1:1 computer initiative and I wanted to be able to include my interpretations of the events that unfolded in this district as a segment of my study. Although I was able to collect some contextual data, my low interviewee response rate, my primary qualitative data collection methodology (phone interviews), and the dates I selected to arrange my interviews (end of the spring semester) limited my ability to collect the in-depth qualitative data that would have enhanced my study.

**Going Beyond the Research Questions**

The purpose of this exploratory study was to enhance our understanding of the factors that promote preservice teachers’ perceptions of readiness to teach in 1:1 classrooms. An analysis of these factors should allow college educators to make pedagogical shifts in preservice teachers’ programs to better prepare new teachers for 21st century classrooms. Although there appeared to be gaps in the technological knowledge base of aspiring teachers enrolled at UNM at the time of this study, 73% of the preservice teachers seemed to share an optimism about their readiness to teach as they prepared to enter their first classrooms. This study provided me with answers to my research questions, but also elicited many other questions related to effectively utilizing technology in 1:1 classrooms.

What professional digital competencies designed for a 1:1 classroom were being taught in preservice teachers’ education courses? Preservice teachers were learning about hardware through their coursework and fieldwork. The level of training they received appeared to be highly dependent on the background of the faculty teaching their courses
and their field study placement. Preservice teachers were less likely to receive training on integrating software apps during their coursework and lacked extensive knowledge regarding software apps, but were confident they would receive training in their school districts.

To what extent do preservice teachers feel prepared to begin their careers teaching in 1:1 classrooms? Although preservice teachers reported a wide range of proficiency levels with the four major constructs of hardware, basic software, educational software, and appropriate faculty modeling, almost three quarters or 73% of the participants responded to the final question on the instrument indicating they were prepared to select technologies to use in their 1:1 classrooms that enhance what they teach, how they teach, and what students learn. Preservice teachers reported levels of proficiency within each of the four constructs were much lower than their perceptions regarding their readiness to use technology to teach in a 1:1 classroom.

**Limitations.** Due to the size of the sample (n = 63), the study is not generalizable (Vogt, 2007). The instrument was not independently validated and although three of the four major constructs appeared to measure aspects of the same thing (hardware proficiency, educational software proficiency, and faculty modeling), the results were inconclusive for the basic software construct. In addition, the qualitative data collection was limited and opportunities to further explore the perceptions of preservice teachers were missed. The study may also have yielded additional insights had I been able to disaggregate the data by elementary and secondary education students.

**Future research.** One of the overriding themes of the literature review was the need for on-going research into an entire host of questions related to technology
integration in education. The notion that we, as educators, are preparing students for a world in which the nature of work is unknown, but the inclusion of technology is essential, is a challenging mandate to address (Aoun, 2017; Collins & Halverson, 2018; Darling-Hammond, 2009; Merrow, 2017). With new technologies on the horizon that will impact how and what we teach, educators, working collaboratively within districts and with universities, must develop systems that allow for fluid shifts in lesson content and delivery. This will be a major challenge as we attempt to harness the power of technology to maximize students’ learning outcomes.

**Policy implications.** School leaders are at risk for falling behind their teaching staff as they often do not have the opportunity to practice utilizing the advanced EdTech skill sets that are surfacing in classrooms. School leaders must also develop comprehensive knowledge about the software programs best suited for the needs of their students. Programs that promote reading or math growth for students with disabilities, English language learners, or at-risk students often do not have a reputable research base to support the claims of the companies promoting their products. Protecting the digital footprint of students is another emerging task for school leaders. More parents are opting out of having their students’ photos or images posted online and school leaders must develop procedures that honor the wishes of parents and acknowledge the importance of cybersecurity.

School leaders are also facing challenges with ensuring that all of their teachers have a minimum set of digital skills that can be used to complete routine tasks or support instruction in the classroom. For instance, confirming that all teachers have the ability to import an email contact list at the start of the year into their individual email program is a
task that school leaders might be responsible for completing. Teachers also need to learn to use programs that allow them to monitor their students’ usage habits, block certain web sites, and ensure that students are not downloading software that allows students to skirt filters.

District leaders are faced with handling the many requests of school leaders for hardware and software products. As some curriculum and instruction leaders struggle to adopt curriculum for the district, school leaders may be requesting products that do not meet the adoption materials guidelines. Should district leaders order software programs for schools based on a request, or should there be a system in place to evaluate programs at the start of the year, providing school leaders with recommendations for specific software programs? These are the types of questions district leaders must address.

