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Technology Usage of Tennessee Agriculture Teachers

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Abstract

This study examined the accessibility and use of instructional technologies by agriculture teachers in Tennessee. Data were collected using a survey instrument to investigate teachers' adoption of technology, sources of acquired technology skills, accessibility and use of technological equipment, and barriers to technology integration. The study found Tennessee agriculture teachers have been slow to adopt technologies for classroom use. Many of the teachers had limited access to the various technologies. Over half of the teachers did not have access to new educational technologies such as a Smartboard, student response clickers, iPads, iPods, or smartphones. Additionally, there was limited access to most social networks, several web tools, a commercial learning management system, and social bookmarking sites. Cost, time, and availability of technology were recognized as barriers to technology integration. It is recommended further research be conducted on a larger scale to examine technology integration in agriculture classrooms. As well, classroom observations and interviews with teachers and administrators can provide a more in-depth understanding of current technology usage in agricultural education.

Keywords: technology, agricultural education, teachers

Technological advancements in society are largely the result of the ability of education systems to teach students how to think critically and solve problems related to technology. When A Nation at Risk was released in 1983, the report recommended computer science be included as a requirement for high school graduation in addition to English, mathematics, science, and social studies (National Commission on Excellence in Education, 1983). Since then, numerous reports have reinforced the need for technology integration in K – 12 settings. Culp, Honey, and Mandinach (2005) examined 28 policy reports published over a twenty-year period (1983 – 2003) that were influential in the area of educational technology. The analysis reinforced the need for an investment in educational technology to prepare students for a dynamic and global workforce. The use of technology was recognized as a way to address a variety of challenges in teaching and learning such as making education more accessible to remote audiences, enhancing the scope and timeliness of content resources, and expanding opportunities for writing and communication. Technology was also considered to be a change agent in promoting a constructivist and inquiry-oriented classroom environment (Culp, Honey, & Mandinach, 2005).

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Schools have made substantial progress in the use of technology to support student learning in core academic areas and the development of students' skills as communicators and researchers (Culp, Honey, & Mandianch, 2005). However, educational policy continues to call for the production of a technologically literate student population. In November 2010, the United States Department of Education published the National Educational Technology Plan 2010. The plan recognized the critical nature of technology stating, "technology is at the core of virtually every aspect of our daily lives and work, and we must leverage it to provide engaging and powerful learning experiences and content" (U.S. Department of Education, 2010, p. 7). Saaevedra and Opfer (2012) also emphasized the potential of technology to encourage problem solving, critical thinking, and communication skills in today's learners.

With a recognized need for 21st century skills in the classroom (Assessment and Teaching of 21st Century Skills, 2012), several groups have developed standards and frameworks to help promote technology integration. The International Society for Technology in Education (2000) released the National Educational Technology Standards for Teachers (NETS·T), identifying specific technological skills and knowledge necessary for teachers to be successful in an evolving educational environment. In 2008, these standards were updated to encompass a more global perspective (International Society for Technology in Education, 2008). There are five broad categories in the technology standards including: Facilitate and Inspire Student Learning and Creativity, Design and Develop Digital-Age Learning Experiences and Assessments, Model Digital-Age Work and Learning, Promote and Model Digital Citizenship and Responsibility, and Engage in Professional Growth and Leadership (International Society for Technology in Education, 2008).

Additional reports have focused on the impact of technology on K-12 education. The NMC Horizon Report is an annual publication identifying emerging technologies and their "potential impact on and use in teaching, learning, and creative inquiry in schools." (Johnson, Adams Becker, Estrada, & Freeman, 2014, p. 1). The report discussed six key developments in technology that will have a potential impact on K-12 education over the next five years. Of the six technologies, two of the technologies predicted to make the most immediate impact included Bring Your Own Device (BYOD) and Cloud Computing. The incorporation of a BYOD philosophy allows for personalized and meaningful learning as students have the opportunity to select the appropriate technology tools to demonstrate their mastery of the content (Johnson et al., 2014).

Technology is also an important focus for preservice teachers. The Council for the Accreditation of Educator Preparation (CAEP) identified three broad standards, indicating skills teacher candidates should be able to demonstrate in the classroom. One of the indicators specifies preservice teachers should have the ability to utilize technology to enhance instruction, contribute to classroom management, and assess student learning (Council for Accreditation of Educator Preparation, 2010).

The conceptual framework informing this study was derived from research on the factors affecting technology integration in K-12 classrooms (Inan & Lowther, 2010). Based on the literature, a path model was developed to explain a hypothesized causal relationships between various factors and technology integration in the classroom. The variables included in the model are age, years of teaching, computer proficiency, computer availability, teachers' beliefs, teachers' readiness, overall support, technical support, and technology integration (see Figure 1).

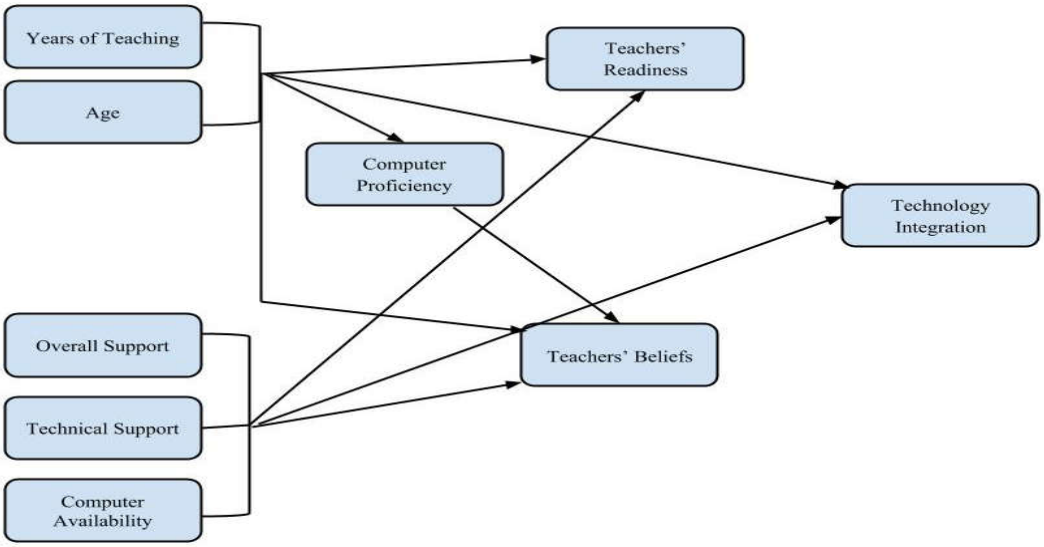

Figure 1. Hypothesized Path Model (Inan & Lowther, 2010)

In the path model proposed by Inan and Lowther (2010), there are several sources of support deemed important in technology integration. The model recognizes overall support which is defined as "teachers' perception of support from administration, peers, parents and community" (p. 141) and technical support which is "teachers' perception of adequacy of technical support, availability of resources, and assistance with computer software and troubleshooting" (p. 141). Hadley and Sheingold (1993) found teachers who were motivated to use technology received a substantial amount of support from a variety of sources – other teachers, school-wide and district-wide technology coordinators, and other educational entities. When examining the unique characteristics found in the school environments of exemplary computer-using teachers, Becker (1994) acknowledged a mutual commitment to technology integration among teachers, relevant and diverse professional development offerings, smaller class sizes, and easy access to computers with time allotted for personal use.

In 2009, a national study was conducted to assess public school teachers' access to and use of educational technology. Ninety-seven percent of public school teachers reported having at least one computer in their classrooms with Internet access available for 93% of classroom computers. Teachers or students used the classroom computers for instructional purposes on a frequent (40%) or occasional basis (29%). Eighty-four percent of teachers had a computer projector available for use, while 51% had access to an interactive whiteboard, and 78% could utilize digital cameras in their classrooms. Teachers used technology software most commonly for word processing, accessing the Internet, entering grades, and maintaining attendance records (Gray, Thomas, & Lewis, 2010).

Kotrlik, Redmann, and Douglas (2003) examined the degree of technology integration in agriculture programs in Louisiana. As part of this research, teachers indicated the types of technology available to support instruction. The most commonly available technology was teacher email accounts (73%, n = 84) and approximately 40% (n = 45) used interactive CDs. When teachers were asked to identify the sources of their technology training, 86% (n = 99) noted participation in workshops or conferences and 73% were self-taught. Other training sources included colleagues and college courses. These findings were similar to a later study by Redmann and Kotrlik (2004), which examined technology use by career and technical education (CTE) teachers in Louisiana. However, a more recent study of Louisiana CTE teachers found 92% (n =

496) acquired technology skills through self-taught means of learning (Kotrlik & Redmann, 2009).

Literature has also suggested teachers' pedagogical beliefs have a profound impact on their use of technology in the classroom (Ertmer, 2005). Ertmer, Gopalakrishnan, and Ross (2000) examined the pedagogical beliefs and classroom practices of exemplary technology-using teachers. Most of the participants articulated a personal teaching philosophy aligning with a constructivist viewpoint. A nationwide survey of teachers with experience in technology integration concluded teachers' motivation and commitment to student learning influenced their efforts to utilize technology in their teaching (Hadley & Sheingold, 1993).

Obstacles to technology integration exist in many different forms. Brickner (1995) identified two main orders of barriers commonly described as reasons why teachers struggle to use technology effectively. First order barriers focus on what teachers are lacking in terms of equipment, access to materials, inadequate technical support, and insufficient planning time. Second order barriers focus on teachers' intrinsic beliefs about teaching, technology, classroom practices, and attitudes toward change. Ertmer (1999) found similar internal and external barriers impeding technology integration. Additional barriers cited by Ertmer (1999) included funding and personal fear of technology.

In a 2002 study conducted by Demetriadis et al., the most commonly cited obstacles to the integration of technology in education were insufficient materials, difficulty integrating materials into the curriculum, and lack of sufficient technical staff. Johnson (2009) found another barrier was general lack of knowledge about technology tools and how to use those tools to achieve higher-level learning and critical thinking within the classroom. It is not enough to have technology available for teachers to use; teachers must also be capable of using the technology effectively and willing to implement technology in their teaching practices.

Similar studies regarding barriers to technology integration in agricultural education have indicated teachers are using technology but not to the fullest potential. This is despite the fact technology is more readily accessible and being used more often in today's classroom (Kotrlik & Redmann, 2009). Ito et al. (2008) emphasized how common social networks, video-sharing sites, online games, and technological gadgets are in the everyday lives of students. With the ease of access to these new technologies and frequency of use by students, teachers have the opportunity to enhance learning through the incorporation of digital media. There has been little research on how agricultural education teachers are using a combination of current technology including social media, web tools, and software. According to the National Research Agenda for Agricultural Education, there is a critical need to promote meaningful and engaged learning in a multitude of environments (Doerfert, 2011). Therefore, this study is an attempt to better understand agriculture teachers' access to and use of technology practices. Such knowledge can help contribute to effective learning environments, informing both preservice teacher preparation and professional development for inservice teachers.

Purpose and Objectives

Prior research in agricultural education has examined technology available for use in teaching, sources of technology training, and barriers to technology integration. However, with rapid changes in educational technology, there is a need to update previous research. The purpose of this study was to examine the accessibility and use of instructional technologies by agricultural educators in Tennessee. The study addressed the following objectives:

1. To describe Tennessee agriculture teachers' perceived level of instructional technology adoption.
2. To describe the extent by which Tennessee agriculture teachers acquired technology skills from various sources.

3. To describe the access to and frequency of use of teacher-based technologies by Tennessee agriculture teachers.
4. To describe Tennessee agriculture teachers' access to and frequency of use of student-based technologies.
5. To describe Tennessee agriculture teachers' access to and use of school-wide technologies.
6. To describe Tennessee agriculture teachers' access to and frequency of use of social networks for instruction.
7. To identify Tennessee agriculture teachers' access to and frequency of use of various web services for instruction.
8. To describe Tennessee agriculture teachers' use of software programs for instruction.
9. To describe the barriers to technology integration in Tennessee agriculture programs.

Methods and Procedures

This descriptive study utilized survey research methodology to examine Tennessee agriculture teachers' acquisition of technological skills and their accessibility to and use of various technologies in classroom instruction and program management. The population for this study consisted of all Tennessee agricultural educators teaching during the 2011-2012 school year (N = 315). The population was determined using the 2011-2012 Tennessee Agriculture Teachers Directory provided by the State Agricultural Education Program Consultant. One teacher opted out of the survey and two teachers had undeliverable email addresses, so the accessible population was N = 312.

The researcher-developed survey instrument included two questions adapted from previous research and survey instruments used by Kotrlik and Redmann (2009), Kotrlik, Redmann, and Douglas (2003), and Redmann and Kotrlik (2004). The first part of the survey instrument included 17 questions related to teachers' adoption of technology, sources of acquired technology skills, accessibility and use of technological equipment, and barriers to technology integration. The second part of the survey instrument was made up of eight demographic questions including gender, age, years of teaching experience, length of teaching contract, number of teachers in agriculture program, and teaching region. Content validity was assessed using an expert panel composed of agriculture teachers and university faculty members. A pilot study was conducted using 23 agriculture teachers in another state. Minor modifications were made to the survey instrument at the conclusion of the pilot study. Since the items on the survey instrument were considered to be mutually exclusive, internal consistency was not an appropriate measure of instrument reliability in this particular study.

SurveyMonkey™, an Intenet-based survey instrument system, was used to send a pre-notice email message to all teachers, informing them of the study and soliciting their assistance. Four days later, each teacher received another email message containing a link to the informed consent and survey instrument. Three reminder email messages were sent out over the course of 15 days. Each reminder included an email message explaining the research study and a link to the informed consent and survey instrument. One hundred fifty seven teachers completed the survey instrument for a response rate of 50.2%. In an effort to control for non-response error, there was a comparison of early to late respondents (Miller & Smith, 1983) and no significant differences were found.

Results and Findings

The population of Tennessee agriculture teachers was comprised of 71% male teachers (n = 104) and 29% female teachers (n = 42). The average agriculture teacher was approximately 41 years old and had been teaching for 13 years. Most of the teachers had 12-month teaching contracts (n = 119, 79.9%), while 11 teachers had 11-month contracts (7.4%) and 18 teachers had 10-month contracts (12.1%). Teachers were representative of all three regions in Tennessee.

There were 66 teachers from the Middle Region (44.3%), with 52 from the East Region (34.9%) and 31 from the West Region (20.8%). There was considerable variation in the number of agriculture teachers per program. Fifty-eight of the teachers taught in a two-teacher program (39.0%), 46 taught in a one-teacher program (30.9%), 22 taught in a three-teacher program (14.8%), 15 taught in a four-teacher program (10.1%), and 8 taught in a program with five or more teachers (5.4%). When comparing the respondents to the demographics of the population, it was concluded that respondents effectively represented the population.

The first objective of this study was to determine Tennessee agriculture teachers' perceived level of technology adoption. Almost half (49.7%) of the teachers allowed others to try out new technologies before adopting them in their own classrooms. Sixty-six of the teachers (42.6%) considered themselves to be among the first to adopt new instructional technologies while six teachers (3.9%) were very innovative in creating their own technological resources. Six teachers (3.9%) were reluctant to adopt any new instructional technologies (See Table 1).

Table 1

Teachers' Perceived Level of Instructional Technology Adoption

Adopter Category	N	%
You create your own technology resources before anyone else	6	3.9%
You are among the first to adopt new technologies as they come available	66	42.6%
You let others test new technologies before you adopt them	77	49.7%
You rarely adopt new technologies	6	3.9%

The second objective was to describe the extent by which Tennessee teachers acquired technology skills from various sources. Possible sources were generated by the researchers and adapted from studies by Kotrlik and Redmann (2009) and Redmann and Kotrlik (2004). Teachers acquired skills to a moderate extent from personal trial and error (38.2%), interaction with other faculty and staff, independent learning, inservices and workshops, and from students. Approximately 49% of the teachers (n = 77) reported personal trial and error was the source they used to acquire technology skills entirely or to a great extent. Undergraduate coursework only contributed to a small extent (39.0%) and distance-learning courses provided the most minimal contribution to the acquisition of technology skills. Fifty-two percent of the teachers (n = 88) indicated they did not receive any technology skills from distance learning courses. Table 2 lists the sources of teachers' technology acquisition.

Table 2

Sources of Teacher's Technology Acquisition

Source	N	M	SD
Personal trial and error	157	2.42	0.79
Interaction with other faculty/staff	155	2.23	0.79
Independent learning	155	2.08	0.88
In-services and workshops	157	1.93	0.82
From students	156	1.89	0.89
Undergraduate coursework	154	1.45	1.02
Distance learning courses	154	0.77	0.98

Note. 0 = not at all, 1 = small extent, 2 = moderate extent, 3 = great extent, 4 = entirely.

The third objective was to describe the access to and frequency of use of teacher-based technologies by Tennessee agriculture teachers. The most frequently used technology was the teacher desktop computer. Other technologies commonly used included digital projectors, teacher laptop computers, and cell phones. Technologies used only a few times a year included Smartboards or Promethean boards, video cameras, document cameras, and iPads or tablet computers. Audio technologies such as iPods and mp3 players, overhead transparency projectors, and student response clickers were rarely used by teachers. Teachers indicated limited access to several of the technologies. Over 60% of the respondents did not have access to an iPad or tablet computer (67%), an iPod/mp3 player (66%), or a student response system such as clickers (63%). Table 3 shows the various types of teacher-based technologies and frequency of use.

Table 3

Use of Teacher-based Technologies

Technology Type	N	M	SD
Teacher desktop computer	155	4.30	1.67
Digital projector	154	4.04	1.53
Teacher laptop	154	3.70	1.93
Cell phone	150	3.57	2.15
DVD player	152	2.96	1.29
Digital camera	152	2.92	1.33
VCR	151	2.07	1.53
Smartphone	154	2.05	2.40
Smartboard	154	1.48	2.11
Video camera	152	1.41	1.46
Document camera	153	1.26	1.73
iPad or tablet computer	154	1.10	1.91
iPod or mp3 player	151	0.80	1.53
Overhead transparency projector	154	0.79	1.33
Student response clickers	155	0.56	1.27

Note. 0 =have access but never use, 1 = use a few times a year, 2 = use a few times a semester, 3 = use monthly, 4 = use weekly, 5 = use daily.

Objective four was to determine Tennessee agriculture teachers' access to and use of various student-based technologies, or rather those technological tools that students own and use. Four of the five technologies were rarely used. Only one, a mobile computing cart was used a few times a year. Access was limited to several technologies. Approximately 74% (n = 110) of participants did not have access to iPods/mp3players and 72% (n = 107) of participants did not have access to iPads or tablet computers for student use in the classroom (see Table 4).

Table 4

Use of Student-based Technologies

Technology Type	N	M	SD
Mobile computing cart	153	1.16	1.50
1:1 computing program	149	0.89	1.46
Student cell phones	151	0.83	1.45
iPad or tablet computer	149	0.52	1.22
iPod or mp3 player	149	0.33	0.95

Note. 0 =have access but never use, 1 = use a few times a year, 2 = use a few times a semester, 3 = use monthly, 4 = use weekly, 5 = use daily.

Objective five was to identify how often Tennessee agriculture teachers used several different school-wide technologies. Participants reported frequent use of an Internet connection (4.65). Eighty-two percent (n = 125) of teachers used the Internet on a daily basis. While most participants had access to a desktop computer lab, library/media center, and a Technology specialist, they reported usage of only a few times a semester to a few times a year. Table 5 lists specific school-wide technologies and frequency of use.

Table 5

Use of School-wide Technologies

Technology Type	N	M	SD
Internet connection	152	4.65	0.88
Desktop computer lab	153	1.64	1.49
Library	153	1.54	1.10
Technology specialist	153	1.28	1.19

Note. 0 =have access but never use, 1 = use a few times a year, 2 = use a few times a semester, 3 = use monthly, 4 = use weekly, 5 = use daily.

Objective six described Tennessee teachers' use of social networks for instruction. As displayed in Table 6, social networks included on the survey instrument were Google Plus, FFA Nation, Facebook, Twitter, MySpace, and LinkedIn. Teachers had limited access to the various social networks; therefore the use in instruction was extremely limited. Only one social network, Google Plus, was used a few times a year.

Table 6

Use of Social Networks for Instruction

Technology Type	N	M	SD
Google Plus	150	0.95	1.69
FFA Nation	151	0.61	1.14
Facebook	150	0.43	1.21
Twitter	150	0.09	0.54
MySpace	150	0.01	0.82
LinkedIn	150	0.01	0.82

Note. 0 =have access but never use, 1 = use a few times a year, 2 = use a few times a semester, 3 = use monthly, 4 = use weekly, 5 = use daily.

Objective seven identified Tennessee agriculture teachers' access to and use of various web services for instruction. A personal teacher website/blog and a chapter website/blog were only used a few times a year, while photo sharing, learning management systems, and social bookmarking were rarely used. Over half of the teachers reported not having access to photo sharing programs such as Flickr or Picasa, learning management systems such as Blackboard or Moodle, or social bookmarking sites such as Diigo, Delicious, or Pinterest. Table 7 lists the web services used for instruction.

Table 7

Use of Web Services for Instruction

Technology Type	N	M	SD
Personal teacher website/blog	150	1.11	1.54
Chapter website/blog	148	1.05	1.47
Video sharing	150	0.81	1.39
Photo sharing	151	0.46	1.09
Learning management system	150	0.38	1.15
Social bookmarking	150	0.37	1.07

Note. 0 =have access but never use, 1 = use a few times a year, 2 = use a few times a semester, 3 = use monthly, 4 = use weekly, 5 = use daily.

Objective eight described the use of software programs for instruction in all three components of the agriculture classroom; instruction, FFA, and SAE. The most commonly used software programs included internet browsers such as Internet Explorer, Mozilla Firefox, or

Apple Safari, classroom management systems for attendance, grades, or other reporting, and word processing software such as Microsoft Word or Apple Pages. Seventy-three percent (n = 109) of teachers reported they used some type of classroom management software on a daily basis, while 65% (n = 98) used an internet browser daily. The least frequently used software programs were video creation and editing programs such as Windows MovieMaker or iMovie, design software such as Landscape PRO or CAD, video conferencing software such as Skype or FaceTime and website composers such as Dreamweaver or SeaMonkey. Sixty-two percent (n = 93) of teachers did not have access to a website composer and 56% (n = 84) did not have access to video conferencing software. Table 8 shows the frequency of use of various software programs for instructional purposes.

Table 8

Use of Software Programs for Instruction

Technology Type	N	M	SD
Internet browser	150	4.30	1.28
Classroom management system	150	4.14	1.66
Word processing	150	4.11	1.17
Presentation programs	150	3.93	1.34
Spreadsheets	151	3.40	1.43
Video or audio player	150	2.28	1.70
Photo editing	149	1.66	1.58
Video editing	148	0.87	1.23
Design software	150	0.77	1.21
Video conferencing	149	0.40	0.96
Website composer	150	0.31	0.76

Note. 0 =have access but never use, 1 = use a few times a year, 2 = use a few times a semester, 3 = use monthly, 4 = use weekly, 5 = use daily.

Objective nine identified the barriers to technology integration in Tennessee agriculture programs. The cost of implementing new technologies was identified as the greatest barrier to technology integration. Other factors that served as moderate barriers included time needed for the developed of technology-based lessons, time available for students to utilize technology, and availability of technology to accommodate all students. Students' levels of interest and current knowledge of technology were identified as minimal barriers to technology inclusion in the classroom. Other barriers identified by teachers included social media restrictions and web filtering software on school computers, students' lack of access to technology at home, and limited teacher knowledge of current technologies.

Table 9

Barriers to Technology Integration

Barrier	M	SD
Cost of implementing new technologies	2.22	0.92
Enough time to develop lessons that use technology	1.79	0.99
Scheduling enough time for students to use technology	1.73	0.90
Availability of technology for the number of students in my classes	1.66	0.98
Availability of effective instructional software for the courses I teach	1.49	0.90
Availability of technical support to effectively use instructional technology	1.43	0.98
My ability to integrate technology in the teaching/learning process	1.22	0.84
Administrative support for integration of technology in the teaching/learning process	0.95	0.86
Student knowledge of existing technology	0.75	0.78
Student interest in technology	0.53	0.69

Note. 0 = not a barrier, 1 = minor barrier, 2 = moderate barrier, 3 = major barrier.

Conclusion, Recommendations and Implications

With a preponderance of technology available for personal and professional use, it is easy to assume technology is being seamlessly integrated into the educational environment. Based on the results of this study, Tennessee agriculture teachers have been slow to adopt technologies for classroom use. Over half of the teachers within this study were either more likely to let others adopt technology before them or would rarely adopt new technology. Other studies have also found there is a certain level of anxiety that may influence early teacher technology adoption (Guerrero, Walker, & Dugdale, 2004; Redmann & Kotrlik, 2004).

Many of the teachers had limited access to the various technologies. Over half of the teachers did not have access to new educational technologies such as a Smartboard, student response clickers, iPads, iPods, smartphones or older technologies such as an opaque projector. Additionally, there was limited access to most social networks, several web services such as photo sharing sites, a commercial learning management system like Blackboard or Moodle, and social bookmarking sites. As described by Inan and Lowther's (2010) path model, computer availability was considered as an important factor influencing the rate of technology integration in the classroom. This is especially important since several departments of education in individual states have included technology integration as a component of teacher evaluation. For example, in North Carolina one indicator on the teacher evaluation rubric requires evidence as to how teachers utilize technology to maximize student learning (Public Schools of North Carolina, 2013). Results from this study are similar to previous findings regarding the types of tasks and programs being used by teachers. The most commonly reported programs being used by teachers were internet browsers, classroom management systems, and word processing software (Gray, Thomas, & Lewis, 2010). Cuban (2001) stated teachers often use technology mainly for

administrative tasks and communication purposes rather than making technology an integral part of the student learning process.

Teachers indicated cost as a moderate barrier to technology integration followed by the minor barriers of time to plan lessons using technology and time for students to use the technology in classes. Availability of technology for the number of students, availability of appropriate instructional software, and availability of technical support were also indicated as being minor barriers. Time, availability, and inadequate support are all classified as first order barriers according to Brickner (1995). The only second-degree barrier indicated as being at least a minor barrier to technology integration was the teachers' ability to integrate technology. Prior research indicates changes in classroom practice do not occur just because availability and other first order barriers are eliminated (Ertmer, Addison, Lane, Ross, & Woods, 1999). Second order barriers such as intrinsic beliefs about the importance of technology, knowledge of teaching, and student interest are not areas agricultural education teachers within this study indicated as being significant barriers to technology integration. Based on this research, teachers in agricultural education in Tennessee may need additional support in acquiring technology to use in the classroom and finding time to adequately incorporate technology into their classroom. Likewise, Inan and Lowther (2010) recognized the importance of both overall support and technical support.

While this study served as a status study to examine accessibility to and use of various instructional technologies, the findings provide an important foundation for future research and practice. Since the current research focused on Tennessee, additional research should be conducted to examine technology integration in other states. When compared to a national study of public school teachers' access to technology (Gray, Thomas, & Lewis, 2010), Tennessee teachers had more limited access to equipment such as interactive whiteboards. Is this finding limited to teachers in this state or are other agriculture teachers limited as to the technology they can use in the classroom?

Qualitative inquiry should also be used to expand on several of the initial findings. Classroom observations could assist in obtaining a more complete picture as to how technology is truly being integrated into agricultural education programs. Interviews with school administrators and career and technical education directors within different school districts may provide additional insight as to expectations for technology inclusion in agriculture classrooms. Additional interviews should be conducted with agriculture teachers to examine why they elect to utilize specific technologies and also their perceptions as to benefits and limitations of technology usage. Teacher interviews could also provide a more in-depth understanding of the barriers limiting technology integration.

In order to support agriculture teachers in their technology integration efforts, professional development must reflect current technology usage. Teachers may become discouraged if they attend a workshop that incorporates technology they are unable to access in their own schools. When professional development workshops specific to technology are offered, several post-workshop evaluations should be conducted with participants throughout the school year. This will allow workshop facilitators to examine what technologies are being implemented and can inform future workshop offerings. Also, workshops with a focus on grant opportunities specific to educational technology could help teachers identify different sources for potential funding.

The creation and upkeep of a technology resource bank may help reduce the time commitment some teachers recognize as a barrier to technology integration. Currently the National Association of Agricultural Educators (NAAE) has an established Communities of Practice for technology in the classroom. This would serve as an excellent place for teachers to share lesson plans providing specific suggestions and directions for technology implementation. Also, instructional videos demonstrating the use of technology could be created and housed on the NAAE site. These resources would be beneficial to the many teachers indicating they acquire

most of their technology skills through personal trial and error. Additionally, this would also help teachers minimize the time spent searching for the most helpful instructional videos.

Finally, preservice teacher education programs can help prepare future teachers who are knowledgeable and confident in their ability to integrate technology. Universities often have access to the most current instructional technology, so teacher educators can model effective integration strategies in their courses. As well, students should be encouraged to utilize technology in microteaching activities. Teacher educators may also identify several teachers considered to be progressive in their use of technology and arrange a field trip or observation experience for their students.

References

Assessment and Teaching of 21st Century Skills. (2012). *What are 21st-century skills?* Retrieved from http://atc21s.org/index.php/about/what-are-21st-century-skills/

Becker, H. J. (1994). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Journal of Research on Computing in Education, 26*(3), 291 – 321.

Brickner, D. (1995). *The effects of first and second order barriers to change on the degree and nature of computer usage of secondary mathematics teachers: A case study* (Unpublished doctoral dissertation). Purdue University, West Lafayette, IN.

Council for Accreditation of Educator Preparation. (2010). CAEP standards for accreditation of educator preparation. Retrieved from http://www.caepsite.org/standards.html.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom.* Cambridge, MA: Harvard University Press.

Culp, K. M., Honey, M., & Mandinach (2005). A retrospective on twenty years of educational technology policy. Journal of Educational Computing Research, 32(3), 279 – 307. doi: 10.2190/7W71-QVT2-PAP2-UDX7

Demetriadis, S., Barbas, A., Molohides, A., Palaigeorgiou, G., Psillos, D., Vlahava, L,…Pombortsis, A. (2002). Cultures of negotiation: Teacher's acceptance/resistance attitudes considering the infusion of technology into schools. *Computers and Education, 41*, 19-37. doi:10.1016/S0360-1315(03)00012-5

Doerfert, D. L. (Ed.) (2011). *National research agenda: American Association for Agricultural Education's research priority areas for 2011-2015.* Lubbock, TX: Texas Tech University, Department of Agricultural Education and Communications.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development, 53*(4), 25 – 39.

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47 – 61.

Ertmer, P. A., Addison, P., Lane, M., Ross, E., & Woods, D. (1999). Examining teachers' beliefs about the role of technology in the elementary classroom. *Journal of Research on Computing in Education, 32*(1), 54 – 71.

Ertmer, P. A., Gopalakrishnan, S., Ross, E. (2000). *Technology-using teachers: Comparing perceptions of exemplary technology use to best practice.* Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Gray, L., Thomas, N., & Lewis, L. (2010). *Teachers' use of educational technology in U.S. public schools: 2009* (NCES 2010-040). Retrieved from http://www.niusileadscape.org/docs/FINAL_PRODUCTS/LearningCarousel/EdTech09.pdf

Guerrero, S., Walker, N., & Dugdale, S. (2004). Technology in support of middle grade mathematics: What have we learned? *Journal of Computers in Mathematics and Science Teaching, 23*(1), 5 – 20.

Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. American Journal of Education, 101(3), 261 - 315.

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development, 58*(2), 137 – 154. doi:10.1007/s11423-009-9132-y

International Society for Technology in Education. (2008). *National educational technology standards for teachers (2nd ed.).* Eugene, OR: Author.

International Society for Technology in Education. (2000). *National educational technology standards for teachers.* Eugene, OR: Author.

Ito, M., Horst, H., Bittanti, M., Boyd, D., Herr-Stephenson, B., Lange, P. G., Pascoe, C. J.., & Robinson, L. (2008). Living and learning with new media: Summary of findings from the digital youth project. Retrieved from http://digitalyouth.ischool.berkeley.edu/files/report/digitalyouth-WhitePaper.pdf

Johnson, D. B. (2009). *The digital disconnect: Unplugging barriers that sustain the phenomena of the unplugged teacher in a technological era* (Unpublished doctoral dissertation). Louisiana State University, Baton Rouge, LA.

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2014). *NMC horizon report: 2014 K-12 edition.* Austin, Texas: The New Media Consortium.

Kotrlik, J. W., & Redmann, D. H. (2009). Analysis of teachers' adoption of technology for use in instruction in seven career and technical education programs. *Career and Technical Education Research, 34*(1), 47 – 77. doi:10.5328/CTER34.1.47

Kotrlik, J. W., Redmann, D. H., & Douglas, B. R. (2003). Technology integration by agriscience teachers in the teaching/learning process. *Journal of Agricultural Education, 44*(3). 78 – 90. doi:10.5032/jae.2003.03078

Miller, L.E., & Smith, K. L. (1983). Handling nonresponse issues. *Journal of Extension, 21*(5), 45 – 50.

National Commission on Excellence in Education. (1983). A nation at risk. Retrieved from http://www2.ed.gov/pubs/NatAtRisk/risk.html

Public Schools of North Carolina. (2013). Evaluation instruments and processes. Retrieved from http://www.ncpublicschools.org/educatoreffect/ncees/instruments/.

Redmann, D. H., & Kotrlik, J. W. (2004). