THE IMPACT OF EDUCATIONAL TECHNOLOGY INTEGRATION ON SCHOOL-BASED AGRICULTURAL EDUCATION TEACHER SELF-EFFICACY

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF SCIENCE

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ABSTRACT

The purpose of this study was to determine the impact of educational technology integration on school-based agricultural education (SBAE) teacher self-efficacy. In-service SBAE teachers from four upper middle-western states were surveyed to assess their current teacher self-efficacy in terms of educational technology in their classroom and curriculum. According to the findings of this study, SBAE teachers are using educational technology in their classroom and curriculum daily and are only slightly confident in their ability to do so. It is recommended that teachers participate in professional development which is focused on not only how to use educational technology, but also on how to teach agriculture content using the educational technology specific to their 1:1 issued device.

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1. INTRODUCTION

As media technology has progressed in society, so too has its use in the classroom. Across each generation and form of technology, issues such as purpose, usefulness, and educational appropriateness in the classroom arose (Cuban, 1986). Filmstrips and radio are among the forms of educational technologies that have entered and exited in the classroom since the early 1900s (Cuban, 1986). Despite the issues, the television and computer, have remained in the classroom and flourished since their introductions. Currently, educational technology has many purposes and can take the form of hardware or software, but the use of nearly all educational technology today hinges upon connecting to the internet.

In order to prepare students for life in a digital world, teachers continue to use educational technology in their classrooms in an attempt to familiarize students with technology (Schrader, 2016). Due to this reality, school districts, almost universally, are handing devices to students and teachers, often in the form of one-to-one (1:1; one device per student). In recent years, 1:1 has become popular due to the availability and access to personal computing devices (Schrader, 2016). However, for 1:1 to be effective, the teacher must create and use curriculum that effectively and purposefully utilizes the technology (Jones, 2017).

There are many differences between school-based agricultural education (SBAE) and general education coursework at the secondary level however, 1:1 technology integration does not vary between the disciplines. Similar to research in core academic class settings (Math, Science, and English), research in SBAE suggests teachers need to use these devices themselves before teaching students how to utilize them for various applications in the field of agriculture (Burke, Schuck, Aubusson, Kearney, & Frischknecht, 2018). The body of research focused on the use of 1:1 technology in the SBAE classroom and the importance of such information specific to SBAE is limited. A gap in this body of work begins in the late 1980s and continues until recently when educational technology gained a greater role in the classroom and researchers started inquiring into the impact on SBAE classrooms. Because of this gap, the research included in the review of literature includes studies conducted in both SBAE classrooms and core academic classrooms.

Three primary and repeated obstacles to implementing educational technology in the classroom emerged from the aggregate of literature: a lack of funding, low teacher self-efficacy, and a lack of professional development focusing on technology integration in the classroom (Raven & Welton, 1989; Camp & Sutphin, 1991; McCaslin & Torres, 1992; Kotrlik, Redmann, Harrison, & Handley, 2000; Cuban, 2001; Wang, Ertmer, & Newby, 2004; Schrader, 2016; Johnson, Levine, Smith, & Haywood, 2010; Stewart, Antonenko, Robinson, & Mwavita, 2013; Williams, Warner, Flowers, & Croom, 2014; Burke, et al., 2018). Continuous advancements in technology create price barriers to access, a hurdle for many school districts as the newest technology is often the highest in cost and the more cost-conscious technology seems outdated in a matter of years, sometimes sooner (Schrader, 2016; Jones, 2017). As technology at-large and educational technology are constantly changing, teachers often lack experience with the current educational technology and thus, form a low self-efficacy related to that educational technology use in their classroom (Raven & Welton, 1989; Wang et al., 2004; Mishra & Koehler, 2006; Niederhauser & Perkman, 2008; Hastings, 2009; Koehler & Mishra, 2009; Stewart, Antonenko, Robinson, & Mwavita, 2013; Irby, 2017). Low teacher self-efficacy related to the use of educational technology could result in the teacher avoiding the technology in their classroom, which evolves into a disadvantage to both the teacher and the students.

Another issue, from current research contributing to low teacher self-efficacy, is the lack of preparatory experiences with educational technology provided in pre-service teacher education programs (Wang et al., 2004). Preservice teachers exposed to technology in their cooperating student teaching site were more likely to implement technology into their future classrooms because of gained confidence in using such technologies (Wang et al., 2004). Due to their level of experience in the classroom and exposure to teaching, in-service teachers hold high technology, pedagogy, and content knowledge. However, despite their disadvantage to in-service teachers in experience and exposure, it was the in-service teachers who reported higher scores of total self-efficacy (Stewart, Antonenko, Robinson, & Mwavita, 2013).

As seen across the literature, a portion of the problem with effective use of educational technology lies in the lack of teacher education and professional development focusing on technology and its application in learning (Raven & Welton, 1989; Dormody & Torres, 2002; Johnson, et al., 2010; Burke, et al., 2018). The most influential factor effecting a teacher's choice to use educational technology in the classroom is their ability to use the technology themselves (Burke, et al., 2018). Over the four decades of available SBAE research, similar to the findings regarding general education courses, many researchers detailed a major need for in-service professional development specific to educational technology as SBAE teachers have both requested and been given educational technology (Kotrlik, et al., 2000; DiBenedetto, Willis, & Barrick, 2018).

1.1. Theoretical Framework

Self-efficacy, specifically teacher self-efficacy is a focus of this research study. Perceived self-efficacy is the foundation of human motivation, performance accomplishments, and emotional well-being (Bandura, 1997). Bandura (1997) asserted that humans need to feel confident in their ability to create desired effects through their actions. Those with low self-efficacy often see challenging tasks as threats and consequently, avoid them (Bandura, 1993). Similarly, in teacher self-efficacy, educators need to feel that they can accomplish tasks and create meaningful change through their actions. Educators must hold high teacher self-efficacy in the areas of content and pedagogy knowledge in order to be confident in their ability to face challenges with technology use.

In order to determine what teachers need to know or do know about classroom technology, Technological Pedagogical Content Knowledge (TPACK) can be used in the field of educational research. TPACK focuses on technology, pedagogy, and content knowledge (Mishra & Koehler, 2006; Thompson & Mishra, 2007; Koehler & Mishra, 2009; Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009). The relationships and overlaps among technology, pedagogy, and content knowledge are categorized into seven components that create the TPACK framework: Technology Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006; Thompson & Mishra, 2007; Koehler & Mishra, 2009; Schmidt, et al., 2009).

1.2. Problem Statement and Need for Study

In the past century, from silent films to digital devices for almost every student in the country, educational technology has come a long way. There are positive and negative outcomes for both students and teachers when incorporating educational technology, which surface through varied empirical inquiry. Available research provides consistent evidence that the obstacles teachers from all disciplines face for educational technology integration are the high price of and lack of funding for educational technology, low teacher self-efficacy, and lack of professional development (Cuban, 1986; Raven & Welton, 1989; Camp & Sutphin, 1991; McCaslin & Torres, 1992; Kotrlik, et al., 2000; Cuban, 2001; Wang, et al., 2004; Hastings, 2009; Johnson, et al., 2010; Stewart, et al., 2013; Irby, 2017; Jones, 2017; Burke, et al., 2018). Of those studies only a handful are specific to teacher self-efficacy regarding technology integration in SBAE (Raven & Welton, 1989; Camp & Sutphin, 1991; McCaslin & Torres, 1992; Kotrlik, et al., 2000; Stewart et al., 2013; Williams et al., 2014).

It is clear within the literature that simply handing out devices to students and teachers will not result in the effective use of educational technology among teachers and students. To the question what role teacher self-efficacy plays in educational technology use in the SBAE classroom, there is also no definitive answer. Additionally, due to the technological demands of the agriculture industry it is imperative for youth to effectively use technology in their educational development (Phipps, et. al, 2008). That imprint could happen in part, through their agricultural education classrooms. Therefore, it is necessary to look deeper into the self-efficacy of SBAE teachers regarding their ability to integrate educational technology in their classrooms and the influences on those perceptions. Further yet, there has been one research study in the past five years to evaluate SBAE teacher self-efficacy of educational technology integration using the TPACK model, framework, and survey instrument (Stewart, Antonenko, Robinson, & Mwavita, 2013). Therefore, this researcher aims to fill this gap in research by inquiring about the self-efficacy of SBAE teachers regarding their ability to integrate educational technology in their classrooms in hopes to contribute to understanding what leads them to those self-perceptions. Doing this will provide a timely, present-day account to educational technology in SBAE.

1.3. Purpose of the Study

The purpose of this study is to determine the perceived teacher self-efficacy of pre-service seniors and in-service SBAE instructors regarding the integration of 1:1 educational technology.

1.4. Research Objectives

The following research objectives guided this study:

1. Describe agricultural educators, programs, and access to educational technology in the selected states.
2. Describe professional development experiences related to educational technology for agricultural educators in the selected states.
3. Describe agricultural education teachers' technological, pedagogical, and content knowledge.
4. Describe agricultural education teachers' self-efficacy related to educational technology.
5. Describe the influence of professional development on teacher self-efficacy.
6. Describe the relationship between teacher self-efficacy and TPACK.

1.5. Terms and Definitions

1:1 computing: Every student has a computing device. These devices can range from laptop computers or tablets to smart cell phones.

Augmented reality (AR): allows the student to see a digital version of a real-world setting, often in the classroom, and interact with objects through sensory inputs and graphics.

Educational technology: Education technology is traditionally thought of as computers, laptops, mobile devices (i.e. smartphones and tablets), digital cameras, social media platforms and networks, software applications, the Internet, etc. that are placed in the classroom for the purpose of enhancing teaching and learning.

Educational technology integration: the use of educational technology resources in daily classroom practices, curriculum, and in the management of a school/ program.

FFA: the National FFA Organization; "an educational, nonprofit, nonpolitical national organization for students enrolled in school-based agricultural education programs; an integral component of agricultural education in public schools that focuses on student leadership and career development; it consists of chartered state associations and student members in local middle school and high school chapters" (Phipps, Osborne, Dyer, & Ball, 2008, p. 531).

SAE: Supervised Agricultural Experience program; "a series of planned, sequential agricultural activities of educational value conducted by students outside of class and laboratory instruction for which systematic instruction and supervision are provided by the teacher" (Phipps, Osborne, Dyer, & Ball, 2008, p. 536).

School Based Agricultural Education (SBAE): "formal agricultural education programs offered in the public schools (as opposed to non-formal agricultural education programs offered by businesses or other non-school agencies)" (Phipps, Osborne, Dyer, & Ball, 2008, p. 537).

Self-efficacy: the belief one holds in their ability to complete a behavior or task

Social Media: are various forms of electronic communication where users create or form online communities or groups to share information, ideas, personal messages, and the like.

Teacher self-efficacy: the belief a teacher holds in their ability to complete a teacher behavior or task.

Technology: an encompassing terms to refer to numerous devices and in some cases, the specific software the devices contain, that are used by teachers and students for advancement of student learning.

Three-dimensional (3D) printing: is the creation of a plastic, three-dimensional model of an item or element. 3D printers allow teachers and students to input data and write codes for printing items.

Virtual reality (VR): computer-generated, customizable, often guided, exploration of a three-dimensional image or video that is often interactive for the participant with the use of compatible equipment.

2. REVIEW OF LITERATURE

2.1. Defining the Use of Technology in Education

2.1.1. What is Technology?

In order to recognize educational technology, it is important to be familiar with what is included in technology. Further, in a world where 'technology' surrounds everything we do, we must differentiate between the definition of technology and the implications of the word, or the products of technology. The National Assessment Governing Board (2018) defined technology as "any modification of the natural world done to fulfill human needs or desires" (p. XV). Those modifications include things such as cell phones, vehicles, medicine, fire, pens and pencils, the toaster oven, indoor plumbing, and myriad other objects which inhabit our daily lives. From here, the implications of the word begin to form. Many may assume technology refers to computers or phones, which are devices derived from technological advancement, but are not alone in the concept of technology. If focusing on the idea that 'technology' is solely laptops, phones, and the like; this form of technology can be digital or analog, old or new; however, in most current research, technology is newer and digital (Koehler & Mishra, 2009).

The fact is, technology effects all realms of human life: medicine, construction, commerce, education, and agriculture. In the domain of agriculture, for example, technology appears in the forms of: precision agriculture, drones, GPS, autonomous equipment and machinery, GMOs, herbicide and pesticide, aquaponics, food science, and so much more. While any technological advancement since the dawn of time can be considered a form of technology, it is necessary to specify the scaled-down focus for this research project. Within the scope of this study, the emphasis is on digital forms of information and communication technologies used in service of student learning at the secondary level.

2.1.2. What is Educational Technology?

In this digitally focused world, technology is woven into education as we progress toward a more digitally dependent world. To analyze the role technology plays in education, we must first define educational technology. A practical definition: "educational technology is traditionally thought of as computers, video projectors, the Internet, and other technologies that are placed in the classroom for the purpose of enhancing teaching and learning" (Williams, 2009, p. 3). For the purpose of this study, the list in the definition above should be adjusted to include, mobile devices (i.e. smartphones and tablets), digital cameras, social media platforms and networks, and software applications. This study's operational definition of the term "technology" refers to numerous devices and in some cases, the specific software the devices contain, used by teachers and students for the advancement of student learning in formal educational settings. To simplify, educational technology is technology which has been created or adapted for the purposes of teaching and/or learning. Educational technology requires teachers to use the technology, be it hardware or software, in combination pedagogy in order to integrate it into their classroom.

2.2. Educational Technology in the Classroom

Technology causes a shift in education as it permeates our daily lives. Technology has become classroom commonplace and, for some students and teachers, a pedagogical requirement. "Most traditional pedagogical technologies are characterized by specificity, stability, and transparency of function; overtime, these technologies achieve a transparency or perception, become commonplace, and in most cases, are not even considered to be technologies" (Koehler & Mishra, 2009, p. 61). In order to prepare students for life in a digital world, teachers need to use educational technology in their classroom in an attempt to familiarize students with technology (Schrader, 2016). Due to this realization, school districts, almost universally, are giving devices to students and expecting teachers to use them as a tool in their curriculum. Thereby, in today's classroom, just as in the past, questions still linger concerning technology's effectiveness in the classroom, teachers' ability to use it, and students' ability to learn with it.

2.2.1. A Brief History of Technology in the Classroom

As technology has progressed, so too has its use in the classroom. Across each generation and form of technology, issues regarding purpose, usefulness, and educational appropriateness found their way alongside the technology. Film strips made their way into the classrooms during the first decade of 1900, but its use presented a list of obstacles for students and teachers (Cuban, 1986). Many schools and classrooms had limited access due to a lack of reliable equipment, teachers were not able to properly use the equipment, film was expensive, the storage and upkeep of the film became too much for teachers, and it was difficult to find film to fit into the curriculum being taught (Cuban, 1986). Due to these challenges, this form of film made its way out of the classroom just as radio made its way into the classroom in the 1920s (Cuban, 1986).

Although radio proved more useful and easier to implement initially, radio had its issues too. By the 1930s local and national broadcasting stations had created educational programs which were used to supplement teacher instruction (Cuban, 1986). While radio was easier to operate and therefore better received than film, teachers still created a list of complaints: high initial cost of the equipment, a lack of access to the equipment, frequent maintenance on the receivers, and not enough content covered through the radio in alignment with curriculum (Cuban, 1986). These reasons caused the radio to disappear out of common classroom educational technology and become obsolete in education by 1950, which provided an open position in educational technology for the next technology – television (Cuban, 1986).

The mid-1950s brought television into the classroom which seemed more effective and accepted than both film and radio (Cuban, 1986). However, teachers seemed to be the last involved in the implementation process and had little say on how they should fit into the coursework resulting in similar issues as the prior classroom technological advances (Cuban, 1986). While teacher concerns were valid, because of the ultimate development of educational programming, the television remains in the classroom today as a form of educational technology. The computer, introduced into the classroom in the 1980s, is another technology which has withstood time and concern in the classroom (Cuban, 1986). The computer brought similar teacher concerns as film, radio, and television (Cuban, 1986) but because of their use in the world outside of classrooms, computers are in classrooms to stay. The ratio of computers to students in 1983 was 1:125, by 2008 it was 1:3, and is currently still climbing as more school districts are adopting 1:1 computing (Cuban, 2014).

2.2.2. Current Educational Technology in the Classroom

2.2.2.1. *Hardware*

During the 2013-14 school year, more than 23 million devices were purchased by school districts in the United States for classroom use by students and teachers (Herold, 2016). Currently, educational technology has many purposes and can take the form of hardware or software. Hardware is considered the physical property or aspect of the technology, such as the device or machine. The hardware, or device, of choice for educational technology use is often tablets, such as the Apple iPad, due to its customizability, touch screen capabilities, and user-friendly features (Herold, 2016; Jones, 2017). Chromebooks, Google's version of a personal laptop, have become more popular in the classroom as of recent years due to their low cost, simple and adaptable processing system, and versatility inside and outside of the classroom (Herold, 2016; Jones, 2017).

2.2.2.2. *Software*

Once devices are in the classroom, software needs to be identified and incorporated to make the devices useful in the teaching and learning experience. Software is the operating system and related programs which the hardware uses to function. Some apps and online services created for instructional and recreational purposes have become popular in schools (Herold, 2016). Because of this, many schools use a mix of digital resources in the classroom. However, due to financial and technical issues, the inclusion of instructional software is often gradual, depending upon the school district (Herold, 2016). Popular software in the 2017 classroom included cloud computing, 3-D printing, augmented reality, and virtual reality (Jones, 2017). Also rising in popularity at the secondary level are online courses as software for live video conferencing is advancing (Jones, 2017).

2.2.2.3. *Internet*

Hardware is purchased and software is incorporated but neither can function to their full potential without the internet. Internet access can be hardwired or wireless but is often wireless for student devices. As many districts purchased devices for students as they converted to 1:1, they found there was not enough bandwidth, the capacity of devices a network can support for data transmission, to provide wireless internet for all devices at once (Schrader, 2016; Herold, 2016; Jones, 2017). Furthermore, issues surrounding a lack of internet are not exclusive to the school as there is a portion of the student population without internet access at home (Schrader, 2016). In 2015, 77.4 percent of the United States' population reported access to internet in their homes and 63.5 percent reported a mobile service plan or data package having access to the internet (see table 702.35 of U.S. Department of Education, 2015, for complete data). This leaves 22 to 36 percent of the population without a means to complete online assignments or assignments requiring internet access outside of school. These are issues that a teacher needs to be mindful of when planning activities using devices for students.

2.2.3. The 1:1 Computing Initiative

One to one computing, or 1:1, is an educational initiative where the school provides one device, be it a laptop, tablet, or smart phone, per student in an attempt to provide each student with a personalized education (Cuban, 2014; Schrader, 2016). Recently, rising in popularity is a new, and certainly cheaper approach for the school district, which is bring your own device (BYOD) where students provide their own device. Regardless of the approach, there have been numerous studies conducted and published since the conception of 1:1, many finding students who are able to use technology in the classroom show more engagement in content, better peer collaboration, motivation to work individually, and improved digital and technological skills (Bebell and Key, 2010; Keengwe, Schnellert, & Mills, 2012; Islam & Grönlund, 2016; Irby, 2017). The authors of these studies also reported positive student outcomes are a result of teachers confidently and effectively using educational technology, demonstrating to their students how to effectively use the technology to enhance learning.

Since the late 1990s, 1:1 computing has been an interest in the world of education, but in recent years it has become a reality due to the availability and popularity of personal portable computing devices (Schrader, 2016). When a school district chooses to implement 1:1 computing a wide variety of reasons typically back the decision. Herold (2016) highlights the following ambitions, often held by school administration, for beginning 1:1 in a school district: lessons tailored for self-paced learning, literacy and career readiness skills, incorporating digital applications to encourage completion of complex and creative tasks, and creating and strengthening communications between parents, students, and teachers. These implications are strong on paper, however without the proper base knowledge put into place with students and teachers, 1:1 implementation and other educational technology will not be beneficial to the user.

There is more to the initiative than giving students a device because the teacher must show the student how to use the device for educational purposes (Schrader, 2016). The teacher must also create and use curriculum which utilizes technology matching the format of the students' device. Ultimately, the success of the 1:1 computing initiative is dependent on the school's vision for the devices, including their ability to create and implement a plan for integration on the teachers' part, including but not limited to professional development for the teachers focusing on the technology (Jones, 2017). Among the constantly changing and updating technology, one should remember the teacher. Often, because of the ever-changing nature of technology and the lack of technology specific professional development, teachers are left feeling out of place among the updates.

2.3. Educational Technology in the SBAE Classroom

In a school-based agricultural education classroom, 1:1 technology integration is no different than in a general education classroom, however there are some fundamental differences of which to be aware. Agricultural education is the education in agriculture and natural resources at the elementary, middle, and high school level, as well as beyond, at both the postsecondary and adult levels (Phipps, Osborne, Dyer, & Ball, 2008). The purpose of agricultural education is to prepare people for entry or advancement in agricultural occupations, entrepreneurship, and agricultural literacy (Phipps, et. al, 2008). School-Based Agricultural Education (SBAE), or agricultural education which takes place in a middle or high school, contains three parts: enrollment and participation in classroom/laboratory instruction, membership and participation in the National FFA Organization, and the creation and upkeep of a Supervised Agricultural Experience (SAE) (Phipps, et. al, 2008).

Learning in SBAE is often based in problems associated with various tasks in both the natural resources and agricultural industries and is conducted through the instruction, methods, program, and courses (Phipps, et. al, 2008). Agricultural educators must maintain up-to-date student learning activities and instructional programs to compete with the ever-changing industries (Phipps, et. al, 2008), emphasizing the evolution of technology in the field of agriculture. Identical to research conducted in core academic classes, research in SBAE and other career and technical education (CTE) courses suggests teachers must be able to use these devices themselves before teaching students how to utilize them for various applications in the field of agriculture (Burke, et al., 2018).

The body of research focused on the use of 1:1 technology in the SBAE classroom and the importance of such information specific to SBAE is limited. Much of the research available was conducted at the introduction of the computer, then called a microcomputer, into the classroom in the 1980s. Following this decade, there was a gap in research from the late 1980s to recent years when educational technology became more popular and researchers started inquiring on its impact on SBAE. Because of this empirical gap, this review of literature is divided by two time periods, that of the wave of data from 1980 to the late 90s and that of the current wave of data from the early 2000s to the mid-2010s.

There are some common findings which have emerged through the research conducted in SBAE related to educational technology integration. One common finding is the importance that technology specific professional development has on teacher self-efficacy related to educational technology integration. Researchers determined that in-service SBAE teachers are in need of professional development related to educational technology integration (Camp & Sutphin, 1991; Kotrlik, et al., 2000; DiBenedetto, et al., 2018). Those SBAE teachers who participated in such professional development were more confident in their abilities to use the educational technology in their classroom (Camp & Sutphin, 1991; Kotrlik, et al., 2000; DiBenedetto, et al., 2018). Researchers also determined that SBAE teachers who do not receive educational technology specific professional development are less likely to integrate educational technology into their curriculum and classroom (Camp & Sutphin, 1991; Kotrlik, et al., 2000; DiBenedetto, et al., 2018).

2.4. Challenges with the Integration of Educational Technology

A 2009 study determined many teachers had earned their degree in a time where educational technology was much different, leading them to inadequate experiences using and exposure to educational technology for teaching and learning (Koehler & Mishra, 2009). Because of this lack of experience with and exposure to educational technology, many teachers felt unprepared to use the technologies in their classroom, thus do not see its importance to their teaching and in turn, students' learning (Koehler & Mishra, 2009). Through the review of literature, three obstacles emerged to implementing educational technology in both core education and SBAE classrooms: a lack of funding, low teacher self-efficacy, and a lack of professional development focusing on technology integration in the classroom (Cuban, 1986; Raven & Welton, 1989; Camp & Sutphin, 1991; McCaslin & Torres, 1992; Kotrlik, et al., 2000; Cuban, 2001; Wang, et al., 2004; Schrader, 2016; Hastings, 2009; Johnson, et al., 2010; Stewart, et al., 2013; Williams et al., 2014; Irby, 2017; Jones, 2017; Burke, et al., 2018). The following sections will explore these three obstacles in more depth.

2.4.1. High Cost of Educational Technology and a Lack of Funding

Advancements in technology cause a rise in cost to access, which is a hurdle to integrate educational technology for many school districts. A study conducted in Kansas SBAE classrooms in 1989 revealed computers were not common due to a lack of funding for both software and hardware (Raven & Welton, 1989). Similarly and more recently, a study conducted in North Carolina SBAE classrooms determined the number one reason teachers did not implement technology in their classroom was the expense (Williams, et al., 2014). The high cost of both hardware and software combined with a lack of funding available by school districts for educational technology is an obstacle preventing many districts from fully integrating educational technology (Jones, 2017).

The newest technology is often the highest in cost and the more cost conscious technology seems outdated in a matter of years, sometimes sooner (Schrader, 2016; Jones, 2017). This leaves technology to be too great of an investment for many school districts. As previously stated, this has been as issue from the conception of educational technology in the classroom (Cuban, 1986). However, if the goal is 1:1 but the cost is too big a barrier, BYOD is an option to aid implementation of 1:1 for the school district. For teachers who want to use a specific application or software, which the device does not include or for which the school will not pay, an option is to include a course fee to cover the cost of the specific software.

We are focusing this study on teacher self-efficacy in a 1:1 setting, and are assuming cost is no longer a barrier if the school has already implemented 1:1. Therefore, the cost of educational technology and a lack of funding for it will not be a main focus of this research, but it should be considered as a factor influencing the adoption and maintenance of or update to the 1:1 initiative for the use district-wide educational technology.

2.4.2. Teacher Self-Efficacy with Educational Technology

The needs of the teachers should not be overlooked within the constantly changing technological landscape, as teachers are often left in a state of turmoil due to unending waves of updates. Because of this state of confusion and a lack of experience with educational technology, teachers form a low self-efficacy related to educational technology use in their classroom (Raven & Welton, 1989; Wang et al., 2004; Mishra & Koehler, 2006; Niederhauser & Perkman, 2008; Hastings, 2009; Koehler & Mishra, 2009; Stewart, et al., 2013; Irby, 2017). When much of this research was gathered, many teachers had earned their degrees in a time period before focus was given to the instructional capacity of educational technology integration, leaving them without the pre-service training related to educational technology integration (Koehler & Mishra, 2009).

Raven and Welton (1989) focused on teachers in Kansas high school SBAE programs and determined the main reason respondents did not use computers in their teaching was the lack of time available to spend learning about computers. Hastings (2009) focused on teacher self-efficacy and educational technology integration in relation to educational technology-specific professional development. Her study revealed a positive correlation between the amounts of technology-focused professional development a teacher completed and their self-efficacy related to using educational technology in their classroom (Hastings, 2009). Hastings (2009) suggested professional development focused on educational technology builds advanced technological skills within teachers which, in turn, creates confidence to use the technology.

A study by Wang, Ertmer, and Newby (2004) examined preservice teacher self-efficacy after their exposure to various learning experiences which integrated technology. They found that in fact, exposure to other professionals' integration of technology into the classroom positively impacted the self-efficacy of the preservice teachers (Wang et al., 2004). "Though enhanced self-efficacy beliefs do not automatically translate into the actual use of technology among teachers, [these beliefs] are a necessary condition for technology integration" (Wang et al., 2004, p. 242). If preservice teachers had cooperating teachers who integrated technology into their classrooms, those preservice teachers would be more likely to implement technology into their classrooms when they graduate because they are confident in using such technologies.

Stewart, Antonenko, Robinson, and Mwavita (2013) investigated the intrapersonal factors affecting the technological, pedagogical, and content knowledge of Oklahoma pre- and in-service agricultural educators by using the TPACK survey instrument. They concluded both pre-service and in-service teachers held high technology, pedagogy, and content knowledge (Stewart, et al., 2013). Specifically, pre-service teachers reported high efficacy in social outcome and in-service teachers held higher efficacy in instructional strategy and technology integration (Stewart, et al., 2013). Additionally, pre-service teachers reported a higher level of confidence in content knowledge than in-service teachers and in-service teachers reported a higher level of self-efficacy, due to their level of experience and exposure (Stewart, et al., 2013).

Irby (2017) studied middle school teacher self-efficacy toward 1:1 integration in their classrooms and the students' perceptions of the technology used for educational purposes. He found teachers chose to use the technology because it lead to student engagement and created motivation to learn (Irby, 2017). In interviews, many teachers shared their interest in learning about educational technology, using educational technology daily, and amount of formal training on how to use the educational technology and how to include it in their curriculum (Irby, 2017). Despite the limited teacher training detailing how to use the 1:1 hardware, it was clear by their common use of technology in the classroom that teachers held high levels of self-efficacy, (Irby, 2017). Although both were perceived as positive, Irby (2017) distinguished between teachers' self-efficacy toward using technology as a means to aid in the preparation for teaching lessons and using technology as a means of delivering content to students.

2.4.3. Lack of Educational Technology Specific Professional Development

Another obstacle to implementing educational technology is a teacher's lack of training on how to use educational technology properly, and in some cases, at all (Jones, 2017). Without the proper instruction, implementing and utilizing the technologies to their fullest potential has proven difficult and at times, impossible for teachers (Jones, 2017). In addition to the initial price of technology, proper training for teachers is another investment for districts and a time commitment from teachers, which is another strike against educational technology in many eyes (Jones, 2017). There is a fair amount of literature discussing the lack of professional development and training available as a reason technology is underutilized in the classroom (Burke, et al., 2018; Cuban, 1986; Cuban, 2001; Dormody & Torres, 2002; Johnson, et al., 2010; Jones, 2017; Koehler & Mishra, 2009; Raven & Welton, 1989).

As seen across the literature, the lack of teacher involvement in the planning of technology integration has resulted in the downfall of many advances in their time (Cuban, 1986; Cuban, 2001). Rather, policy makers have pushed for the purchase of technology and its integration into the classroom because they see the importance (Cuban, 1986; Cuban, 2001). However, the rising problem lies in the lack of teacher education and professional development focusing on technology and its application in learning (Johnson, et al., 2010). The most influential factor contributing to the inclusion of technology in the classroom is the teacher's ability to use the technology (Burke, et al., 2018). Koehler and Mishra (2009) felt teachers have not been given adequate training for incorporating and using educational technology. Burke, et al. (2018) proposed teachers could be taught to accept and use the technology through professional development targeted toward teaching the technology and implementation techniques.

Camp and Sutphin (1991) looked into the needs of SBAE teachers in integrating and implementing educational technology into SBAE. Upon analysis, the realization was “too few computing and computer-related curriculum materials and guidelines are available for agriculture teachers” (Camp & Sutphin, 1991, p. 43). Participants reported curriculum, including educational technology in SBAE, is needed and it should address applications, benefits, uses, and types of educational technology available and related to agriculture (Camp & Sutphin, 1991). Further, these SBAE teachers all felt a need for assistance in planning curriculum that both instructs about and applies educational technology in the SBAE classroom (Camp & Sutphin, 1991).

Another study focused on educational technology professional development needs of SBAE teachers in Louisiana (Kotrlik, et al., 2000). These researchers found teachers held value in using educational technology but felt they did not have the knowledge to integrate the educational technology into their curriculum (Kotrlik, et al., 2000). Because of these thoughts and a lack of opportunities for educational technology specific professional development provided by universities, respondents shared they are forced to self-seek information and training on educational technology (Kotrlik, et al., 2000). Often, the researchers suggested a high priority be placed on developing the educational technology knowledge and skills of both preservice and in-service SBAE teachers (Kotrlik, et al., 2000).

Hastings (2009) found teachers who completed moderate to high amounts of professional development specific to educational technology regularly used educational technology in their classroom. The study revealed teachers who received professional development focused on educational technology integration not only utilized technology more frequently but their students also more frequently used the technology (Hastings, 2009). “Technology-Related Professional Development is necessary not only because technology continues to advance in terms of hardware and software, but more importantly, to reinforce the concept of integrating technology” (Hastings, 2009, p. 135).

Raven and Welton (1989) found SBAE teachers did not integrate computers into their classroom due to a lack of computer related in-service and computer-based curriculum (Raven & Welton, 1989). Similarly, Dormody and Torres (2002) studied graduates of the agricultural education program at New Mexico State University in relation to their growth in 28 teacher competencies since graduation. ‘Using computer technology in the classroom’ was the lowest ranked competency, making it the highest priority in-service professional development need (Dormody &Torres, 2002). Educational technology use in the SBAE classroom has become an interest to many agricultural education researchers. Over the four decades of published research, many researchers’ findings detailed a major need for in-service professional development specific to educational technology as SBAE teachers have both requested and been given educational technology (Kotrlik, et al., 2000; DiBenedetto, et al., 2018).

2.4.4. Summary

Following this review of research literature, there are apparent gaps in time and research which should be highlighted. First is a reoccurring theme presenting itself as a gap across the literature: forty years have passed since the first article was published regarding the challenges of educational technology in SBAE and yet the report of challenges and barriers is unchanged. From 1989 to 2018, the same obstacles (being the price of the technology, a lack of teacher self-efficacy to use the educational technology, and a lack of professional development specific to the implementation of educational technology in the classroom) have been found through extensive research then reported and there has yet to be a break from the pattern. There were numerous recommendations for further research on the matter however, there has yet to be a study conducted and published acknowledging these reoccurring challenges of integrating educational technology and posed solutions.

Second is the lack of information available specific to the integration of educational technology into the SBAE classroom and the teacher self-efficacy of SBAE teachers. While it is clear that there is a minimal difference between the SBAE teachers and general education teachers in terms of teacher self-efficacy, there is still only one study which has utilized the TPACK framework and instrument to gather data in SBAE classrooms. Because of the underutilization of TPACK in researching SBAE teachers' use of educational technology, the importance the role pedagogy plays in educational technology integration and in turn, teacher self-efficacy is not clear. Being able to determine if these factors play a role in educational technology integration would help to advance agricultural education in the high school classroom.

Worth mentioning is while there appears to be no difference in the way SBAE and general education teachers' form and perceive their teacher self-efficacy, there is a huge content knowledge difference, accompanied by a few pedagogical differences, which should be taken into account when comparing the available research. In the same avenue, there is limited research conducted using pre-service agricultural education teachers as a sample, meaning there is a small amount of information for post-secondary/ collegiate agricultural educators to pull from when planning curriculum for pre-service teachers.

Third is the lack of professional development available across education. With the rise in popularity of 1:1, districts should be focusing on training teachers and students to use the provided devices, however it is clear this is not happening. In this light, it is clear professional development is linked to teacher self-efficacy, in that if teachers are taught how to use the technology and are trained in how to integrate the educational technologies into their curriculum, they will be more confident in their ability to use the devices. In turn, the training will boost their teacher self-efficacy making them more likely to use the 1:1 devices in their classrooms with their students, which is often to motivating factor behind the school's adoption and implementation of 1:1.

Through this review of literature, it is clear that simply handing out devices to students and teachers will not result in the effective use of educational technology among the students and teachers. It is also clear there is no definitive answer to the question what role teacher self-efficacy plays in educational technology use in the SBAE classroom. Furthermore, there is limited data available which was gathered from an agricultural education classroom. Therefore, it is necessary to look deeper into the self-efficacy of SBAE teachers regarding their ability to integrate educational technology in their classrooms.

2.5. Theoretical Framework

How can teachers integrate educational technology into their teaching? While there is no best way to integrate educational technology into curriculum, in an effort to determine what teachers needed to know or did know about classroom technology integration, Technological Pedagogical Content Knowledge (TPACK) was introduced to the educational research field (Mishra & Koehler, 2006). This framework focuses on three areas of teacher knowledge: technology, pedagogy, and content, from which the name "TPACK" comes (Thompson &

Mishra, 2007). The TPACK framework is derived from Shulman's (1986; 1987) construct of Pedagogical Content Knowledge (PCK) which describes how a teacher's understanding of educational technologies interacts with PCK to produce effective teaching with technology.

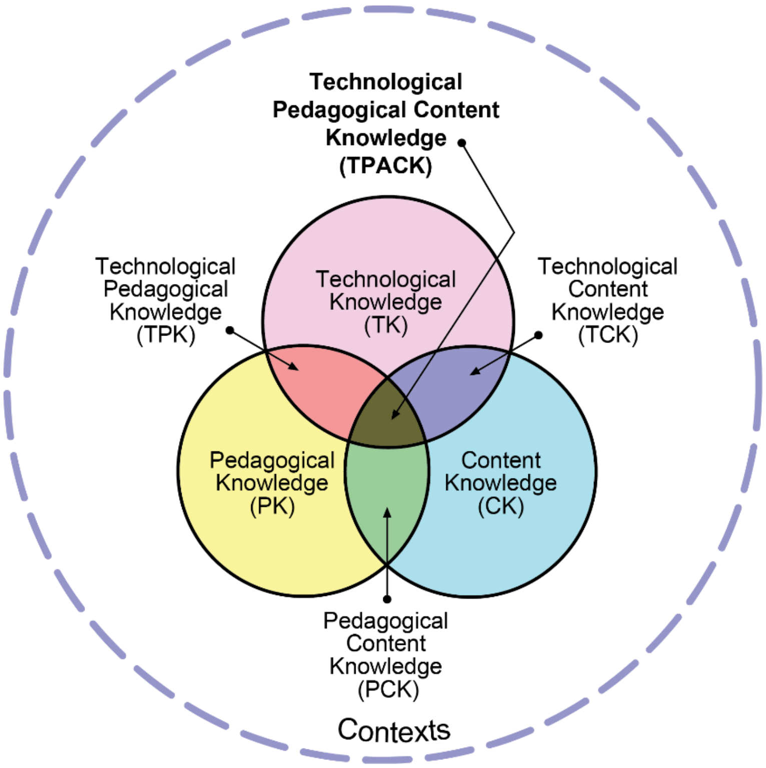

Figure 1. TPACK framework (graphic from http://tpack.org).

The model for the TPACK framework includes a circle for each of the three main components of technology, content and pedagogical knowledge situated to overlap, showing the relationships which exist between each of the main components (Figure 1). The TPACK framework is composed of the relationships between a teacher's technological knowledge, pedagogical knowledge, and content knowledge and each interworking overlap (Mishra & Koehler, 2006; Koehler & Mishra, 2009; Schmidt, et al., 2009). These relationships and overlaps are categorized into seven components that create the TPACK framework and are discussed below:

1. Technology Knowledge (TK): the definition of TK is more fluid due to the nature of technological innovations (Koehler & Mishra. 2009). Put loosely, TK is the ability to "apply [knowledge] productively at work and in their daily lives, to recognize when information technology can assist or impede the achievement of a goal, and to continually adapt to changes in information technology. Acquiring TK in this manner enables a person to accomplish a variety of different tasks using information technology and to develop different ways of accomplishing a given task" (Koehler & Mishra. 2009, p. 64).
2. Content Knowledge (CK): "Teachers' knowledge about the subject matter to be learned or taught" (Koehler & Mishra, 2009, p. 63). In his construct, Shulman (1986) defined this knowledge as including concepts, theories, ideas, organizational frameworks, and an understanding of evidence and proof.
3. Pedagogical Knowledge (PK): "Teachers' deep knowledge about the processes and practices or methods of teaching and learning. They encompass, among other things, overall educational purposes, values, and aims. This generic form of knowledge applies to understanding how students learn, general classroom management skills, lesson planning, and student assessment." (Koehler & Mishra, 2009, p. 64).
4. Pedagogical Content Knowledge (PCK): "Consistent with and similar to Shulman's idea of knowledge of pedagogy that is applicable to the teaching of specific content. Central to Shulman's conceptualization of PCK is the notion of the transformation of the subject matter for teaching. PCK covers the core business of teaching, learning, curriculum, assessment and reporting, such as the conditions that promote learning and the links among curriculum, assessment, and pedagogy" (Koehler & Mishra, 2009, 64).

5. Technological Content Knowledge (TCK): "An understanding of the manner in which technology and content influence and constrain one another. Teachers need to understand which specific technologies are best suited for addressing subject-matter learning in their domains and how the content dictates or perhaps even changes the technology—or vice versa" (Koehler & Mishra, 2009, p. 65).
6. Technological Pedagogical Knowledge (TPK): "An understanding of how teaching and learning can change when particular technologies are used in particular ways. This includes knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies" (Koehler & Mishra, 2009, p. 65).
7. Technological Pedagogical Content Knowledge (TPACK): "the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones" (Koehler & Mishra, 2009, p. 66).

The TPACK framework works to determine what and how pedagogy is implemented in hand with technological knowledge in practice (Koehler & Mishra, 2009). When these techniques are identified, educators are better able to understand the discrepancies in the integration of educational technology (Koehler & Mishra, 2009). Implications for TPACK, as defined by Koehler and Mishra (2009), include the promotion of research in teacher education, teacher professional development, and teachers' use of technology, specifically, technology integration as an additional resource for students and teachers.

A major influence for this theoretical framework is self-efficacy, specifically teacher self-efficacy. Bandura (1997) centered his framework around self-efficacy. Perceived self-efficacy, or "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments," is the foundation of human motivation, performance accomplishments, and emotional well-being (Bandura, 1997, p. 3). Bandura theorized that humans need to feel they can produce desired effects through their actions, and if not, they will have little incentive to undertake activities or to persevere in the face of difficulties (Bandura, 1997). Those with low self-efficacy often see challenging tasks as threats and thus avoid them, while people with high self-efficacy approach such tasks as a potential accomplishment to be mastered (Bandura, 1993).

Bandura's theory of self-efficacy can be applied to teachers as well, creating the idea of teacher self-efficacy in which a teacher must believe in their ability to create desired outcomes through their actions in order to face problems in teaching. Educators need to feel that they can accomplish tasks and create meaningful change through their actions. Educators must hold high teacher self-efficacy in content and pedagogy knowledge in order to be confident in their ability to face challenges in these area, if not, the teacher is likely to avoid pedagogical or content related difficulties which may arise. However, to alter teacher self-efficacy, one's beliefs and perceptions of their abilities must be changed which is a difficult task (Niederhauser & Perkman, 2008).

Knowing the importance teacher self-efficacy has in a teacher's likelihood of using educational technology, it is important to gather as much data as possible on teacher perceptions of educational technology. Although the TPACK framework and instrument focuses on both educational technology integration and the formation of related teacher self-efficacy, this researcher is striving for further specific information regarding the formation of teacher self-efficacy. Because of this, the inclusion of a second survey, Intrapersonal Technology Integration Scale (ITIS), whose framework focuses more on teacher self-efficacy formation, will be utilized in hand with the TPACK instrument.

3. **METHODOLOGY**

3.1. Purpose of the Study

The purpose of this study is to determine the perceived teacher self-efficacy of pre-service seniors and in-service SBAE instructors regarding the integration of 1:1 educational technology.

3.2. Research Objectives

The following research objectives will guide this study:

1. Describe agricultural educators, programs, and access to educational technology in the selected states.
2. Describe professional development experiences related to educational technology for agricultural educators in the selected states.
3. Describe agricultural education teachers' technological, pedagogical, and content knowledge.
4. Describe agricultural education teachers' self-efficacy related to educational technology.
5. Describe the influence of professional development on teacher self-efficacy.
6. Describe the relationship between, professional development experiences, teacher self-efficacy, and TPACK.

3.3. Research Design

This descriptive relational study utilized agricultural teacher professional's responses to survey questions regarding their self-efficacy in relation to the implementation of educational technology. The study used quantitative methods in the form of a survey utilizing closed ended questionnaire items and a Likert-scale matrix.

3.4. Variables

The independent variables for this research study and those included in the in-service agricultural education teacher instrument include: gender, age, years of classroom experience, professional development, student/teacher access to devices, frequency of device usage, highest degree completed, licensure status, coursework preparation for educational technology, school district's value on educational technology, the number of students enrolled in the agricultural education program, the average number of students in a high school level agricultural education class, and the number of students in the high school. Independent variables included as items in the pre-service agricultural education teacher instrument include gender, age, years of classroom experience, professional development, student/teacher access to devices, frequency of device usage, highest degree completed, licensure status, and coursework preparation for educational technology.

Years of classroom experience, professional development, access to devices, coursework preparation for educational technology, and school district's value on educational technology were considered covariates within the study because each variable is previously represented in literature as influential to teacher self-efficacy. Gender, age, frequency of device usage, highest degree completed, licensure status, the number of students enrolled in the agricultural education program, the average number of students in a high school level agricultural education class, and the number of students in the high school are included as variables of interest for the present study as they are believed to impact teacher self-efficacy in the classroom.

The dependent variables for this research study were (1) SBAE teacher self-efficacy specific to educational technology use and (2) their Technological, Pedagogical, and Content Knowledge. Technological Pedagogical Content Knowledge (TPACK) is derived from the framework created by Koehler and Mishra (2006). Educational technology is operationalized as technology (computers, mobile devices, digital cameras, social media platforms and networks, software applications, the Internet, etc.) which has been created or adapted for the purposes of teaching and/or learning. Educational technology requires teachers to use the technology, be it hardware or software, in combination pedagogy in order to integrate it into their classroom.

3.5. Subject Selection

The target population for this study was in-service agricultural education instructors in North Dakota (*n* = 105), South Dakota (*n* = 100), Minnesota (*n* = 261), and Iowa (*n* = 286), and senior agricultural education pre-service teachers enrolled at South Dakota State University (*n* = 20), the University of Minnesota (*n* = 9), and Iowa State University (*n* = 27). The pre-service teachers at North Dakota State University were excluded from this study due to the relationship between the researcher and those agricultural education pre-service teachers. The population consisted of 752 (*n*) in-service teachers and 56 (*n*) pre-service teachers, creating a total population (*N*) of 808 agricultural educators and potential subjects.

3.6. Instrumentation

The survey instruments used for this research study were a combination of TPACK and Intrapersonal Technology Integration Scale (ITIS). Two forms of the instrument were created, a form for pre-service agricultural education teachers and a form for in-service agricultural education teachers. The TPACK instrument contains 46 items categorized in seven sections. The sections are Technology Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and TPACK (Technology Pedagogy and Content Knowledge), respectively. The TPACK instrument contains an additional twenty-one questions that this researcher excluded for this research study due to the incompatibility between the focus of the questions and the purpose of this study. Participants were asked to answer all questions and instructed to select "Neither Agree or Disagree" if they are uncertain of or neutral about a response.

Of the seven TPACK sections, TCK, TPK, and PCK were included in this research survey. Due to the utilization of ITIS, the TK and TPACK sections were deemed redundant in the survey and omitted. The CK and PK sections were also omitted because the questions do not contribute directly to the focus of this research, teacher self-efficacy related to educational technology integration. The PCK section was altered in two ways: first, from a Likert scale to a combination of Likert and multiple choice where respondents 'select all which apply'; and second, to include the eight topic areas in SBAE which were pulled from National AFNR Standards for SBAE. These changes reduce the number of survey item and improve clarity in the instrument. The TCK section was altered by replacing the content area word or phrase in the statement with content areas which, again, align with the National AFNR Standards for SBAE. Doing this added four items to this section but also improved connection to agricultural education teachers and clarified the purpose of these statements.

The ITIS instrument was developed by Niederhauser and Perkmen in 2008 as a means to measure teacher self-efficacy in relation to technology integration (Niederhauser & Perkmen, 2008). Through their validation process, Niederhauser and Perkmen (2008) determined teachers' interpersonal beliefs are central to understanding the likelihood that they would integrate technology into their classroom. Specifically, teacher responses showed self-efficacy, outcome expectations, and interest are important factors which influence the likelihood of a teacher implementing technology into their classroom (Niederhauser & Perkmen, 2008). Through the use of the ITIS instrument, researchers may determine teachers' internal belief system in order to address any professional development needs for technology integration (Niederhauser & Perkmen, 2008).

The ITIS instrument uses a five-point Likert scale for 25 (*n)* items which are divided into three main categories: self-efficacy, outcome expectations, and interest (Niederhauser & Perkmen, 2008). In the self-efficacy section, confidence in using instructional technology is measured through six statements. The outcome expectations are measured through a response to nine statements broken into three categories: performance outcome expectations, self-evaluative outcome expectations, and social outcome expectations. In the interest section of the instrument, a teacher's interest in using technology in the classroom is assessed through six items. When a teacher completes all 25 items of the instrument their level of comfort in intrapersonal technology integration is apparent to the researcher. For this research, item number 23 in ITIS was excluded from the survey due to a lack of clarity of intent of the question. Additionally, due to the split target audience of pre- and in-service teachers, the verb tense of some statements in ITIS were changed for clarity reasons for the pre-service teacher survey.

Demographic items for the instruments align directly with the independent variables previously stated in this chapter. Items combined from demographic items, ITIS, and the sections of TCK, TPK, and PCK from the TPACK instrument create a total of 36 (N) items in the pre-service instrument and 40 (N) items in the in-service instrument.

3.7. Data Collection

This descriptive relational study utilized agricultural teacher professional's responses to survey questions regarding their self-efficacy in relation to the implementation of educational technology. In-service teacher survey took place from April 25 – May 10, 2019. The survey was available via Qualtrics and distributed to the SBAE teachers in the selected states by a link included in the email asking for participation.

3.8. Data Analysis

The present study used quantitative methods in the form of a survey utilizing closed ended questionnaire items and a five point Likert-scale matrix. Options on the Likert-scale included strongly disagree, disagree, neutral, agree, and strongly agree. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software version 24. Descriptive statistics were run to analyze independent and dependent variables, objectives one, two, three, and four, including means and standard deviations. Group means for objective five were analyzed using a one-factor between subjects ANOVA model where teacher technology self-efficacy and the components of TPACK will serve as dependent variables, respectively. Pearson correlations were used for objective six which included ITIS self-efficacy, PCK, TPK, and TCK.

4. SBAE TEACHERS' SELF-EFFICACY RELATED TO EDUCATIONAL TECHNOLOGY: A STUDY USING TPACK AND ITIS

4.1. Abstract

The purpose of this study was to determine the teacher self-efficacy of in-service school-based agricultural education (SBAE) instructors related to educational technology through the use of TPACK and Interpersonal Technology Integration Scale (ITIS). In-service SBAE teachers from four mid-west states were surveyed to assess their current teacher self-efficacy in terms of educational technology in their classroom and curriculum. According to the findings of this study, while somewhat unconfident in their abilities to do, SBAE teachers are using educational technology in their classroom, curriculum, and for some, daily schedule. It is recommended that teachers participate in professional development which is focused on not only how to use educational technology, but also on how to teach using the educational technology specific to their 1:1 issued device.

4.2. Introduction

The digital technology we use day-to-day is constantly updating to meet new demands for speed, size, and versatility; educational technology is updated in the same manner, for the same reasons. Across each generation and form of technology, issues such as purpose, usefulness, and educational appropriateness in the classroom has arisen (Cuban, 1986). Despite the issues, two educational technologies, being the television and computer, have remained in the classroom and, since their introductions, flourished. Educational technology is technology which is created or adapted for the purposes of teaching and/or learning. Some examples include, but are not limited to, computers, video projectors, the Internet, mobile devices (i.e. smartphones and tablets), digital cameras, social media platforms and networks, and software applications (apps).

Educational technology requires teachers to use the technology in hand with pedagogy for classroom implementation.

In order to prepare students for life in a digital world, teachers continue to use educational technology in their classrooms in an attempt to familiarize students with technology (Schrader, 2016). Due to this reality, school districts, almost universally, are handing devices to students and teachers, often in the form of 1:1. One to one computing, or 1:1, is an educational initiative where the school provides one device, be it a laptop, tablet, or smart phone, per student in an attempt to provide personalized education and access to information (Cuban, 2014; Schrader, 2016). However, for 1:1 to be effective, the teacher must create and use curriculum which effectively utilizes technology (Jones, 2017).

Similar to research in core academic class settings, research in SBAE suggests teachers need to use these devices themselves before teaching students how to utilize them for various applications in the field of agriculture (Burke, Schuck, Aubusson, Kearney, & Frischknecht, 2018). To that end, the body of research focused on the use of 1:1 technology in the SBAE classroom is limited. A gap in research begins in the late 1980s and continues until recent years when current educational technology gained its presence in the classroom. Because of this gap, the research included in the review of literature contains studies conducted in both SBAE classrooms and core academic classrooms. Technology causes a shift in education as it permeates our daily lives. In order to prepare students for life in a digital world, teachers need to use educational technology in their classroom in an attempt to familiarize students with technology (Schrader, 2016). Due to this realization, school districts, almost universally, are giving devices to students and expecting teachers to use them as a tool in their curriculum.

Thereby, in today's classroom, just as in the past, questions still linger concerning technology's effectiveness in the classroom, teachers' ability to use it, and students' ability to learn with it.

4.3. Review of Literature

Educational technology has many purposes and can take the form of hardware or software. Hardware is considered the physical property or aspect of the technology, such as the device or machine. Software is the operating system and related programs which the hardware uses to function. The hardware, or device, of choice for educational technology use is often tablets, such as the Apple iPad or Chromebook, due to customizability, touch screen capabilities, and user-friendly features (Herold, 2016; Jones, 2017). The software, often in the form of apps and online (internet) services, are what makes the devices useful, educational tools.

In an educational environment, neither hardware nor software can function without the internet. Internet can be hardwired or wireless, but is often wireless (Wi-Fi) for student devices in schools. As 1:1 increased in popularity bandwidth issues developed, or the capacity of devices a network can support for data transmission, resulting in poor connection or no connection from devices to internet (Schrader, 2016; Herold, 2016; Jones, 2017). Furthermore, outside of school, some students do not have access to the internet (U.S. Department of Education, 2015). These are potential issues teachers should be mindful of when planning activities using devices for students.

Numerous studies have been conducted and published since the conception of 1:1, many finding students who are able to use technology in the classroom show more engagement in content, better peer collaboration, motivation to work individually, and improved digital and technological skills (Bebell and Key, 2010; Keengwe, Schnellert, & Mills, 2012; Islam & Grönlund, 2016; Irby, 2017). Positive student outcomes were also determined as a result of teachers confidently and effectively using educational technology, demonstrating to their students how to effectively use the technology to enhance learning (Bebell and Key, 2010; Keengwe, Schnellert, & Mills, 2012; Islam & Grönlund, 2016; Irby, 2017).

Agricultural educators must develop and maintain up-to-date student learning activities and instructional programs to compete with the ever-changing agricultural and related industries (Phipps, Osborne, Dyer, & Ball, 2008), emphasizing the evolution of technology in the field of agriculture. Even though the body of research focused on the use of 1:1 technology in the SBAE classroom and the importance of such information specific to SBAE is limited, three obstacles to implementing educational technology in both core education and SBAE classrooms consistently emerge. These obstacles are: a lack of funding, low teacher self-efficacy, and a lack of professional development focusing on technology integration in the classroom (Raven & Welton, 1989; Camp & Sutphin, 1991; Kotrlik, Redmann, Harrison, & Handley, 2000; Cuban, 2001; Wang, Ertmer, & Newby, 2004; Schrader, 2016; Johnson, Levine, Smith, & Haywood, 2010; Stewart, Antonenko, Robinson, & Mwavita, 2013; Williams, Warner, Flowers, & Croom, 2014; Burke, Schuck, Aubusson, Kearney, & Frischknecht, 2018).

Teachers are often left in a state of turmoil due to technological updates; because of this and a lack of experience with educational technology, teachers lack confidence related to the use and purposeful integration of educational technology use in their classroom (Raven & Welton, 1989; Wang et al., 2004; Mishra & Koehler, 2006; Niederhauser & Perkman, 2008; Hastings, 2009; Koehler & Mishra, 2009; Stewart, Antonenko, Robinson, & Mwavita, 2013; Irby, 2017). In 1989, SBAE teachers did not use computers in their teaching due to the lack of time available to spend learning about computers (Raven & Welton, 1989). A more recent study revealed a positive correlation between the amounts of educational technology specific professional development a teacher completed and their self-efficacy related to using educational technology in their classroom (Hastings, 2009).

The lack of teacher involvement in the planning of technology inclusion has resulted in the downfall of many advances in their time (Cuban, 1986; Cuban, 2001). Policy makers have pushed for the purchase of technology and its integration into classrooms because they perceive an importance (Cuban, 1986; Cuban, 2001); however, the problem lies in the lack of teacher education and professional development focusing on technology and its application to learning (Johnson, Levine, Smith, & Haywood, 2010). While this problem has been identified for some time, the lack of available professional development focused on educational technology integration offered to teachers remains apparent.

The most influential factor contributing to the inclusion of technology in the classroom is the teacher's ability to use the technology (Burke, Schuck, Aubusson, Kearney, & Frischknecht, 2018). Koehler and Mishra (2009) felt teachers have not been given adequate training for incorporating and using educational technology. In 2000, Louisiana SBAE teachers valued using educational technology but felt they did not have the knowledge to integrate the educational technology into their curriculum (Kotrlik et al., 2000). SBAE teacher, like their peers, need assistance in planning curriculum that both instructs about and applies educational technology in the SBAE classroom (Camp & Sutphin, 1991). Hastings (2009) found teachers who completed moderate to high amounts of professional development specific to educational technology regularly used educational technology in their classroom.

Through this review of literature, it is clear that simply handing out devices to students and teachers will not result in the effective use of educational technology among the students and teachers. It is also clear there is no definitive answer to the question what role teacher self-efficacy plays in educational technology use in the SBAE classroom. Furthermore, there is limited data available which was gathered from an agricultural education classroom. Therefore, it is necessary to look deeper into the self-efficacy of SBAE teachers regarding their ability to integrate educational technology in their classrooms.

4.4. Conceptual Framework

How can teachers integrate educational technology into their teaching? While there is no best way to integrate educational technology into curriculum, in an effort to determine what teachers needed to know or did know about classroom technology integration, Technological Pedagogical Content Knowledge (TPACK) was introduced to the educational research field (Mishra & Koehler, 2006). Implications for TPACK, as defined by Koehler and Mishra (2009), include the promotion of research in teacher education, teacher professional development, and teachers' use of technology, specifically, technology integration as an additional resource for students and teachers.

The TPACK framework is composed of the relationships between a teacher's technological knowledge, pedagogical knowledge, and content knowledge and each interworking overlap (Mishra & Koehler, 2006; Koehler & Mishra, 2009; Schmidt, Baran, & Thompson, 2009). These relationships and overlaps are categorized into seven components that create the TPACK framework: Technology Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK). The model for the TPACK framework includes a circle for each of the three main components of technology, content and pedagogical knowledge situated to overlap, showing the relationships which exist between each of the main components (Figure 1).

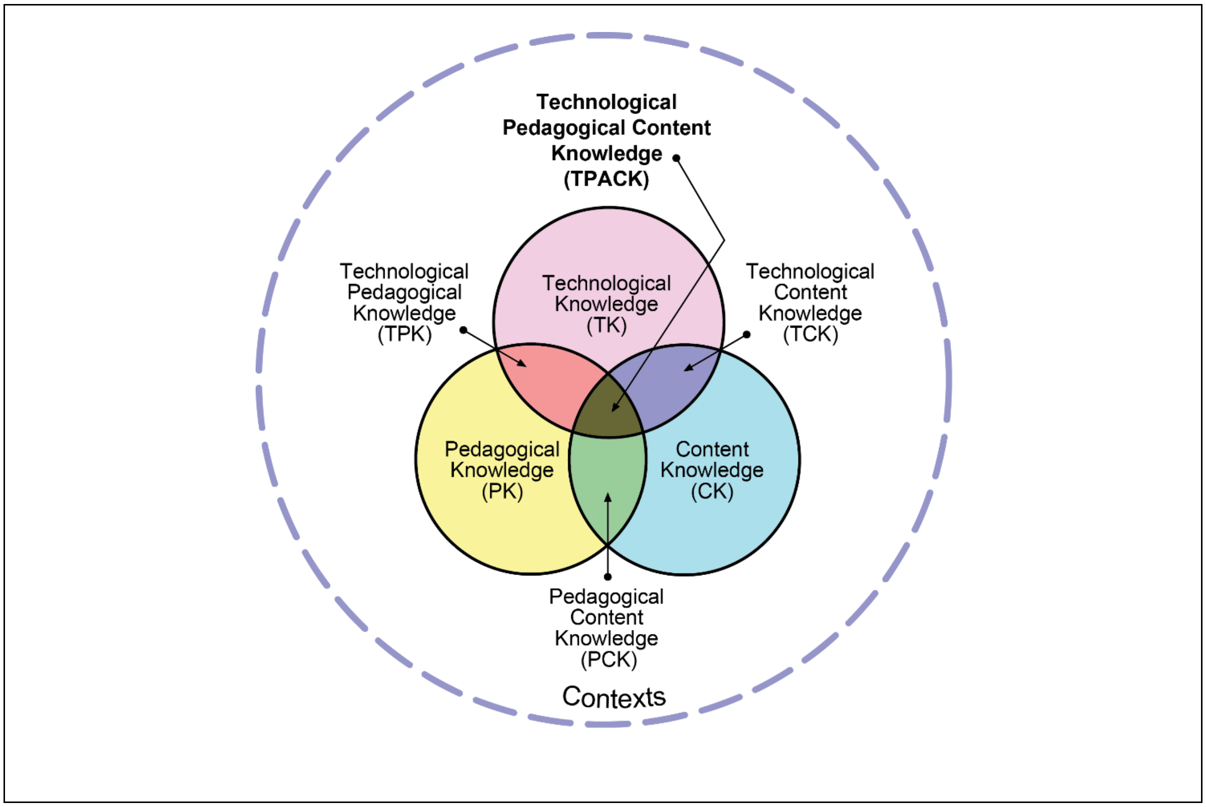

Figure 2. TPACK framework (graphic from http://tpack.org).

A major influence for this theoretical framework is self-efficacy, specifically teacher self-efficacy. Bandura (1997) based his framework on self-efficacy, theorizing that humans need to feel they can produce desired effects through their actions, and if not, they will have little incentive to undertake activities or to persevere in the face of difficulties. Those with low self-efficacy often see challenging tasks as threats and thus avoid them, while people with high self-efficacy approach such tasks as a potential accomplishment to be mastered (Bandura, 1993).

Bandura's theory of self-efficacy can be applied to teachers as well, creating the idea of teacher self-efficacy in which a teacher must believe in their ability to create desired outcomes through their actions in order to face problems in teaching. Educators need to feel that they can accomplish tasks and create meaningful change through their actions. However, to alter teacher self-efficacy, one's beliefs and perceptions of their abilities must be changed which is a difficult task (Niederhauser & Perkman, 2008).

Knowing the important role teacher self-efficacy plays in a teacher's likelihood of using educational technology, it is important to gather as much data as possible on teacher perceptions of educational technology. Although the TPACK framework and instrument focuses on both educational technology integration and the formation of related teacher self-efficacy, specific information regarding the formation of teacher self-efficacy is needed. For this research study, only PCK, TPK, and TCK were included in the instrument in order to 1) shorten the number of items, 2) the other components did not align with the study purpose to assess the self-efficacy, related to educational technology, of pre- and in-service school-based agricultural education teachers, and 3) the TPACK instrument is geared toward elementary teachers. Because of these, the inclusion of a second survey, Intrapersonal Technology Integration Scale (ITIS), whose content focuses more on teacher self-efficacy formation, was included in the survey.

4.5. Purpose and Objectives

The purpose of this study is to determine the perceived teacher self-efficacy of pre-service seniors and in-service SBAE instructors regarding the use and integration of 1:1 educational technology. The following research objectives guided this study:

1. Describe agricultural educators, programs, and access to educational technology in the selected states.
2. Describe agricultural education teachers' technological, pedagogical, and content knowledge.
3. Describe agricultural education teachers' self-efficacy related to educational technology.
4. Describe the relationship between teacher self-efficacy and TPACK.

4.6. Methods

4.6.1. Population

The target population for this study was in-service agricultural education instructors in North Dakota (*n* = 105), South Dakota (*n* = 100), Minnesota (*n* = 261), and Iowa (*n* = 286); and agricultural education pre-service teachers enrolled at South Dakota State University (*n* = 20), the University of Minnesota (*n* = 9), and Iowa State University (*n* = 27). The pre-service teachers at North Dakota State University were excluded from this study due to the relationship between the researcher and those agricultural education pre-service teachers. The population consisted of 752 (*n*) in-service teachers and 56 (*n*) pre-service teachers, creating a total population (*N*) of 808 agricultural educators.

4.6.2. Instrumentation

The survey instruments used for this research study were a combination of TPACK and the Intrapersonal Technology Integration Scale (ITIS). Two forms of the instrument were created, a form for pre-service agricultural education teachers and a form for in-service agricultural education teachers. The TPACK instrument contains 46 items categorized in seven sections, three of which, Technological Content Knowledge, Technological Pedagogical Knowledge, and Pedagogical Content Knowledge were retained for this research survey. Technology Knowledge, Technology Pedagogy, and Content Knowledge were excluded due to the overlap with ITIS. The Content Knowledge and Pedagogical Knowledge sections were omitted because items did not contribute to teacher self-efficacy related to educational technology integration.

The PCK section was altered in two ways; first, the format of items are a combination of five-point Likert scale and multiple choice where respondents ‘select all which apply’ and second, the items' content area are the eight topic areas in SBAE, pulled from National AFNR Standards for SBAE. These changes improve clarity in the instrument for both the pre- and in-service agricultural education teachers. The TCK section was also altered by replacing the each item's content area with the content areas in alignment with the National AFNR Standards for SBAE. Again, doing this improved application to agricultural education teachers and clarified the purpose of these statements.

The ITIS instrument was developed by Niederhauser and Perkmen in 2008 as a means to measure teacher self-efficacy in relation to technology integration (Niederhauser & Perkmen, 2008). It uses a five-point Likert scale for 25 items which are divided into three categories: self-efficacy, outcome expectations, and interest (Niederhauser & Perkmen, 2008). Due to the split target audience of pre- and in-service teachers, the verb tense of some statements were changed for clarity reasons for the pre-service teacher survey.

Demographic items for the instruments align directly with the independent variables previously stated. Items combined from demographic items, ITIS, and the sections of TCK, TPK, and PCK from the TPACK instrument create a total (N) of 36 items in the pre-service instrument and (N) 40 items in the in-service instrument.

4.6.3. Data Collection and Analysis

This descriptive relational study utilized agricultural teacher professional's responses to survey questions regarding their self-efficacy in relation to the implementation of educational technology. In-service teacher survey took place from April 25 – May 10, 2019. The survey was available via Qualtrics and distributed to the SBAE teachers in the selected states by a link included in the email asking for participation. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software version 24. Descriptive statistics were run to analyze independent and dependent variables, including means and standard deviations.

4.7. Findings

Research objective one was to describe agricultural educators, programs, and access to educational technology in the selected states. From the selected states, 120 (*n*) teachers completed the survey from the available sample of 752 in-service teachers, and a total of 16 surveys were excluded from the results of the study due to incompletion or response set issues. Characteristics of the sample are found in Table 1. The distribution of gender for the sample favored female (63.5%, n = 66) over male (36.5%, n = 38) of those reported.

Age range among the teachers varied with the largest group reporting 31-40 years of age (27.9%, n = 29), corresponding to 11-20 years teaching experience (27%, n = 28), assuming traditional licensure path. A large portion of in-service teachers completed their agricultural education degree in a traditional teacher preparation program (86.5%, n = 90). Although close, more respondents held a Bachelor's degree (55.8%, n = 58) than a Master's degree (44.2%, n = 46). The majority of responding in-service teachers reported an SBAE program size of 1-150 students (76%, n = 79).

Table 1
In-Service Teacher Demographics (n = 104)

Variable	***n***	**%**
Gender		
Male	38	36.5
Female	66	63.5
Age Range		
20-25	14	13.5
26-30	23	22.1
31-40	29	27.9
41-50	20	19.2
51+	18	17.3
Highest Degree Completed		
Bachelor's	58	55.8
Master's	46	44.2
Path to Licensure		
Traditional Teacher Prep Program	90	86.5
Graduate Licensure (TLO or Great Plains IDEA)	4	3.8
Alternative Access	6	5.8
PRAXIS Test (or similar licensure test)	4	3.8
Years of Experience		
0	1	1
1-5	30	28.8
6-10	23	22.1
11-15	14	13.5
16-20	14	13.5
21+	22	21.2

From the selected states, 19 (*n*) pre-service SBAE teachers completed the survey from the available sample of 56 pre-service teachers, and a total of one survey was excluded from the results of the study due to incompletion. Characteristics of the sample are found in Table 2. The distribution of gender for the sample favored female (77.8%, $n = 14$) over male (22.2%, $n = 4$) of those reported. Age range among the teachers differed as the largest group reporting was 20-25 years of age (88.9%, $n = 16$), corresponding with 1-5 years of experience teaching (61.1%, $n = 11$), assuming traditional licensure path. A large portion of per-service teachers completed their agricultural education degree in a traditional teacher preparation program (78.9%, $n = 15$). More respondents held a Bachelor's degree (72.2%, $n = 13$) than a Master's degree (22.2%, $n = 4$).

Table 2
Pre-Service Teacher Demographics (n = 18)

Variable	***n***	**%**
Gender		
Male	4	22.2
Female	14	77.8
Age Range		
>20	1	5.6
20-25	16	88.9
26-30	1	5.6
Highest Degree Completed		
Bachelor’s	13	72.2
Master’s	4	22.2
Path to Licensure		
Traditional Teacher Prep Program	15	78.9
PRAXIS Test (or similar licensure test)	3	15.8
Years of Experience		
0	6	33.3
1-5	11	61.1
21+	1	5.6

Characteristics of SBAE program and high school size can be found in Table 3. Most SBAE programs averaged 51-100 students (40.4%, *n* = 42) while the next most common size program is 101-150 students (18.3%, *n* = 19), and a very close third most common being the smallest size program, 1-50 students (17.3%, *n* = 18). Number of students in a high school ranged from 40 to 2500 with the most common high school size being 100-200 students (20.2%, *n* = 21).

Table 3
School and Agricultural Education Program Demographics

Variable	***n***	**%**
Number of Students in Ag. Ed. Program		
1-50	18	17.3
51-100	42	40.4
101-150	19	18.3
151-200	5	4.8
201-250	4	3.8
251-300	9	8.7
301-350	2	1.9
351-400	2	1.9
401+	1	1.0
Number of Students in High School		
>100	19	18.3
100-200	21	20.2
201-300	11	10.6
301-400	20	19.2
401-500	6	5.7
501-600	5	4.8
601-700	3	2.9
701-800	2	1.9
801-900	5	4.8
901-1000	3	2.9
1001-1500	3	2.9
1501-2000	3	2.9
2001-2500	2	1.9

Characteristics of access to educational technology and frequency of use by in-service SBAE teachers can be found in Table 4. While 2.9 percent (n = 3) of in-service agricultural education teachers reported no access to devices for educational technology and only one (*n* = 1) teacher utilized BYOD in their classroom, a surprising 76 percent (*n* = 79) of in-service teachers reported being 1:1 in the classroom/ school. Of the 101 SBAE teachers utilizing devices for educational technology in their classroom, 47.1 percent (*n* = 49) are using the devices daily in instruction and 31.7 percent (*n* = 33) are using them at least three times a week.

Table 4
In-Service Teacher Technology Demographics (n = 103)

Variable	*n*	%
Access to Devices		
1:1	79	76.0
BYOD	1	1.0
COW (Computers On Wheels/mobile cabinet)	16	15.4
LMC (Library Media Center)	5	4.8
None	3	2.9
Frequency of Device Usage		
Daily	49	47.1
4 Classes a Week	6	5.8
3 Classes a Week	33	31.7
2 Classes a Week	12	11.5
1 Class a Week	4	3.8

Characteristics of access to educational technology and frequency of use by pre-service SBAE teachers can be found in Table 5. While 5.6 percent (n = 1) of pre-service agricultural education teachers reported no access to devices for educational technology and no (*n* = 0) teachers utilized BYOD in their student teaching classroom, a surprising 77.8 percent (*n* = 14) of pre-service teachers reported being 1:1 in the classroom/ school. Of the 18 pre-service SBAE teachers utilizing devices for educational technology in their classroom, 55.6 percent (*n* = 10) are using the devices daily in instruction and 22.2 percent (*n* = 4) are using them at least three times a week.

Table 5
Pre-Service Teacher Technology Demographics (n = 18)

Variable	*n*	%
Access to Devices		
1:1	14	77.8
COW (Computers On Wheels/mobile cabinet)	2	11.1
LMC (Library Media Center)	1	5.6
None	1	5.6
Frequency of Device Usage		
Daily	10	55.6
4 Classes a Week	1	5.6
3 Classes a Week	4	22.2
2 Classes a Week	3	16.7

Objective two was to describe agricultural education teachers' technological, pedagogical, and content knowledge. Results for pre-service and in-service teacher objective two responses can be found in Table 6 and Table 7. For this research study, the TPACK section of the survey includes three components: Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Pedagogical Content Knowledge (PCK). Of the 104 total in-service and 20 pre-service teacher respondents, 103 in-service and 19 pre-service SBAE teachers completed all three components of the TPACK section.

Table 6
In-Service Teacher TPACK

Variable	***n***	**%**	**M**	**SD**	**Range**
Technological Content Knowledge	103		3.39	.58	1-5
Technological Pedagogical Knowledge	103		3.83	.54	1-5
Pedagogical Content Knowledge	103		4.10	.66	1-5
Most Confident Content					
Animal Science	86	83.5			
Plant Science	72	69.9			
Natural Resource Management	52	50.5			
Agricultural Mechanics	43	41.7			
Agribusiness	40	38.8			
Food Science	39	37.9			
Environmental Science	37	35.9			
Biotechnology	13	12.6			
Least Confident Content					
Biotechnology	59	57.3			
Agricultural Mechanics	41	39.8			
Agribusiness	40	38.8			
Food Science	37	35.9			
Environmental Science	26	25.2			
Natural Resource Management	24	23.3			
Plant Science	15	14.6			
Animal Science	5	4.9			

The TCK section included eight items which inquire about the teacher's content knowledge related to technology. In the TCK section, the mean (M) response was 3.36 with a standard deviation (SD) of .58 for in-service teachers and the mean (M) response was 3.48 with a standard deviation (SD) of .62 for pre-service teachers. The TPK section included nine items which inquire about the teacher's pedagogical knowledge related to technology. In the TPK section, the mean (M) in-service teacher response was 3.83 with a standard deviation (SD) of .54 and the mean (M) pre-service teacher response was 3.83 with a standard deviation (SD) of .54.

Table 7
Pre-Service Teacher TPACK (n = 19)

Variable	***n***	**%**	**M**	**SD**	**Range**
Technological Content Knowledge	18	-	3.486	.624	2-5
Technological Pedagogical Knowledge	17	-	3.83	.543	2-4.56
Pedagogical Content Knowledge	18	-	3.94	.236	3-4
Most Confident					
Animal Science	18	94.7			
Plant Science	14	73.68			
Agribusiness	6	31.57			
Agricultural Mechanics	5	26.31			
Natural Resource Management	5	26.31			
Biotechnology	4	21.05			
Food Science	4	21.05			
Environmental Science	3	15.79			
Least Confident					
Agricultural Mechanics	11	57.89			
Biotechnology	9	47.37			
Environmental Science	7	36.84			
Food Science	6	31.57			
Agribusiness	6	31.57			
Natural Resource Management	4	21.05			
Plant Science	2	10.52			
Animal Science	0	0			

In the PCK section, the mean (M) response was 4.10 with a standard deviation (SD) of .664 for in-service teachers and the mean (M) response was 3.94 with a standard deviation (SD) of .236 for pre-service teachers. Also in the PCK section, in-service and pre-service teachers were asked to select the content areas they felt both most and least confident in teaching. The in-service teachers ranked Animal Science (*n* = 86), Plant Science (*n* = 72), and Natural Resource Management (*n* = 52) as the top three the content areas they felt most confident teaching. The pre-service teachers ranked Animal Science (*n* = 18), Plant Science (*n* = 14), and Agribusiness (*n* = 6) as the top three content areas they felt most confident teaching. The in-service teachers ranked Biotechnology (*n* = 59), Agricultural Mechanics (*n* = 41), and Agribusiness (*n* = 40) as the top three the content areas they felt least confident teaching. The pre-service teachers ranked Agricultural Mechanics (*n* = 11), Biotechnology (*n* = 9), and Environmental Science (*n* = 7) as the top three content areas they felt least confident teaching.

Objective three was to describe agricultural education teachers' self-efficacy related to educational technology, (Table 8). Of the 104 total in-service respondents, 93 SBAE teachers provided usable responses for the ITIS section of the survey. Of the 18 total pre-service respondents, 13 post-secondary students completed the ITIS section of the survey. In ITIS, the in-service mean (M) response was 3.85 with a standard deviation (SD) of .55; the minimum response was a two and the maximum response was a five. The pre-service mean (M) response was 3.88 with a standard deviation (SD) of .47; the minimum response was a three and the maximum response was a four.

Table 8
ITIS Self-Efficacy

Variable	***n***	**M**	**SD**	**Range**
In-Service Teacher Self-Efficacy	93	3.85	.55	2.33 – 5
Pre-Service Teacher Self-Efficacy	13	3.88	.48	3-4.83

Objective four was to describe the relationship between teacher self-efficacy and TPACK. A Pearson correlation was used to determine if a relationship existed between self-efficacy and PCK, TPK, and TCK, (Table 9). Significant relationships were found between all three constructs (PCK, TCK, and TPK) and educational technology self-efficacy as measured by

ITIS. Pedagogical Content Knowledge was significantly correlated with teacher self-efficacy, r = .23, p <.05 (two-tailed). Stronger, significant relationships between TPK and teacher self-efficacy, $r = .69$, $p < .01$ (two-tailed) and TCK and teacher self-efficacy, $r = .41$, $p < .01$ (two-tailed) were revealed through the Pearson correlations.

Table 9

In-Service Teacher Self-Efficacy and TPACK

Variable	Self-Efficacy
PCK	
Pearson Correlation	.231*
Significance (2-tailed)	.027
TPK	
Pearson Correlation	.695**
Significance (2-tailed)	.000
TCK	
Pearson Correlation	.406**
Significance (2-tailed)	.000
Self-Efficacy	
Pearson Correlation	1
Significance (2-tailed)	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.8. Discussion/Recommendations/Conclusion

Demographic data from the survey show the majority of pre- and in-service SBAE teachers completed their degree through traditional licensure and the largest portion of in-service respondents were midcareer teachers. Over three fourths of the responding pre- and in-service teachers reported the use of 1:1 in their classroom or school. Of those 1:1 teachers, nearly half in-service and over half of pre-service teachers use the device in daily instruction. Of the remaining in-service teachers, one third use them at least three times a week.

These results indicate educational technology in the form of devices used for 1:1 are now commonplace in mid-western school-based agricultural education classrooms. While it has been assumed that 1:1 has been introduced to most United States school systems (Herold, 2016), it is apparent that SBAE teachers are using these devices frequently, some conscientiously, in their classroom. Knowing the average SBAE classroom from this research study reaches somewhere from 50 to 100 students, teachers have the potential to not only expose those students to educational technology, but teach them how to use technology in the field of agriculture through the integration and incorporation of educational technology.

Our TPACK findings indicate pre- and in-service teachers are most confident in their pedagogical content knowledge (PCK) when compared to technological content knowledge (TCK) and technological pedagogical knowledge (TPK). This shows that agricultural education teachers are more confident in teaching about the agricultural content than the technological content, which is logical as SBAE teachers are trained to teach agriculture, not technology. These findings are congruent with prior research conducted using TPACK in agricultural education (Stewart, et al., 2013). However, this is now an issue as it is clear that educational technology in now common in the SBAE classroom, therefore teachers need to be prepared to teach both their agricultural content and technological content.

Data also indicated that teachers are slightly more confident in their knowledge of how to teach about technology (TPK) than their ability to teach the technology itself (TCK). This is another promising finding as given the proper professional development, SBAE teachers will likely be able to plan and implement content to teach agricultural content using educational technology and teach the technology to their students. Previous research determined SBAE teachers who participated in professional development related to educational technology held high self-efficacy in using the educational technology in their classroom and those who did not partake in the professional development were not likely to implement the educational technology (Camp & Sutphin, 1991; Kotrlik, et al., 2000; DiBenedetto, et al., 2018).

Data from the ITIS portion of the survey reveals SBAE teacher self-efficacy in relation to educational technology is lacking as the average teacher responses were only slightly higher than 'neutral'. Again, this is interesting as 76 percent of teachers are using educational technology in their classrooms and nearly half of those teachers are using it daily. Now, one begins to wonder, if devices are being used but teachers are not confident in their ability to use them, is the educational technology being used properly and to its fullest potential? According to Bandura (1993), those with low self-efficacy often see challenging tasks as threats and consequently avoid them; we assume the same is true for a teacher who sees educational technology as a challenge. Consequently, in order for a teacher to feel confident in their ability to teach using educational technology, they must hold high teacher self-efficacy in the areas of content and pedagogy knowledge in order to be confident in their ability to face challenges with educational technology use.

Significant relationships were found between TPK and self-efficacy at the .01 level, TCK and self-efficacy also at the .01 level, and PCK and self-efficacy at the .05 level. It can be assumed the three constructs of TPACK would reveal higher relationships due to their connected framework. Describing the Pearson correlations reveals that a teacher's self-efficacy using educational technology is strongly related to their perceived pedagogical knowledge of educational technology. Therefore, a teacher with more tools in their teaching toolbox with regard to educational technology would be more confident in their abilities to teach using educational technology in their classroom.

A few interpretive limitations exist with the results of this study. Notably, due to the research design, the pre- and in-service SBAE teachers included are from the selected states therefore represent a narrow sample. Consequently, the results are only applicable to those teachers who responded to the survey among the mid-western agricultural education teachers. However, the size and scope of the study were logical for the time frame for data collection and the nature of the research project. Another limitation, related to data analysis, was that we assume all participants were honest, which is a common assumption in survey related data collection. Finally, since not all components of TPACK were used for the instrument, it could be argued that TPACK analysis is incomplete. However, the excluded components of the TPACK framework and instrument were not compatible with the desired outcomes of this research. The complete TPACK instrument is geared toward elementary teachers and because the focus of this research was SBAE teachers at the secondary level, incongruent TPACK components were excluded.

While not every element of the theoretical framework for this study imparted substantial impact on teacher self-efficacy, this study assisted in the work toward understanding teacher self-efficacy in relation to educational technology. Future research should look deeper into the impact of specialized professional development on educational technology teacher self-efficacy. Additionally, research could extend further analysis of the ITIS instrument in order to get a more accurate measure of SBAE teacher self-efficacy related to educational technology. The instrument has some room for improvement to better align with agricultural education; these changes would provide a more thorough response and could potentially better answer the remaining question: what is hindering SBAE teacher self-efficacy related to teaching and using educational technology?

5. SCHOOL-BASED AGRICULTURAL EDUCATION TEACHERS' SELF-EFFICACY RELATED TO PROFESSIONAL DEVELOPMENT: A STUDY USING TPACK AND INTERPERSONAL TECHNOLOGY INTEGRATION SCALE

5.1. Abstract

The purpose of this study was to determine the influence of professional development on teacher self-efficacy and TPACK, specifically TPK, TCK, and PCK. In-service SBAE teachers from four mid-west states were surveyed to assess their current teacher self-efficacy in terms of educational technology in their classroom and curriculum. According to the findings of this study, SBAE teachers are participating in school-provided professional development related to educational technology which has taught them TPK, but lacked in TCK and PCK. While somewhat unconfident in their abilities to do, SBAE teachers are using educational technology in their classroom, curriculum, and for some, daily schedule. It is recommended that teachers participate in professional development which is focused on not only how to use educational technology, but also on how to teach agriculture content using the educational technology specific to their 1:1 issued device.

5.2. Introduction

In this digitally focused world, technology is woven into education as we progress toward a more digitally dependent world. In order to prepare students for life in a digital world, teachers need to use educational technology in their classroom in an attempt to familiarize students with technology (Schrader, 2016). Due to this realization, school districts, almost universally, are giving devices (educational technology) to students and expecting teachers to use them as a tool in their curriculum. Educational technology is technology which has been created or adapted for the purposes of teaching and/or learning. Educational technology requires teachers to use the technology, be it hardware or software, in combination pedagogy in order to integrate it into their classroom.

Educational technology has many purposes and can take the form of hardware or software. Hardware is considered the physical property or aspect of the technology, such as the device or machine. Software is the operating system and related programs which the hardware uses to function. The hardware, or device, of choice for educational technology use is often tablets, such as the Apple iPad or Chromebook, due to customizability, touch screen capabilities, and user-friendly features (Herold, 2016; Jones, 2017). The software, often in the form of apps and online (internet) services, are what makes the devices useful, educational tools. However, due to financial and technical issues, the inclusion of instructional software is gradual (Herold, 2016).

In an educational environment, neither hardware nor software can function without the internet. Internet can be hardwired or wireless, but is often wireless (Wi-Fi) for student devices. As 1:1 increased in popularity, schools began to have issues with bandwidth, or the capacity of devices a network can support for data transmission, resulting in poor connection or no connection from devices to internet (Schrader, 2016; Herold, 2016; Jones, 2017). Furthermore, outside of school, some students do not have access to the internet (U.S. Department of Education, 2015). These are potential issues a teacher should be mindful of when planning activities using devices for students.

5.3. Review of Literature

There is an apparent gap in educational technology research conducted in school based agricultural education (SBAE). Forty years have passed since the first article was published in the *Journal of Agricultural Education* regarding the challenges of educational technology in

SBAE and yet, the report of challenges and barriers is unchanged today. From 1989 to 2018, the same obstacles (specifically the price of the technology, a lack of teacher self-efficacy to use the educational technology, and a lack of professional development specific to the implementation of educational technology in the classroom) have been found and reported. There were numerous recommendations for further research on these or related matters, however, there has yet to be a study conducted and published which addresses the reoccurring nature of these challenges in integrating educational technology.

Educational technology use in the SBAE classroom has become an interest to many agricultural education researchers. Over the four decades of published research, many researchers' findings detailed a major need for in-service professional development specific to educational technology as SBAE teachers have both requested and been given educational technology (Kotrlik, et al., 2000). A teacher's lack of training on how to use educational technology is an obstacle to proper and effective implementation (Burke, et al., 2018; Cuban, 1986; Cuban, 2001; Dormody & Torres, 2002; Johnson, et al., 2010; Jones, 2017; Koehler & Mishra, 2009; Raven & Welton, 1989).

As seen across the literature, the lack of teacher involvement in the planning of technology inclusion has resulted in the downfall of many advances in their time (Cuban, 1986; Cuban, 2001). Nonetheless, policy makers have pushed for the purchase of technology and its integration into the classroom because they see the importance (Cuban, 1986; Cuban, 2001). Yet, the existing problem lies in the lack of teacher education and professional development focusing on technology and its application in learning (Johnson, et al., 2010).

Raven and Welton (1989) found SBAE teachers did not integrate computers into their classroom due to a lack of computer related in-service and computer-based curriculum (Raven &

Welton, 1989). Similarly, Dormody and Torres (2002) studied graduates of the agricultural education program at New Mexico State University in relation to their growth, since graduation, in 28, predetermined teacher competencies. 'Using computer technology in the classroom' was the lowest ranked competency, making it the highest priority in-service professional development need (Dormody &Torres, 2002).

Camp and Sutphin (1991) looked into the needs of SBAE teachers in integrating and implementing educational technology into SBAE. Upon analysis, the realization was "too few computing and computer-related curriculum materials and guidelines are available for agriculture teachers" (Camp & Sutphin, 1991, p. 43). Participants reported curriculum, including educational technology in SBAE, is needed and it should address applications, benefits, uses, and types of educational technology available and related to agriculture (Camp & Sutphin, 1991). Further, these SBAE teachers all felt a need for assistance in planning curriculum that both instructs about and applies educational technology in the SBAE classroom (Camp & Sutphin, 1991).

Another study focused on educational technology professional development needs of SBAE teachers in Louisiana (Kotrlik, et al., 2000). These researchers found teachers held value in using educational technology but felt they did not have the knowledge to integrate the educational technology into their curriculum (Kotrlik, et al., 2000). Because of these thoughts and a lack of opportunities for educational technology specific professional development provided by universities, respondents shared they were forced to self-seek information and training on educational technology (Kotrlik, et al., 2000).

Hastings (2009) found teachers who completed moderate to high amounts of professional development specific to educational technology regularly used educational technology in their classroom. The study revealed teachers who received professional development focused on educational technology integration not only utilized technology more frequently but their students also more frequently used the technology (Hastings, 2009). “Technology-Related Professional Development is necessary not only because technology continues to advance in terms of hardware and software, but more importantly, to reinforce the concept of integrating technology” (Hastings, 2009, p. 135).

The most influential factor contributing to the inclusion of technology in the classroom is the teacher’s ability to use the technology (Burke, et al., 2018). Koehler and Mishra (2009) felt teachers have not been given adequate training for incorporating and using educational technology. Burke, et al. (2018) proposed teachers could be taught to accept and use the technology through professional development targeted toward teaching the technology and implementation techniques.

Through this review of literature, it is clear that simply handing out devices to students and teachers will not result in the effective use of educational technology among the students and teachers. It is also clear there is no definitive answer to the question what role teacher self-efficacy plays in educational technology use in the SBAE classroom. Furthermore, there is limited data available which was gathered from an agricultural education classroom; therefore, it is necessary to look deeper into the self-efficacy of SBAE teachers regarding their ability to integrate educational technology in their classrooms.

5.4. Conceptual Framework

How can teachers integrate educational technology into their teaching? While there is no best way to integrate educational technology into curriculum, in an effort to determine what teachers needed to know or did know about classroom technology integration, Technological Pedagogical Content Knowledge (TPACK) was introduced to the educational research field

(Mishra & Koehler, 2006). Implications for TPACK, as defined by Koehler and Mishra (2009), include the promotion of research in teacher education, teacher professional development, and teachers' use of technology, specifically, technology integration as an additional resource for students and teachers.

The TPACK framework is composed of the relationships between a teacher's technological knowledge, pedagogical knowledge, and content knowledge and each interworking overlap (Mishra & Koehler, 2006; Koehler & Mishra, 2009). These relationships and overlaps are categorized into seven components that create the TPACK framework: Technology Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK).

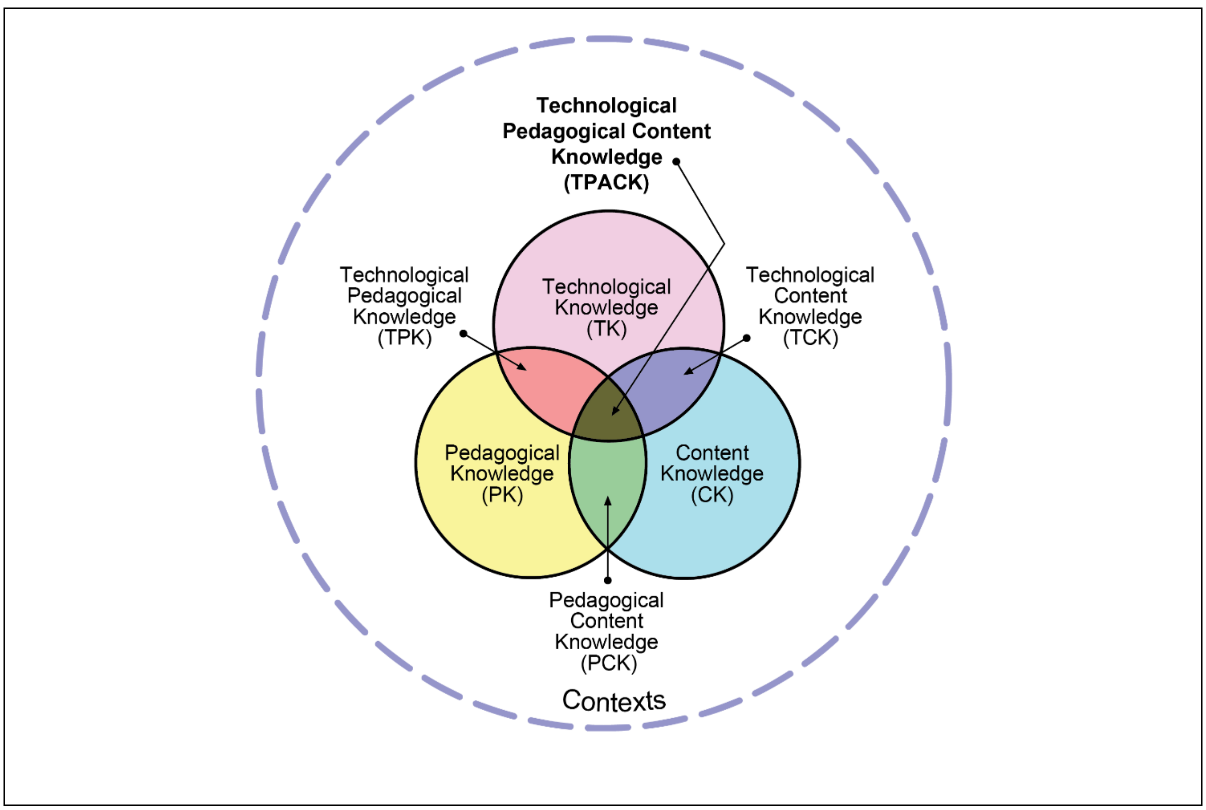

Figure 3. TPACK framework (graphic from http://tpack.org).

The model for the TPACK framework includes a circle for each of the three main components of technology, content and pedagogical knowledge situated to overlap, showing the relationships which exist between each of the main components (Figure 1). Due to its emphasis on technology-specific teacher self-efficacy and how such perceptions are formed, the TPACK framework and instrument will enable this researcher to gain insights into the target audiences' self-efficacy in relation to educational technology integration. When this information is collected and analyzed for this research study, it will reveal the driving factors behind the formation of SBAE teacher self-efficacy specific to educational technology integration.

A major influence for this theoretical framework is self-efficacy, specifically teacher self-efficacy. Bandura (1997) based his framework on self-efficacy, theorizing that humans need to feel they can produce desired effects through their actions, and if not, they will have little incentive to undertake activities or to persevere in the face of difficulties. Those with low self-efficacy often see challenging tasks as threats and thus avoid them, while people with high self-efficacy approach such tasks as a potential accomplishment to be mastered (Bandura, 1993).

Bandura's theory of self-efficacy can be applied to teachers as well, creating the idea of teacher self-efficacy in which a teacher must believe in their ability to create desired outcomes through their actions in order to face problems in teaching. Educators need to feel that they can accomplish tasks and create meaningful change through their actions. However, to alter teacher self-efficacy, one's beliefs and perceptions of their abilities must be changed which is a difficult task (Niederhauser & Perkman, 2008).

Knowing the important role teacher self-efficacy plays in a teacher's likelihood of using educational technology, it is important to gather as much data as possible on teacher perceptions of educational technology. Although the TPACK framework and instrument focuses on both educational technology integration and the formation of related teacher self-efficacy, specific information regarding the formation of teacher self-efficacy is needed. Because of this, the inclusion of a second survey, Intrapersonal Technology Integration Scale (ITIS), whose content focuses more on teacher self-efficacy formation, was included in the survey.

5.5. Purpose and Objectives

The purpose of this study is to determine the perceived teacher self-efficacy of pre-service seniors and in-service SBAE instructors regarding the integration of 1:1 educational technology. The following research objectives will guide this study:

1. Describe agricultural educators, programs, and access to educational technology in the selected states.
2. Describe professional development experiences related to educational technology for agricultural educators in the selected states.
3. Describe the influence of professional development on teacher self-efficacy.

5.6. Methods

5.6.1. Population

The target population for this study was in-service agricultural education instructors in North Dakota (*n* = 105), South Dakota (*n* = 100), Minnesota (*n* = 261), and Iowa (*n* = 286); and agricultural education pre-service teachers enrolled at South Dakota State University (*n* = 20), the University of Minnesota (*n* = 9), and Iowa State University (*n* = 27). The pre-service teachers at North Dakota State University were excluded from this study due to the relationship between the researcher and those agricultural education pre-service teachers. The population consisted of 752 (*n*) in-service teachers and 56 (*n*) pre-service teachers, creating a total population (*N*) of 808 agricultural educators.

5.6.2. Instrumentation

The survey instruments used for this research study were a combination of TPACK and Intrapersonal Technology Integration Scale (ITIS). Two forms of the instrument were created, a form for pre-service agricultural education teachers and a form for in-service agricultural education teachers. The TPACK instrument contains 46 items categorized in seven sections, three of which, Technological Content Knowledge, Technological Pedagogical Knowledge, and Pedagogical Content Knowledge were included in this research survey. The sections Technology Knowledge and Technology Pedagogy and Content Knowledge were excluded due to the overlap with ITIS. The Content Knowledge and Pedagogical Knowledge sections were omitted because items did not contribute to teacher self-efficacy related to educational technology integration.

The PCK section was altered in two ways; first, the format of items are a combination of five-point Likert scale and multiple choice where respondents ‘select all which apply’ and second, the items’ content area are the eight topic areas in SBAE, pulled from National AFNR Standards for SBAE. These changes improve clarity in the instrument for both the pre- and in-service agricultural education teachers. The TCK section was also altered by replacing the each item’s content area with the content areas in alignment with the National AFNR Standards for SBAE. Again, doing this improved correlation to agricultural education teachers and clarified the purpose of these statements.

The ITIS instrument was developed by Niederhauser and Perkmen in 2008 as a means to measure teacher self-efficacy in relation to technology integration (Niederhauser & Perkmen, 2008). The ITIS instrument uses a five-point Likert scale for 25 items which are divided into three main categories: self-efficacy, outcome expectations, and interest (Niederhauser & Perkmen, 2008). For this research, item number 23 in ITIS was excluded from the survey due to ambiguity of the intent of the question. Additionally, due to the split target audience of pre- and in-service teachers, the verb tense of some statements were changed for clarity reasons for the pre-service teacher survey.

Demographic items for the instruments align directly with the independent variables previously stated in this chapter. Items combined from demographic items, ITIS, and the sections of TCK, TPK, and PCK from the TPACK instrument create a total (N) of 36 items in the pre-service instrument and (N) 40 items in the in-service instrument.

5.6.3. Data Collection and Analysis

This descriptive relational study utilized agricultural teacher professional's responses to survey questions regarding their self-efficacy in relation to the implementation of educational technology. In-service teacher survey took place from April 25 – May 10, 2019. The survey was available via Qualtrics and distributed to the SBAE teachers in the selected states by a link included in the email asking for participation.

The present study used quantitative methods in the form of a survey utilizing closed ended questionnaire items and a Likert-scale matrix. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software version 24. Descriptive statistics were run to analyze independent and dependent variables, including means and standard deviations. Group means for objective three were analyzed using a one-factor between subjects ANOVA.

5.7. Findings

Objective one was to describe agricultural educators, programs, and access to educational technology in the selected states. From the selected states, 120 (*n*) teachers completed the survey from the available sample of 752 in-service teachers, and a total of 16 surveys were excluded from the results of the study due to incompletion or response set. Characteristics of the sample are found in Table 1. The distribution of gender for the sample favored female (63.5%, *n* = 66) over male (36.5%, *n* = 38) of those reported.

Table 10
In-Service Teacher Demographics

Variable	***n***	**%**
Gender		
Male	38	36.5
Female	66	63.5
Age Range		
20-25	14	13.5
26-30	23	22.1
31-40	29	27.9
41-50	20	19.2
51+	18	17.3
Highest Degree Completed		
Bachelor's	58	55.8
Master's	46	44.2
Path to Licensure		
Traditional Teacher Prep Program	90	86.5
Graduate Licensure (TLO or Great Plains IDEA)	4	3.8
Alternative Access	6	5.8
PRAXIS Test (or similar licensure test)	4	3.8
Years of Experience		
0	1	1
1-5	30	28.8
6-10	23	22.1
11-15	14	13.5
16-20	14	13.5
21+	22	21.2

Age range among the teachers varied and the largest group reporting was 31-40 years of age (27.9%, *n* = 29), corresponding with 11-20 years of experience teaching (27%, *n* = 28), assuming traditional licensure path. A large portion of in-service teachers completed their agricultural education degree in a traditional teacher preparation program (86.5%, *n* = 90). Although close, more respondents held a Bachelor's degree (55.8%, *n* = 58) than a Master's degree (44.2%, *n* = 46). The majority of responding in-service teachers reported an SBAE program size of 1-150 students (76%, *n* = 79).

Characteristics of SBAE program and high school size can be found in Table 2. Most SBAE programs average 51-100 students (40.4%, *n* = 42) while the next most common size program is 101-150 students (18.3%, *n* = 19), and a very close third most common being the smallest size program, 1-50 students (17.3%, *n* = 18). Number of students in a high school ranged from 40 to 2500 with the most common high school size being 100-200 students (20.2%, *n* = 21).

Table 11
School and Agricultural Education Program Demographics

Variable	***n***	**%**
Number of Students in Ag. Ed. Program		
1-50	18	17.3
51-100	42	40.4
101-150	19	18.3
151-200	5	4.8
201-250	4	3.8
251-300	9	8.7
301-350	2	1.9
351-400	2	1.9
401+	1	.96
Number of Students in High School		
>100	19	18.3
100-200	21	20.2
201-300	11	10.6
301-400	20	19.2
401-500	6	5.7
501-600	5	4.8
601-700	3	2.9
701-800	2	1.9
801-900	5	4.8
901-1000	3	2.9
1001-1500	3	2.9
1501-2000	3	2.9
2001-2500	2	1.9

Characteristics of access to educational technology and frequency of use can be found in Table 3. While 2.9 percent (n = 3) of in-service agricultural education teachers reported no access to devices for educational technology and only one (*n* = 1) teacher utilized BYOD in their classroom, a surprising 76 percent (*n* = 79) of in-service teachers reported being 1:1 in the classroom/ school. Of the 101 SBAE teachers utilizing devices for educational technology in their classroom, 47.1 percent (*n* = 49) are using the devices daily in instruction and 31.7 percent (*n* = 33) are using them at least three times a week.

Table 12
Technology Demographics

Variable	***n***	**%**
Access to Devices		
1:1	79	76
BYOD	1	0.96
COW (Computers On Wheels/mobile cabinet)	16	15.4
LMC (Library Media Center)	5	4.8
None	3	2.9
Frequency of Device Usage		
Daily	49	47.1
4 Classes a Week	6	5.8
3 Classes a Week	33	31.7
2 Classes a Week	12	11.5
1 Class a Week	4	3.8

Objective two was to describe professional development experiences related to educational technology for agricultural educators in the selected states. From the selected states, 120 (*n*) teachers completed the survey from the available sample of 752 in-service teachers, and a total of 16 surveys were excluded from the results of the study due to incompletion or response set. Characteristics of the sample are found in Table 4. Teachers were asked to report the number of hours of professional development they had engaged in the past five years. Teachers indicated a range of one to 50 hours of professional development related to educational technology with the mean (M) estimate over five years being 19.45 hours (SD = 14.92).

Table 13
Teacher Professional Development (PD)

Variable	***n***	**%**	
Where/How PD was obtained			
School Employer	90	86.5	
Professional Organization	72	69.2	
Other	23	22.1	
Most effective PD			
School Employer	36	34.6	
Professional Organization	48	46.2	
Other	17	16.3	
Technology Course in Undergrad or Grad			
Yes	41	39.4	
No	54	51.9	
Yes, in both degrees	9	8.7	

	n	**M**	**SD**	**Range**
Hours of PD in the past 5 years	102	19.45	14.92	1-50

When asked where the in-service teacher received their professional development related to educational technology, 86.5 percent (*n* = 90) selected from their school employer. An ‘other’ option was included for this item and teacher responses were categorized into nine groups. The most popular categories were College (*n* = 6), Workshops/ Conferences (*n* = 5), and Google/Apple trainings (*n* = 4). When asked why the professional development was effective, 54.6 percent of teachers’ (n = 48) responses related to an application to either the agricultural education classroom/ their curriculum or the school-issued device they utilized in their classroom. Other responses included things such as the professional development was current or relevant, involved collaboration with other teachers, and included some sort of hands-on or experiential learning component. The majority of respondents had not taken a technology in the classroom or related course in their undergraduate or graduate preparation (n = 54).

Objective three was to describe the influence of professional development on teacher self-efficacy and TPACK. Data was interpreted using an Analysis of Variance (ANOVA) model for hours of professional development in relation to both teacher self-efficacy (ITIS) and TPACK (PCK, TCK, and TPK). Results from objective three can be found in Table 5. A significant ANOVA model ($p < .05$) was rendered for self-efficacy of in-service SBAE teachers engaging in 11-20 and 21-50 hours of professional development related to educational technology ($p = .030$). A second significant ANOVA model was rendered for technological pedagogical knowledge of in-service SBAE teachers engaging in 1-10 and 21-50 hours of professional development ($p = .045$). No other TPACK variables for in-service teachers contributed significantly ($p < .05$) to the overall ANOVA model for hours of professional development related to educational technology. The significant difference came from those in-service teachers who had reported 21-50 hours of professional development.

Table 14
The Impact of Hours of PD on Teacher Self-Efficacy and TPACK

Variable	SS		df	MS	F	Sig. (P)
ITIS	Between Groups	1.994	2	.997	3.655	.030
	Within Groups	24.010	88	.273		
PCK	Between Groups	.058	2	.029	.065	.937
	Within Groups	44.140	98	.450		
TCK	Between Groups	1.772	2	.886	2.671	.074
	Within Groups	32.504	98	.332		
TPK	Between Groups	1.700	2	.850	3.203	.045
	Within Groups	24.952	94	.265		

5.8. Discussion/Recommendations/Conclusion

The majority of teachers completed their degree through traditional licensure and the largest portion of respondents were midcareer teachers. The average size of agricultural education program is between 50 and 100 students. Over three fourth of the responding teachers reported being 1:1 in their classroom or school. Of those teachers who are 1:1, nearly half use the device in daily instruction and a third are using them at least three times a week. These results indicate educational technology in the form of devices used for 1:1 are now commonplace in mid-western school-based agricultural education classroom. While it has been assumed that 1:1 has been introduced to most school systems (Herold, 2016), the data show that this is now fact and it is apparent that SBAE teachers are using these devices frequently, some religiously, in their classroom. It is imperative that a teacher is able to select, use, and troubleshoot educational technology best suited for their content area (Koehler & Mishra, 2009).

In their professional development experience in the past five years, teachers are participating in about 19 hours, which amounts to between four and five hours a year. Most of that professional development was attained from the school employer, indicating that school officials are seeing the importance in educating their teachers to use the devices they are implementing through 1:1. When given the opportunity for open answer regarding the effectiveness of the professional development, teachers supplied a myriad of responses which were categorized. Over half of respondents mentioned a connection to either their agriculture content, the specific school-issued device, or both. Other popular responses involved mention of opportunities for collaboration with other agricultural education teachers, a hands-on or experiential component, and information that was current or relevant to them or students.

The ANOVA model used the depend variables of TPK, TCK, PCK, and teacher self-efficacy. Technological Pedagogical Knowledge (TPK) is an understanding of how teaching and learning changes when educational technology is included (Koehler & Mishra, 2009). Technological Content Knowledge (TCK) is an understanding of how technology and subject content matter interact with one another (Koehler & Mishra, 2009). Pedagogical Content Knowledge (PCK) included the basics of teaching, learning, curriculum, assessment, and the interactions between them. Teacher self-efficacy is one's beliefs in their ability to establish and implement action to accomplish a task in teaching or a related task (Bandura, 1997).

We found that teachers participating in 11 to 20 and 21-50 hours of professional development specific to educational technology held a high teacher self-efficacy in teaching about and using educational technology. According to the ANOVA model findings, the more professional development specific to educational technology a teacher participates in, the more likely the teacher is to build self-efficacy in using educational technology in teaching. This is congruent with previous findings by Camp & Sutphin (1991), Kotrlik, et al. (2000), and DiBenedetto, et al. (2018) where teachers are more likely to incorporate educational technology when they are exposed to it through professional development. It was also determined through the ANOVA model that teachers participating in 1 to 10 and 21 to 50 hours of educational technology professional development were more confident in their abilities to teach using educational technology (TPK). This indicates the more educational technology professional development a teacher has, the more likely they are to build pedagogical strategies in using educational technology into their curriculum and teaching (Camp & Sutphin, 1991; Kotrlik, et al., 2000; DiBenedetto, et al., 2018).

Further, results show teachers were not more confident in their Technological Content Knowledge or Pedagogical Content Knowledge after participating in educational technology professional development. While it seems logical that professional development specific to educational technology did not strengthen teachers' understanding of agriculture content, there is something to be said about the lack of boost in TCK. Johnson, et al. (2010) determined the problem lies in a lack of professional development focusing on educational technology and its application in the classroom. Educational technology professional development should focus on information about the technology being shown and discussed along with how the technology can be used and integrated into the agriculture content (Koehler & Mishra, 2009; Burke, et al., 2018).

Findings conclude that professional development related to educational technology is in fact being offered to SBAE teachers and the teachers are participating in the professional development. However, the ANOVA model shows the professional development offered is not working to build teacher self-efficacy as teachers reported a moderate score for educational technology self-efficacy (Table 5). Based on open-end responses to survey items, SBAE teachers are being taught how to implement the device into their classroom, but they are missing instruction about the technology itself and how to apply it to the agriculture content they are teaching. Also lacking is a presence of educational technology education in preparatory coursework for agricultural education majors (Table 4). If exposed to educational technology and taught how to integrate as pre-service teachers, would these in-service teachers hold higher teacher self-efficacy in relation to educational technology?

Knowing that teacher self-efficacy plays a strong role in educational technology integration in the classroom, this study suggests that SBAE teacher self-efficacy is somewhat lacking in relation to educational technology. This implies that professional development related to educational technology use in the classroom should focus on the educational technology itself and how to integrate it into the agricultural education curriculum. To accomplish this, teacher education could include instruction on educational technology to expose pre-service teachers to educational technology in hand with curriculum writing. In a positive light, it is promising that pre-service teachers are being exposed to educational technology in their preparation (Table 4) as it was determined pre-service teachers exposed to technology in their cooperating student teaching site were more likely to implement technology into their future classrooms (Wang et al., 2004).

Future research could focus on a qualitative analysis of the in-service SBAE teacher self-efficacy in relation to educational technology. While this type of study would be smaller scale, the detailed, in-depth analysis could be the missing piece to answering the lingering questions regarding teacher self-efficacy on educational technology. A complete study would look at both quantitative and qualitative data in order to complete the field. A similar mixed methods longitudinal study of SBAE teachers' levels of professional development specific to educational technology integration could be helpful in identifying specific professional development experiences which educate teachers on both how and what to teach regarding educational technology in the agricultural education classroom. A complete study would look at both quantitative and qualitative data in order to better answer the remaining question: specifically, what should professional development regarding educational technology include in order to be effective in building teacher self-efficacy?

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APPENDIX A. IN-SERVICE TEACHER SURVEY

Start of Block: Default Question Block

The purpose of this study is to determine how educational technology integration influences teacher self-efficacy among agricultural education teachers in North Dakota, South Dakota, Minnesota, and Iowa.   If you choose to complete this survey, you will answer questions and respond to statements regarding your ability to use and comfort level with educational technology in your ag ed classroom. The survey will take you approximately 10-15 minutes to complete.   If you have questions about your rights, an unresolved question, a concern or complaint about this research you may contact the IRB office at 701.231.8995, toll-free at 855-800-6717 or via email (ndsu.irb@ndsu.edu).   The first question will ask if you consent to taking the survey. If yes, you will start the questionnaire immediately following, if no, thank you for your time and consideration.

You are freely making a decision to join this research study.   Answering 'yes' means you are an Agriculture Teacher and you agree to participate in the research study and you will be permitted to the first survey question.   Answering 'no' means you do not wish to participate in the survey and you will be prompted to the end of the survey.

○ Yes

○ No

Thank you for continuing! Let's do this!

What is your gender?

- ◯ Male
- ◯ Female
- ◯ Other

What is your age range?

- ◯ 20-25
- ◯ 26-30
- ◯ 31-40
- ◯ 41-50
- ◯ 51+

Including this year, how many years of agricultural education teaching experience do you have?

- ◯ 0
- ◯ 1-5
- ◯ 6-10
- ◯ 11-15
- ◯ 16-20
- ◯ 21+

In the past 5 years, how many hours of professional development related to teaching with technology have you participated in? (Slide the bar to indicate your approx. hours of PD)

0 50

Indicate Hours	

Where/ how did you obtain this professional development? (Select all which apply)

- ☐ School employer
- ☐ Professional organization
- ☐ Other

If 'other' from above, please describe:

____

Of those, which was the most effective/ beneficial professional development?

- ○ School employer
- ○ Professional organization
- ○ Other

Why do you feel it was the most effective for you?

____

Did you complete a teaching with technology (or related) course in your undergraduate or graduate degree coursework?

- ◯ Yes
- ◯ No
- ◯ Yes, in both degrees

You're off to a good start! Thank you!

What access to devices do you and students have in your school setting?

- ◯ 1:1 (students all assigned a device)
- ◯ Student BYOD (Bring Your Own Device)
- ◯ COW (Computers On Wheels/Mobile cabinet)
- ◯ Through Library/Media Center (LMC)
- ◯ None of the above

What is your highest degree completed?

- ◯ Associate's Degree
- ◯ Bachelor's Degree
- ◯ Master's Degree
- ◯ Doctorate

How did you qualify for/obtain your Ag Ed teaching license?

◯ Traditional Teacher Preparation Program

◯ Graduate Licensure (TLO or Great Plains IDEA)

◯ Alternative Access (including Emergency lic.)

◯ Minor Equivalency

◯ PRAXIS Test (or similar licensure test)

What is the number of students enrolled in your agricultural education program?

____

At your school, what is the average number of students enrolled in an agricultural education class?

____

What is the number of students in your high school?

____


YOU'RE MAKING A DIFFERENCE
KEEP GOING!
Social Work Tutor

School district educational technology values:

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
My school district values effective use of educational technology.	○	○	○	○	○
My school district dedicates resources toward current educational technology.	○	○	○	○	○
My school district provides teacher support for developing curriculum using technology.	○	○	○	○	○
My school district actively promotes the use of technological devices in my teaching.	○	○	○	○	○

In your typical class, how frequently do your students utilize a technological device as part of their learning?

○ Daily

○ 4 classes a week

○ 3 classes a week

○ 2 classes a week

○ 1 class a week

○ 0 classes a week

Technology is a broad concept and can be used to refer to many different things. For this survey, technology is referring to digital technology/technologies. That is, the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc.

Your responses to the following statements will demonstrate your level of Pedagogical Content Knowledge (PCK), or your familiarity with teaching approaches in hand with agricultural education content knowledge.
Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I can select effective teaching approaches to guide student thinking and learning across my curriculum.	○	○	○	○	○

I am MOST confident selecting effective teaching approaches to guide student thinking and learning in: (select all AFNR areas which apply)

- ☐ Agribusiness
- ☐ Animal Science
- ☐ Biotechnology
- ☐ Environmental Science
- ☐ Food Science
- ☐ Natural Resource Management
- ☐ Plant Science
- ☐ Agricultural Mechanics

I am LEAST confident selecting effective teaching approaches to guide student thinking and learning in: (select all AFNR areas which apply)

- ☐ Agribusiness
- ☐ Animal Science
- ☐ Biotechnology
- ☐ Environmental Science
- ☐ Food Science
- ☐ Natural Resource Management
- ☐ Plant Science
- ☐ Agricultural Mechanics

Remember, **technology is assumed to be the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc.**

Your responses to the following statements will provide your level of Technological Content Knowledge (TCK), or your ability to use technology when teaching agricultural education content.

Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I know about technologies I can use for understanding and teaching Agribusiness.	○	○	○	○	○
I know about technologies I can use for understanding and teaching Animal Science.	○	○	○	○	○
I know about technologies I can use for understanding and teaching Biotechnology.	○	○	○	○	○
I know about technologies I can use for understanding and teaching Environmental Science.	○	○	○	○	○
I know about technologies I can use for understanding and teaching Food Science.	○	○	○	○	○
I know about technologies I can use for understanding and teaching Natural Resource Management.	○	○	○	○	○

I know about technologies I can use for understanding and teaching Plant Science.	○	○	○	○	○
I know about technologies I can use for understanding and teaching Agricultural Mechanics.	○	○	○	○	○

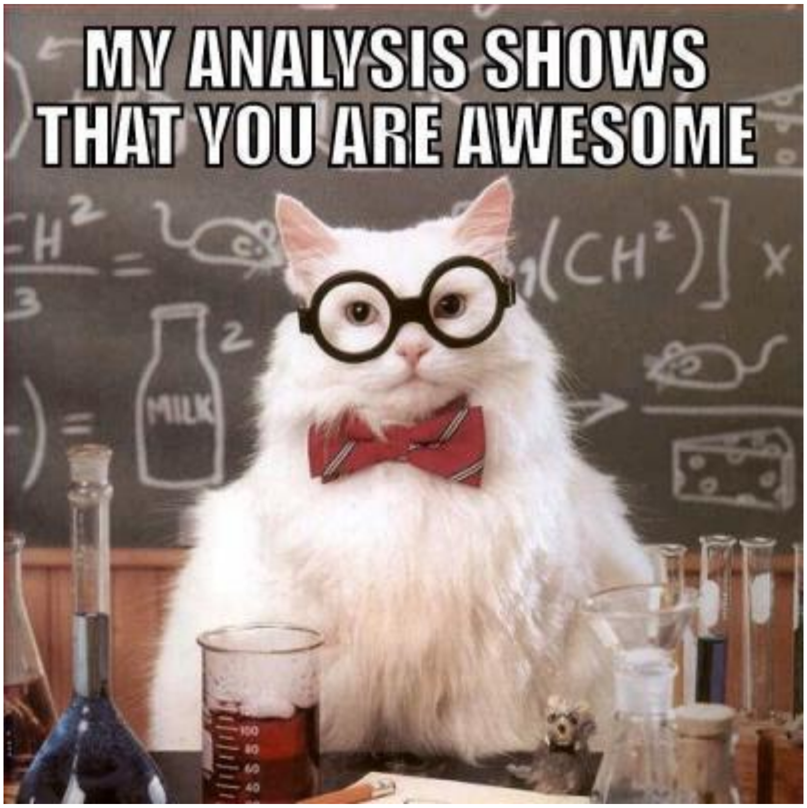
Remember, technology is assumed to be the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc.

Your responses to the following statements will demonstrate your level of Technological Pedagogical Knowledge (TPK), or your comfort level in using technology in hand with pedagogy.

Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I can choose technologies that enhance the teaching approaches for a lesson.	○	○	○	○	○
I can choose technologies that enhance students' learning for a lesson.	○	○	○	○	○
My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.	○	○	○	○	○
I am thinking critically about how to use technology in my classroom.	○	○	○	○	○
I can adapt the use of the technologies that I am learning about to different teaching activities.	○	○	○	○	○

I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.	○	○	○	○	○
I can use strategies which combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.	○	○	○	○	○
I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.	○	○	○	○	○
I can choose technologies that enhance the content for a lesson.	○	○	○	○	○



I think you are awesome for making it this far! Please keep going!

This section is designed to measure your beliefs about technology integration in your classroom.

Please remember, **technology is assumed to be the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc.**

Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I am confident that I have the necessary skills to use technology for instruction.	○	○	○	○	○
Using instructional technology in the classroom makes it easier for me to teach.	○	○	○	○	○
My teaching career uses instructional technology skills.	○	○	○	○	○
I have an interest in reading articles or books about instructional technology.	○	○	○	○	○
Using instructional technology in the classroom increases my effectiveness as a teacher.	○	○	○	○	○
I am interested in working with instructional technology tools.	○	○	○	○	○

Using instructional technology in the classroom makes my teaching more exciting.	○	○	○	○	○
I feel confident that I can effectively use instructional technology in my teaching.	○	○	○	○	○

This section is designed to measure your beliefs about technology integration in your classroom.

Remember, **technology is assumed to be the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc.**

Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Effectively using instructional technology in the classroom increases my sense of accomplishment.	○	○	○	○	○
I am fully committed to using instructional technology in my classroom.	○	○	○	○	○
Using instructional technology in the classroom makes my teaching more satisfying.	○	○	○	○	○
I can regularly incorporate appropriate instructional technologies into my lessons to enhance student learning.	○	○	○	○	○
Effectively using instructional technology in the classroom increases my colleagues' respect of my teaching ability.	○	○	○	○	○
I take as many instructional technology classes as possible.	○	○	○	○	○

My colleagues see me as competent effectively using instructional technology in the classroom.	○	○	○	○	○
I can select appropriate instructional technology for instruction based on standards-based pedagogy.	○	○	○	○	○

This section is designed to measure your beliefs about technology integration in your classroom.

Please remember, **technology is assumed to be the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc.**

Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I have an interest in working on a project involving instructional technology concepts.	○	○	○	○	○
Using instructional technology in the classroom increases my productivity.	○	○	○	○	○
I can teach relevant subject matter with appropriate use of instructional technology.	○	○	○	○	○
I am interested in learning about new educational software.	○	○	○	○	○
I can help students when they have difficulty with instructional technology.	○	○	○	○	○
I plan to increase my knowledge about technology integration.	○	○	○	○	○

Effectively using instructional technology in the classroom increases my status among my colleagues.	○	○	○	○	○
I have an interest in attending instructional technology workshops during my teaching career.	○	○	○	○	○

THANK YOU SO MUCH for completing the survey. I appreciate your time in answering all the questions and I look forward to analyzing the data. I hope you have a great rest of your day!

End of Block: Default Question Block

APPENDIX B. PRE-SERVICE TEACHER SURVEY

Start of Block: Default Question Block

NDSU AGRICULTURAL EDUCATION

The purpose of this study is to determine how educational technology integration influences teacher self-efficacy among agricultural education teachers in North Dakota, South Dakota, Minnesota, and Iowa. If you choose to complete this survey, you will answer questions and respond to statements regarding your ability to use and comfort level with educational technology in your ag ed classroom. The survey will take you approximately 10-15 minutes to complete. If you have questions about your rights, an unresolved question, a concern or complaint about this research you may contact the IRB office at 701.231.8995, toll-free at 855-800-6717 or via email (ndsu.irb@ndsu.edu). The first question will ask if you consent to taking the survey. If yes, let's get ready to rumble! If no, thank you for your time and consideration.

You are freely making a decision whether to be in this research study. Answering 'yes' means you agree to participate in the research study and you will be directed to the first survey question. Answering 'no' means you do not wish to participate in the survey and you will be prompted to the end of the survey.

○ Yes

○ No

Page Break

Thank you for continuing! Let's do this!

Page Break

What is your gender?

- ◯ Male
- ◯ Female
- ◯ Transgender
- ◯ Other
- ◯ Prefer not to answer

What is your age range?

- under 20
- 20-25
- 26-30
- 31-40
- 41-50
- 51+

Including this year, how many years of agricultural education classroom teaching experience do you have?

- 0
- 1-5
- 6-10
- 11-15
- 16-20
- 21+

In the past 5 years, how many hours of professional development related to teaching with technology have you participated in? (Use Slider below to indicate hours)

0 5 10 15 20 25 30 35 40 45 50

Indicate Hours	

Where/ how did you obtain this professional development? (Select all which apply)

- ◯ School employer
- ◯ Professional organization
- ◯ Other
- ◯ N/A

If 'other' from above, please describe:

____

Of the choices above, which was the most effective/ beneficial professional development?

- ◯ School employer
- ◯ Professional organization
- ◯ Other
- ◯ N/A

Why do you feel it was the most effective for you?

____

Page Break

You're off to a good start! Thank you!

Did you complete a teaching with technology (or related) course in your undergraduate or graduate degree coursework?

◯ Yes

◯ No

◯ Yes, in both degrees

In your current placement/ student teaching site, what access to devices do you and students have?

◯ 1:1 (students all assigned a device)

◯ BYOD (Bring Your Own Device)

◯ COW (Computers On Wheels/Mobile cabinet)

◯ Through Library/Media Center (LMC)

◯ None of the above

What is your highest degree completed (nearly complete)?

◯ Associate's Degree

◯ Bachelor's Degree

◯ Master's Degree

◯ Doctorate

What is your licensure status?

- ○ Traditional Teacher Preparation
- ○ Graduate Licensure (TLO or Great Plains IDEA)
- ○ Alternative Access (incl Emergency lic)
- ○ Minor Equivalency
- ○ PRAXIS Test

In your teaching experiences, how frequently do your students utilize a technological device as part of their learning?

- ○ Daily
- ○ 4 classes a week
- ○ 3 classes a week
- ○ 2 classes a week
- ○ 1 class a week
- ○ 0 classes a week

Page Break

You've made it this far, you're doing great!

Page Break

Your responses to the following statements will demonstrate your level of Pedagogical Content Knowledge (PCK), or your familiarity with pedagogy in hand with agricultural education content knowledge.
Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I can select effective teaching approaches to guide student thinking and learning across my curriculum.	○	○	○	○	○

I am MOST confident selecting effective teaching approaches to guide student thinking and learning in: (select all AFNR areas which apply)

- ☐ Agribusiness
- ☐ Animal Science
- ☐ Biotechnology
- ☐ Environmental Science
- ☐ Food Science
- ☐ Natural Resource Management
- ☐ Plant Science
- ☐ Agricultural Mechanics

I am LEAST confident selecting effective teaching approaches to guide student thinking and learning in: (select all AFNR areas which apply)

- ☐ Agribusiness
- ☐ Animal Science
- ☐ Biotechnology
- ☐ Environmental Science
- ☐ Food Science
- ☐ Natural Resource Management
- ☐ Plant Science
- ☐ Agricultural Mechanics

For this survey, **technology is assumed to be the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc.**

Your responses to the following statements will provide your level of Technological Content Knowledge (TCK), or your ability to use technology when teaching agricultural education content.

Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I know about technologies that I can use for understanding and teaching Agribusiness.	○	○	○	○	○
I know about technologies that I can use for understanding and teaching Animal Science.	○	○	○	○	○
I know about technologies that I can use for understanding and teaching Biotechnology.	○	○	○	○	○
I know about technologies that I can use for understanding and teaching Environmental Science.	○	○	○	○	○
I know about technologies that I can use for understanding and teaching Food Science.	○	○	○	○	○

I know about technologies that I can use for understanding and teaching Natural Resource Management.	○	○	○	○	○
I know about technologies that I can use for understanding and teaching Plant Science.	○	○	○	○	○
I know about technologies that I can use for understanding and teaching Agricultural Mechanics.	○	○	○	○	○

Page Break

Page Break

Remember, technology is assumed to be the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc.

Your responses to the following statements will demonstrate your level of Technological Pedagogical Knowledge (TPK), or your comfort level in using technology in hand with pedagogy.

Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I can choose technologies that enhance the teaching approaches for a lesson.	○	○	○	○	○
I can choose technologies that enhance students' learning for a lesson.	○	○	○	○	○
My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.	○	○	○	○	○
I am thinking critically about how to use technology in my classroom.	○	○	○	○	○
I can adapt the use of the technologies that I am learning about to different teaching activities.	○	○	○	○	○

I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.	○	○	○	○	○
I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.	○	○	○	○	○
I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.	○	○	○	○	○
I can choose technologies that enhance the content for a lesson.	○	○	○	○	○

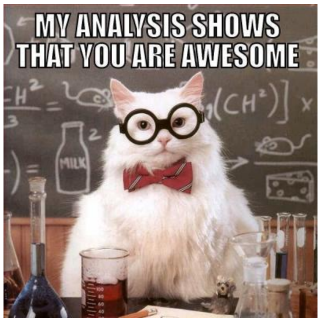
This section is designed to measure your beliefs about technology integration in your classroom.

Remember, technology is assumed to be the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc.

Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I am confident that I have the necessary skills to use technology for instruction.	○	○	○	○	○
Using instructional technology in the classroom will make it easier for me to teach.	○	○	○	○	○
My teaching career will use instructional technology skills.	○	○	○	○	○
I have an interest in reading articles or books about instructional technology.	○	○	○	○	○
Using instructional technology in the classroom will increase my effectiveness as a teacher.	○	○	○	○	○
I am interested in working with instructional technology tools.	○	○	○	○	○

Using instructional technology in the classroom will make my teaching more exciting.	○	○	○	○	○
I feel confident that I can effectively use instructional technology in my teaching.	○	○	○	○	○



My data analysis shows you are doing great, keep it up!

This section is designed to measure your beliefs about technology integration in your classroom.

Remember, technology is assumed to be the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc.

Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Effectively using instructional technology in the classroom will increase my sense of accomplishment.	○	○	○	○	○
I am fully committed to using instructional technology in my future classroom.	○	○	○	○	○
Using instructional technology in the classroom will make my teaching more satisfying.	○	○	○	○	○
I can regularly incorporate appropriate instructional technologies into my lessons to enhance student learning.	○	○	○	○	○
Effectively using instructional technology in the classroom will increase my colleagues' respect of my teaching ability.	○	○	○	○	○
I plan to take as many instructional technology classes as possible.	○	○	○	○	○

My colleagues will see me as competent if I effectively use instructional technology in the classroom.	○	○	○	○	○
I can select appropriate instructional technology for instruction based on curriculum standards-based pedagogy.	○	○	○	○	○

Page Break

This section is designed to measure your beliefs about technology integration in your classroom. Remember, technology is assumed to be the digital tools we use such as computers, laptops, tablets, cell phones, interactive whiteboards, educational software programs, digital cameras, etc. Please answer all the questions to the best of your ability and if you are uncertain of or neutral about your response, you may choose "Neither agree nor disagree"	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

I have an interest in working on a project involving instructional technology concepts.	○	○	○	○	○
Using instructional technology in the classroom increases my productivity.	○	○	○	○	○
I can teach relevant subject matter with appropriate use of instructional technology.	○	○	○	○	○
I am interested in learning about new educational software.	○	○	○	○	○
I can help students when they have difficulty with instructional technology.	○	○	○	○	○
I plan to increase my knowledge about technology integration.	○	○	○	○	○

Effectively using instructional technology in the classroom increases my status among my colleagues.	◯	◯	◯	◯	◯
I have an interest in attending instructional technology workshops during my teaching career.	◯	◯	◯	◯	◯

Page Break

THANK YOU SO MUCH for completing the survey. I appreciate your time in answering all the questions and I look forward to analyzing the data. I hope you have a great rest of your day!

End of Block: Default Question Block

APPENDIX C. IN-SERVICE TEACHER E-MAIL TO PARTICIPATE

Dear **[STATE]** Ag Teacher,

Classroom technology can be amazing and frustrating at the same time...we would like to learn of your experiences. Hello! I am a graduate student at North Dakota State University pursuing my Master's degree in Agricultural Education. I am conducting research on the use of educational technology by agricultural education pre-service and in-service teachers in North Dakota, South Dakota, Minnesota, and Iowa. I invite you to participate in a 10-15-minute survey that will ask you to provide responses regarding your experiences and preparedness to use educational technology in the agricultural education classroom.

What's in it for you?

Benefits of this study include determining how to improve teaching in the Ag Ed classroom with educational technology (such as using computers, tablets, etc.). Also, we will create information for better teacher professional development focused on educational technology.

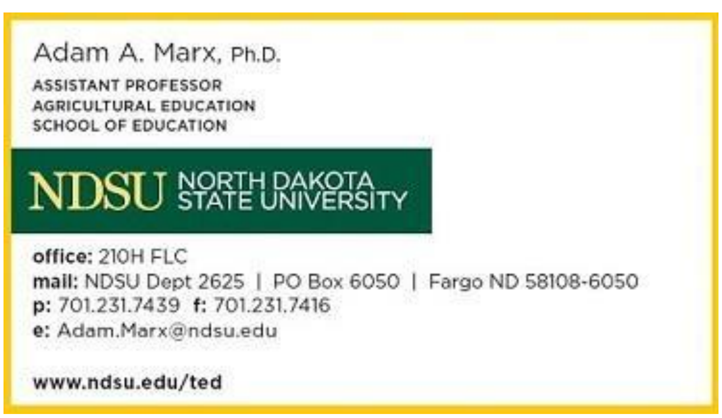
We want to constantly improve your abilities as a teacher! Your participation in this research is your choice; you may change your mind and stop participating at any time and your responses are completely anonymous. If you have questions about your rights or a concern about this research, you may contact the IRB office at 701.231.8995, toll-free at 855-800-6717 or via email (ndsu.irb@ndsu.edu). Please see the attached consent form for more information. You may also contact me, Macey, at macey.kleinjan@ndsu.edu; or my advisor Dr. Adam Marx, adam.marx@ndsu.edu.

If you would like to participate in this research, please click here to begin the 10-15-minute anonymous survey, or please find the link to the anonymous survey below. Please complete the survey before May 2, 2019.

Survey Link: https://ndstate.co1.qualtrics.com/jfe/form/SV_brRo1OUQjjCXhU9

Thank you for your time and consideration to participate in this study!

Macey Kleinjan
North Dakota State University
Graduate Teaching Assistant/Agricultural Education
Master's Student/School of Education



APPENDIX D. PRE-SERVICE TEACHER E-MAIL TO PARTICIPATE

Dear Agricultural Education Students,

Classroom technology can be amazing and frustrating at the same time...we would like to learn of your experiences. Hello! I am a graduate student at North Dakota State University pursuing my Master's degree in Agricultural Education. I am conducting research on the use of educational technology by agricultural education pre-service and in-service teachers in North Dakota, South Dakota, Minnesota, and Iowa. I invite you to participate in a 10-15-minute survey that will ask you to provide responses regarding your experiences and preparedness to use educational technology in the agricultural education classroom.

What's in it for you?

Benefits of this study include determining how to improve teaching in the Ag Ed classroom with educational technology (such as using computers, tablets, etc.). Also, we will create information for better teacher professional development focused on educational technology.

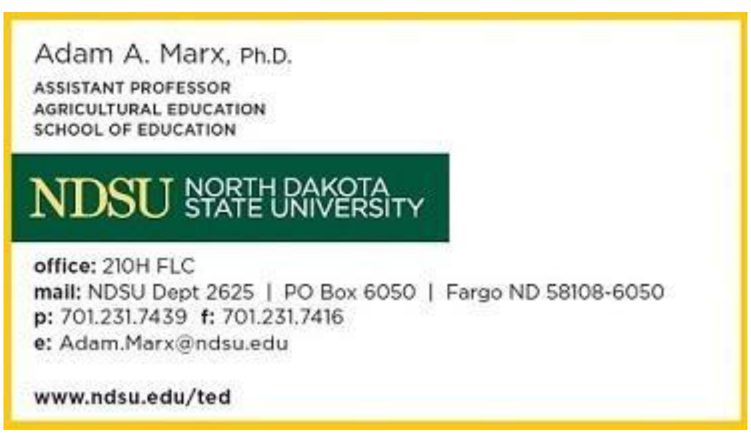
We want to constantly improve your abilities as a teacher! That said, your participation in this research is voluntary; you may change your mind and stop participating at any time. Your responses are completely anonymous. If you have questions about your rights or a concern about this research, you may contact the NDSU IRB office at 701.231.8995, toll-free at 855-800-6717 or via email (ndsu.irb@ndsu.edu). You may also contact me, Macey, at macey.kleinjan@ndsu.edu; or my advisor Dr. Adam Marx, adam.marx@ndsu.edu.

To participate in this research, please click here to begin the 10-15-minute anonymous survey, or please find the link to the anonymous survey below. Please complete the survey before May 2, 2019.

Survey Link: https://ndstate.co1.qualtrics.com/jfe/form/SV_cFSt762ato1Z6Kx

Thank you for your time and consideration to participate in this study!

Macey Kleinjan
North Dakota State University
Graduate Teaching Assistant/Agricultural Education
Master's Student/School of Education



APPENDIX E. INTERNAL REVIEW BOARD APPROVAL

NDSU NORTH DAKOTA STATE UNIVERSITY

April 16, 2019

Dr. Adam Marx
School of Education

Re: IRB Determination of Exempt Human Subjects Research:
Protocol #HE19228, "The Impact of Educational Technology Integration on School-Based Agricultural Education Teacher Self-Efficacy"

Co-investigator(s) and research team: Macey Kleinjan
Date of Exempt Determination: 4/16/2019 Expiration Date: 4/15/2022
Study site(s): online
Sponsor: n/a

The above referenced human subjects research project has been determined exempt (category #2(i)) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, Protection of Human Subjects). This determination is based on the original protocol submission (received 4/9/2019).

Please also note the following:

- If you wish to continue the research after the expiration, submit a request for recertification several weeks prior to the expiration.
- The study must be conducted as described in the approved protocol. Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
- Notify the IRB promptly of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
- Report any significant new findings that may affect the risks and benefits to the participants and the IRB.

Research records may be subject to a random or directed audit at any time to verify compliance with IRB standard operating procedures.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.
Sincerely,

Kristy Shirley, CIP, Research Compliance Administrator

For more information regarding IRB Office submissions and guidelines, please consult http://www.ndsu.edu/research/integrity_compliance/irb/. This institution has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

INSTITUTIONAL REVIEW BOARD
NDSU Dept 4000 | PO Box 6050 | Fargo ND 58108-6050 | 701.231.8995 | Fax 701.231.8098 | ndsu.edu/irb

Shipping address: Research 1, 1735 NDSU Research Park Drive, Fargo ND 58102

NDSU is an EO/AA university.