University educators, responsible for preparing aspiring teachers, are also facing mounting challenges to ensure that preservice teachers are ready to move into their first classrooms. Are university faculty modeling appropriate EdTech skills that preservice teachers will need as they transition to their first classrooms or is there a tendency for the EdTech training to be delivered during the field work? Should there be a required digital literacy assessment for teacher candidates to provide baseline data and a pathway to achieving digital literacy before they graduate? If a digital literacy assessment is valid, what types of tasks should the assessment encompass?

**Concluding remarks.** I began this study by highlighting the protean nature of educational technology. In the years since I began analyzing the growth of EdTech in the classroom, I have witnessed the shifts in hardware, software, and professional digital competencies within my own school district and in the literature. The shifts have been
significant, but the ability of school districts to ensure that school leaders and teachers are using technology in a manner that will best promote positive student outcomes is complex. Technology utilization varies by teacher and by schools. Some schools have a high percentage of teachers who have moved quickly to acquire EdTech skills while other schools have needed to focus on other critical issues, to include student wellness and school safety. The inclusion of digital learning coaches has been a critical element of school districts’ digital learning plans, as the specific responsibilities of digital coaches have evolved.

The support network that is required to maintain a 1:1 initiative is immense. School districts that commit to 1:1 initiatives must have community support to ensure that the infrastructure, hardware, software, and internet capabilities are maintained. The annual funding required to support a district the size of Santa Fe Public Schools, a 1:1 school district in New Mexico with approximately 13,000 students, is about 11 million dollars. Recognizing that annual technology expenditures similar to that of Santa Fe Public Schools are essential, school districts must work with community, state, and national leaders to ensure that a steady funding allocation is provided.

The drawbacks of technology utilization are gaining momentum. Educators will need to familiarize themselves with the emerging literature on screen time guidelines, privacy mandates, the efficacy of personalized learning software, among many other issues. The extent to which technology is impacting the everyday lives of citizens is probably much more significant than people realize. How then will educators ensure that we minimize the costs to our children associated with technology usage and maximize the benefits? This is the challenge that educators have in front of them. This year, John
Goodenough, developer of the lithium-ion battery, reflected, “Technology is morally neutral; its value to society depends on how we use it” (Goodenough, 2019, p. 44). Our response to this insight will reveal much about our shared values.

If educators can use the inherent power of technology to uphold our shared belief in the value of educating all students for the lives of safety, security, and belonging they deserve, we will be remembered as a society that used its tools to promote the ideals that strengthen a nation and its people.
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Appendix A

Informed Consent for Electronic Questionnaire

3-3-19

Laura Jeffery, a doctoral student at the University of New Mexico, is conducting a research study under the supervision of her faculty advisor, Dr. Allison M. Borden. The purpose of the research is to examine preservice teachers' perceptions of readiness for teaching in 1:1 classrooms. You are being asked to participate because you are a preservice teacher. Your responses will add to an emerging body of knowledge on how digital technology is changing education.

If you would like to receive a $5 Starbucks gift card as a small token of appreciation for completing this survey, you will have an opportunity to enter your name and email address at the conclusion of this survey.

Your participation will involve answering 17 survey questions. The survey should take about 8 minutes to complete. The survey includes questions such as the following: To what extent are you proficient with the following presentation apps (PowerPoint, Prezi, etc.)? Your involvement in the research is voluntary, and you may choose not to participate. You can refuse to answer any of the questions at any time. There are no names or identifying information associated with your responses. There are no known risks in this research, but some individuals may experience discomfort or loss of privacy when answering questions. Data will be stored on the principal investigator's laptop, in her home, physically secured by lock, and electronically secured by password. Participants' email addresses will be replaced by a unique number identifier on the data spreadsheet, and the email addresses will be deleted once the identifier number has been assigned.

The findings from this project will provide information on the types of technology strategies preservice teachers may utilize in their first classrooms, and will clarify the technology strategies that education faculty are modeling for preservice teachers. If published, results will be presented in summary form only. Although the research is intended to improve future teacher training in digital literacy, you will not receive direct benefits by participating in this study.

If you have any questions, concerns, or complaints about the research, please feel free to call Dr. Allison M. Borden, the student investigator's faculty advisor, at 505-277-1285. If you have questions regarding your rights as a research participant, or about what you should do in case of any harm to you, or if you want to obtain information or offer input, please contact the UNM Office of the IRB (OIRB) at (505) 277-2644 or irb.unm.edu.

* 1. By selecting "yes," you are agreeing to participate in the study.
   - [ ] Yes
   - [ ] No
### Preservice Teachers' Perceptions of Readiness for Teaching in 1:1 Classrooms

2. Are you in your final year of a preservice teachers' education program?
   - [ ] Yes
   - [ ] No

3. When do you anticipate moving into your first teaching job?
   - [ ] Spring Semester 2019
   - [ ] Summer 2019
   - [ ] Fall Semester 2019
   - [ ] Spring Semester 2020
   - [ ] Other (please specify)

4. What is your status?
   - [ ] Undergraduate Student at UNM
   - [ ] Graduate Student at UNM
   - [ ] Undergraduate Student at SFCC
   - [ ] Graduate Student at SFCC

5. What is your gender?
   - [ ] Female
   - [ ] Male
   - [ ] Other

6. In what year were you born? (enter 4-digit birth year; for example, 1976)
   - [ ]
7. To what extent do you agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am proficient using a SmartBoard with students in a 1:1 classroom.</td>
<td>○</td>
<td>○</td>
<td>○</td>
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</tr>
<tr>
<td>I am proficient using a document camera with students in a 1:1 classroom.</td>
<td>○</td>
<td>○</td>
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</tr>
<tr>
<td>I am proficient using iPads with students in a 1:1 classroom.</td>
<td>○</td>
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</tr>
<tr>
<td>I am proficient using Chromebooks with students in a 1:1 classroom.</td>
<td>○</td>
<td>○</td>
<td>○</td>
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</tr>
<tr>
<td>I am proficient using laptops with students in a 1:1 classroom.</td>
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<td>○</td>
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</tbody>
</table>

8. How will you assess your future students' technology readiness?


9. To what extent do you agree with the following statements?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am proficient using apps for language instruction in a 1:1 classroom (Rosetta Stone, Babbel, etc.).</td>
<td></td>
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<tr>
<td>I am proficient using lesson planner apps (Google Classroom, Daily Lesson Planner, OnCourse, etc.).</td>
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<tr>
<td>I am proficient using math apps in a 1:1 classroom (Khan Academy, IXL, Cool Math Games, XtraMath, PhET, Math Playground, Desmos, etc.).</td>
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<tr>
<td>I am proficient using student monitoring/usage apps in a 1:1 classroom (GoGuardian, LightsOut, etc.).</td>
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<tr>
<td>I am proficient using news apps in a 1:1 classroom (BBC, CNN, The Guardian, Business Inside, Forbes, History Channel, etc.).</td>
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</tr>
</tbody>
</table>
### 10. To what extent do you agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am proficient providing written feedback to students using an online</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>editing app in a 1:1 classroom.</td>
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<tr>
<td>I am proficient building and maintaining a class webpage.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am proficient using presentation apps (Google Slides,</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>PowerPoint, Prezi, etc.).</td>
<td></td>
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<tr>
<td>I am proficient using quiz apps in a 1:1 classroom (Quizlet, Quizzes,</td>
<td>○</td>
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<tr>
<td>Quizizz, etc.).</td>
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</table>
11. To what extent do you agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am proficient using science apps in a 1:1 classroom (Scratch, NCBi, Code, etc.).</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>I am proficient using spreadsheet apps</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>(Google Sheets, Excel, etc.).</td>
<td></td>
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<tr>
<td>I am proficient using storage apps in a 1:1 classroom (Google Drive, OneDrive, etc.).</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>I am proficient using assessment apps in a 1:1 classroom (Plickers, Socrative, GoShowBox, Secretive, etc.).</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I am proficient using study aid apps in a 1:1 classroom Study Island, Renaissance, Study.com, SoftSchool, Grammarly, etc.).</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>I am proficient using apps for creating surveys in a 1:1 classroom (Google Forms, SurveyMonkey, etc.).</td>
<td>☐</td>
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</tbody>
</table>

12. How will you teach digital citizenship?
13. To what extent do you agree with the following statements?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am proficient using teaching aid apps in a 1:1 classroom (Edpuzzle, Newsela, BrainPop, Scratch, MobyMax, Kids A-Z, Front Row, History BrainPOP, Discovery Education, Beanstalks, Scholastic, IXL, Spelling City, etc.).</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am proficient using social media apps (Facebook, Twitter, SnapChat, Instagram, etc.).</td>
<td>○</td>
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</tr>
<tr>
<td>I am proficient using typing apps in a 1:1 classroom (Nitro Type, TypingClub, etc.).</td>
<td>○</td>
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</tr>
<tr>
<td>I am proficient using video apps in a 1:1 classroom (online, YouTube, etc.).</td>
<td>○</td>
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</tr>
<tr>
<td>I am proficient in assessing educational technology apps for use in my 1:1 classroom.</td>
<td>○</td>
<td>○</td>
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</tr>
</tbody>
</table>
14. To what extent do you agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>My mathematics education professors appropriately modeled technology usage for 1:1 classrooms in their teaching.</td>
<td>○</td>
<td>○</td>
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</tr>
<tr>
<td>My literacy education professors appropriately modeled technology usage for 1:1 classrooms in their teaching.</td>
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</tr>
<tr>
<td>My science education professors appropriately modeled technology usage for 1:1 classrooms in their teaching.</td>
<td>○</td>
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<td>○</td>
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</tr>
<tr>
<td>My social studies education professors appropriately modeled technology usage for 1:1 classrooms in their teaching.</td>
<td>○</td>
<td>○</td>
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</tr>
<tr>
<td>My instructional technology professors appropriately modeled technology usage for 1:1 classrooms in their teaching.</td>
<td>○</td>
<td>○</td>
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</tbody>
</table>
15. To what extent do you agree with the following statements?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am proficient using apps for classroom management in a 1:1 classroom (Google Classroom, Microsoft Class Notebook, etc.).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am proficient using apps for student collaboration in a 1:1 classroom (Padlet, Bubbl.us, Meetmee, etc.).</td>
<td></td>
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</tr>
<tr>
<td>I am proficient using apps for student creativity in a 1:1 classroom (Canva, Works, Storybird, Inkers, etc.).</td>
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</tr>
<tr>
<td>I am proficient using apps for data analysis in a 1:1 classroom (NWEA MAP, Classworks, Istation, etc.).</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>I am proficient using apps for creating documents (Google Documents, Word Documents, etc.).</td>
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<td></td>
</tr>
</tbody>
</table>
16. To what extent do you agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am proficient using apps for email (Gmail, Outlook, etc.).</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am proficient in recognizing filter bypass tools (Facebook, Twitter, etc.).</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am proficient using educational gaming apps in a 1:1 classroom (Kahoot, ABCya, Prodigy, etc.).</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am proficient using gradebook apps (PowerTeacher).</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am proficient using graphing calculator apps in a 1:1 classroom.</td>
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</tbody>
</table>

17. To what extent do you agree with the following statement? I am prepared to select technologies to use in my 1:1 classroom that enhance what I teach, how I teach, and what students learn.

- [ ] Strongly agree
- [ ] Agree
- [ ] Disagree
- [ ] Strongly disagree
Appendix B

Interview Questions for Preservice Teachers

1. What type of instruction have you received for integrating hardware technology in your first classroom?

2. What type of instruction have you received for integrating software apps in your first classroom?

3. Describe how you will use hardware technology in your first classroom.

4. Describe how you will use software apps in your first classroom.

5. Did you review educational software in your preservice program?

6. Did you design lessons for 1:1 classrooms in your preservice program?

7. Who should be responsible for teaching preservice teachers about digital citizenship?

8. How would you define “digital natives”?

9. How important is social media proficiency for preservice teachers?

10. What types of software do you recommend for students needing interventions?

11. How do you keep up with the trends in educational technology?

12. What types of technology issues did your education faculty seek assistance with resolving during your program?

13. What types of technology issues are you most likely to seek assistance with resolving if you accept a position in a 1:1 classroom?

14. Do you feel prepared to teach in a 1:1 classroom for your first teaching assignment?

15. How will educational technology change in the next 10 years?
LJ: This is LJ. We communicated a short time ago regarding an interview for this evening.

N: Yes.

LJ: Okay, Before we get started I just wanted to double check and make sure that you had a chance to look over the protocol that I sent.

N: Yes.

LJ: Okay. And also do I have your consent to record our interview?

N: Yes.

LJ: Great and I just also wanted to let you know I have a couple of interviews tonight and I'll be able to send a Starbucks gift card later this evening once I finish up.

N: Okay.

LJ: Okay, great and I just wanted to really express my appreciation for your willingness to answer the questions. There are about 15 questions and I'll just go through and read them and just respond. There's nothing complicated in the questions and I can certainly clarify if there's a question that needs that for you.

N: Sounds good. Ok.

LJ: The first question is what type of instruction have you received for integrating hardware technology in your first classroom? T

N: The most effective instruction I’ve had in technology has been in my student teaching. We talked about technology in my methods classes, but they haven't really been useful.
To do it with a classroom has been definitely the most effective way about learning equipment knowledge is actually in my classroom.

LJ: Question 2 is what type of instruction have you received for integrating software apps in your first classroom?

N: So I have taken the technology class, such as the MCAS, I forget the number, and we talked a lot about those program. We didn't talk a lot about how to utilize those programs effectively, but we talked about how they exist and what we could do in theory, but not practicality.

LJ: Okay, so you never, perhaps, would download software and then actually look more closely at them from either the student or the teacher perspective?

N: Probably not on my own.

LJ: Okay, I see. The next question is describe how you will use hardware technology in your first class?

N: I will most likely have a promethean board and using the board with the laptop is probably the biggest way that I will use this technology provided and then I am pretty confident in using PBs because I had one in my classroom.

LJ: The next question is how you will use software apps in your first classroom?

N: I will use what is given to me. So I know that teachers are given programs to use for assessment for teaching and they will probably be the only ones I would use and they are given to me and that way I know I'm expected to use them.

LJ: The next question is did you review educational software in your preservice program?
N: We touched on this a little bit. Not really. We’ve talked about them, but I haven’t done anything with them. I’m not really talked about it… These programs were brought there but not actually doing anything with them.

LJ: And the next question is did you design lessons for one-to-one classrooms in your preservice program?

N: No.

LJ: And Question 7 is who should be responsible for teaching preservice teachers about digital citizenship?

N: I think it should be the university teachers because that way preservice teachers have at least an idea of what to expect with digital citizenship and all that before they enter their student teaching, but once they enter, they could get help but I think the university teachers should be the main teachers.

LJ: The next question is how would you define digital natives?

N: I would define digital natives as somebody who has grown up and been around technology for most of their lives. So, I’m not sure that I say that I am a digital native, but for sure the students who are learning now are because they have had access to computers and phones and tablets for all of their whole lives.

LJ: The next question is how important is social media proficiency for preservice teachers?

N: I think it is important to have at least a basic understanding of social media because even if you don’t use it in your personal life, there are very high chances that your students might or your school might so having a basic understanding is very good so that we don’t have to learn everything from scratch.
LJ: We are on question 10 so we’re making some progress. This question is what types of software do you recommend for students needing interventions?

N: I don't know of any software programs off the top of my head because I have not had to deal with those situations yet in my teachings, but if I had a student who needed interventions, I would consult a mentor teacher or principal and ask them if they have any interventions.

LJ: Question 11 is how do you keep up with the trends in educational technology?

N: I am on Pinterest a lot when looking through things for classrooms. And that has a lot of the new cool things in education. So that’s the biggest, where I see the most trends in education.

LJ: Question 12 is what types of technology issues did your education faculty seek assistance with actually resolving during your program that you would've witnessed?

N: So like if they had trouble turning on the computer?

LJ: Yes, those kinds of things.

N: Okay when the smart board would not work, they would have to call in a technology assistant to help with that. But other than that, they have all been pretty proficient in the technology available in the classrooms.

LJ: Question 13 is what types of technology issues are you most likely to seek assistance with resolving if you accept a position in a one-to-one classroom?

N: I would probably have to seek help with more of the hardware technology. Once I get it working, then I'm pretty much fine with it, but if for some reason something is not working, or if a plug is not in the right spot, I don't exactly know how to fix that. So those are probably the kinds of thing I would need help with.
LJ: The next question is do you feel prepared to teach in a one-to-one classroom for your first teaching assignment?

N: I think I feel pretty prepared. I'm not graduated yet until December so I think once that comes I would will be more prepared, but I think right now if asked to teach, I would be prepared.

LJ: Our last question is how will educational technology change in the next 10 years?

N: It’s kind of impossible to say because technology has changed so much. What can you answer now that is going to look like. I can for sure see more technology in classrooms. Right now all classrooms have iPads or chrome books and a Promethean board, but I can see more learning being online instead of on paper and students having more time on the screen than with the class.

LJ: Thank you so much for your time this evening. I really appreciate it. It's actually fascinating to listen to preservice teachers just coming out of a program but I do have a couple more. I think I mentioned at the start, so it will be about 9 o'clock and I’ll email you your gift card and again I so appreciate your time and I wish you the best in the remainder of your program and in making progress towards graduation. Thank you.

N: All right, take care. Thank you, bye.
Appendix D

Codebook

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Preservice Teachers’ Perceptions of Readiness for Teaching in a 1:1 Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview</td>
<td>A study of preservice teachers’ perceptions of readiness for teaching in a 1:1 classroom as they neared completion of their teacher candidacy program.</td>
</tr>
<tr>
<td>Source</td>
<td>The data source for this study included the responses to surveys from preservice teachers enrolled in the University of New Mexico’s elementary and secondary education program.</td>
</tr>
<tr>
<td>Sample Size</td>
<td>This survey involved 63 participants drawn from the University of New Mexico’s teacher candidacy program.</td>
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<tr>
<th>Col #</th>
<th>Variable Name</th>
<th>Variable Description</th>
<th>Variable Metric/Labels</th>
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<td>1</td>
<td>ID</td>
<td>Respondent Identification Code</td>
<td>Integers</td>
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<td>2</td>
<td>FINALYR</td>
<td>0 = No 1 = Yes</td>
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<td>3</td>
<td>GRADDATE</td>
<td>Expected Graduation Date</td>
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<td>4</td>
<td>STATUS</td>
<td>Undergraduate or Graduate Student</td>
<td>0 = Grad 1 = Undergrad</td>
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<td>GENDER</td>
<td>Gender</td>
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</tr>
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<td>6</td>
<td>DOB</td>
<td>Year Born</td>
<td>Scale</td>
</tr>
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<td>---</td>
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</table>
| 7 | HWSB | Proficient using SmartBoard in a 1:1 classroom | 1 = strongly disagree  
|   |     | 2 = disagree  
|   |     | 3 = agree  
|   |     | 4 = strongly agree  |
| 8 | HWDC | Proficient using document camera in a 1:1 classroom | 1 = strongly disagree  
|   |     | 2 = disagree  
|   |     | 3 = agree  
|   |     | 4 = strongly agree  |
| 9 | HWIP | Proficient using iPad in a 1:1 classroom | 1 = strongly disagree  
|   |     | 2 = disagree  
|   |     | 3 = agree  
|   |     | 4 = strongly agree  |
| 10 | HWCB | Proficient using Chromebook in a 1:1 classroom | 1 = strongly disagree  
|   |     | 2 = disagree  
|   |     | 3 = agree  
|   |     | 4 = strongly agree  |
| 11 | HWLP | Proficient using laptop in a 1:1 classroom | 1 = strongly disagree  
|   |     | 2 = disagree  
|   |     | 3 = agree  
|   |     | 4 = strongly agree  |
| 12 | SWEDLANGU | Proficient using language apps in a 1:1 classroom | 1 = strongly disagree  
|   |     | 2 = disagree  
|   |     | 3 = agree  
|   |     | 4 = strongly agree  |
| 13 | SWEDLESSO | Proficient using lesson planner apps in a 1:1 classroom | 1 = strongly disagree  
|   |     | 2 = disagree  
|   |     | 3 = agree  
|   |     | 4 = strongly agree  |
| 14 | SWEDMATH | Proficient using math apps in a 1:1 classroom | 1 = strongly disagree  
|   |     | 2 = disagree  
|   |     | 3 = agree  
|   |     | 4 = strongly agree  |
| 15 | SWEDMONIT | Proficient using monitoring apps in a 1:1 classroom | 1 = strongly disagree  
|   |     | 2 = disagree  
|   |     | 3 = agree  
<p>|   |     | 4 = strongly agree  |</p>
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</table>
| 16 | SWEDNEWS | Proficient using news apps in a 1:1 classroom | 1 = strongly disagree  
2 = disagree  
3 = agree  
4 = strongly agree |
| 17 | SWEDEDIT | Proficient using editing apps in a 1:1 classroom | 1 = strongly disagree  
2 = disagree  
3 = agree  
4 = strongly agree |
| 18 | WEBPAGE | Proficient building and maintaining a class webpage | 1 = strongly disagree  
2 = disagree  
3 = agree  
4 = strongly agree |
| 19 | SWBAPRESE | Proficient using presentation apps in a 1:1 classroom | 1 = strongly disagree  
2 = disagree  
3 = agree  
4 = strongly agree |
| 20 | SWEDQUIZ | Proficient using quiz apps in a 1:1 classroom | 1 = strongly disagree  
2 = disagree  
3 = agree  
4 = strongly agree |
| 21 | SWEDSCIEN | Proficient using science apps in a 1:1 classroom | 1 = strongly disagree  
2 = disagree  
3 = agree  
4 = strongly agree |
| 22 | SWBASHEET | Proficient using spreadsheet apps in a 1:1 classroom | 1 = strongly disagree  
2 = disagree  
3 = agree  
4 = strongly agree |
| 23 | SWEDSTORA | Proficient using storage apps in a 1:1 classroom | 1 = strongly disagree  
2 = disagree  
3 = agree  
4 = strongly agree |
| 24 | SWEDASSES | Proficient using assessment apps in a 1:1 classroom | 1 = strongly disagree  
2 = disagree  
3 = agree  
4 = strongly agree |
<p>| | | | |</p>
<table>
<thead>
<tr>
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</table>
| 25 | SWEDSTUDY | Proficient using study aid apps in a 1:1 classroom | 1 = strongly disagree  
                           |     | 2 = disagree  
                           |     | 3 = agree  
                           |     | 4 = strongly agree  |
| 26 | SWEDSURVE | Proficient using apps for creating surveys in a 1:1 classroom | 1 = strongly disagree  
                           |     | 2 = disagree  
                           |     | 3 = agree  
                           |     | 4 = strongly agree  |
| 27 | SWEDTEACH | Proficient using teaching aid apps in a 1:1 classroom | 1 = strongly disagree  
                           |     | 2 = disagree  
                           |     | 3 = agree  
                           |     | 4 = strongly agree  |
| 28 | SWSMSOCIAL | Proficient using social media apps | 1 = strongly disagree  
                           |     | 2 = disagree  
                           |     | 3 = agree  
                           |     | 4 = strongly agree  |
| 29 | SWEDTYPE | Proficient using typing apps in a 1:1 classroom | 1 = strongly disagree  
                           |     | 2 = disagree  
                           |     | 3 = agree  
                           |     | 4 = strongly agree  |
| 30 | SWEDVIDEO | Proficient using video apps in a 1:1 classroom | 1 = strongly disagree  
                           |     | 2 = disagree  
                           |     | 3 = agree  
                           |     | 4 = strongly agree  |
| 31 | ASSESSEDTECH | Proficient assessing educational technology apps for use in a 1:1 classroom | 1 = strongly disagree  
                           |     | 2 = disagree  
                           |     | 3 = agree  
                           |     | 4 = strongly agree  |
| 32 | MODMATH | Mathematics education professors appropriately modeled technology usage for a 1:1 classroom | 1 = strongly disagree  
                           |     | 2 = disagree  
                           |     | 3 = agree  
                           |     | 4 = strongly agree  |
| 33 | MODLITER | Literacy education professors appropriately modeled technology usage for a 1:1 classroom | 1 = strongly disagree  
                           |     | 2 = disagree  
                           |     | 3 = agree  
<pre><code>                       |     | 4 = strongly agree  |
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<tr>
<td></td>
<td><strong>MODSCIEN</strong></td>
<td>Science education professors appropriately modeled technology usage for a 1:1 classroom</td>
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<tr>
<td></td>
<td><strong>MODSOCIAL</strong></td>
<td>Social studies education professors appropriately modeled technology usage for a 1:1 classroom</td>
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<td></td>
<td><strong>MODTECHN</strong></td>
<td>Instructional technology education professors appropriately modeled technology usage for a 1:1 classroom</td>
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<tr>
<td></td>
<td><strong>SWEDCLASS</strong></td>
<td>Proficient using apps for classroom management in a 1:1 classroom</td>
</tr>
<tr>
<td></td>
<td><strong>SWEDCOLLA</strong></td>
<td>Proficient using apps for student collaboration in a 1:1 classroom</td>
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<tr>
<td></td>
<td><strong>SWEDCREAT</strong></td>
<td>Proficient using apps for student creativity in a 1:1 classroom</td>
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<td><strong>SWEDDATA</strong></td>
<td>Proficient using apps for data analysis in a 1:1 classroom</td>
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<tr>
<td></td>
<td><strong>SWBADOCUM</strong></td>
<td>Proficient using apps to create documents</td>
</tr>
<tr>
<td></td>
<td><strong>SWBAEMAIL</strong></td>
<td>Proficient using apps for email</td>
</tr>
</tbody>
</table>
|   | SWEDFILTE       | Proficient in recognizing filter bypass tools | 1 = strongly disagree  
|   |                 |                                               | 2 = disagree  
|   |                 |                                               | 3 = agree  
|   |                 |                                               | 4 = strongly agree  
|---|-----------------|-----------------------------------------------|----------------------|
| 44| SWEDGAME        | Proficient using educational gaming apps in a 1:1 classroom | 1 = strongly disagree  
|   |                 |                                               | 2 = disagree  
|   |                 |                                               | 3 = agree  
|   |                 |                                               | 4 = strongly agree  
| 45| SWEDGRADE       | Proficient using gradebook apps               | 1 = strongly disagree  
|   |                 |                                               | 2 = disagree  
|   |                 |                                               | 3 = agree  
|   |                 |                                               | 4 = strongly agree  
| 46| SWEDGRAPH       | Proficient using graphing calculator apps in a 1:1 classroom | 1 = strongly disagree  
|   |                 |                                               | 2 = disagree  
|   |                 |                                               | 3 = agree  
|   |                 |                                               | 4 = strongly agree  
| 47| RTT             | Prepared to select technologies to use in a 1:1 classroom that enhance what is taught, how it is taught, and what students learn | 1 = strongly disagree  
|   |                 |                                               | 2 = disagree  
|   |                 |                                               | 3 = agree  
|   |                 |                                               | 4 = strongly agree  
| 48| HARDWAREPROF    | HWSB+HWDC+HWIP+HWCB+HWLP                      | 1 = strongly disagree  
|   |                 |                                               | 2 = disagree  
|   |                 |                                               | 3 = agree  
|   |                 |                                               | 4 = strongly agree  
| 49| SOFTWAREBASICPROF | SWBAPRESE+SWBASHEET+SWBADOCUM+SWBAEMAIL              | 1 = strongly disagree  
|   |                 |                                               | 2 = disagree  
|   |                 |                                               | 3 = agree  
|   |                 |                                               | 4 = strongly agree  
| 50| SOFTWAREEDUCPROF | SWEDLANGU+SWEDLESSO+SWEDMATH+SWEDMONIT+SWEPDONES+SWEPEDEDIT+SWEPEDQUIZ+SWEPEDSCHOOL+SWEPEDSTORA+S
|   |                 | WEDASSESS+SWEPEDSTUDY+SWEPEDSURVEY+SWEPEDTEACH+SWEPEDTYPE+SWEPEDVIDEO | 1 = strongly disagree  
|   |                 |                                               | 2 = disagree  
|   |                 |                                               | 3 = agree  
<p>|   |                 |                                               | 4 = strongly agree  |</p>
<table>
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<td>51</td>
<td>MODELINGFACULTY</td>
<td>MODMATH+MODLITER+MODSCIEN+MODSOCIAL+MODTECHN</td>
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</tbody>
</table>
|   |   | 1 = strongly disagree  
|   |   | 2 = disagree  
|   |   | 3 = agree  
|   |   | 4 = strongly agree  |
| 52 | AGErc | YOB - 2019 |
| 53 | RTTrc | Prepared to select technologies to use in a 1:1 classroom that enhance what is taught, how it is taught, and what students learn |
|   |   | 1 = 0  
|   |   | 2 = 0  
|   |   | 3 = 1  
|   |   | 4 = 1  |
| 54 | HARDWAREPROFrc | HWSB+HWDC+HWIP+HWCB+HWLP |
|   |   | 5-14 = 0  
|   |   | 15-20 = 1  |
| 55 | SOFTWAREBASICPROFrc | SWBAPRESE+SWBASHEET+SWBADOCUM+SWBAEMAIL |
|   |   | 4-11 = 0  
|   |   | 12-16 = 1  |
| 56 | SOFTWAREEDUCPROFrc | SWEDLANGU+SWEDLESSO+SWEDMATH+SWEDMONIT+SWEDEWS+SWEDEEDIT+SWEDEQUIZ+SWEDESCIEN+SWEDESTORA+SWEDEASSES+SWEDESTUDY+SWEDESDURVE+SWEDETEACH+SWEDETYPE+SWEDEVIDEO+SWEDECLASS+SWEDECOLLA+SWEDECREAT+SWEDEDDATA+SWEDEDFILTE+SWEDEGAME+SWEDEGRADE+SWEDEDGRAPH |
|   |   | 23-68 = 0  
|   |   | 69-92 = 1  |
| 57 | MODELINGFACULTYrc | MODMATH+MODLITER+MODSCIEN+MODSOCIAL+MODTECHN |
|   |   | 5-14 = 0  
|   |   | 15-20 = 1  |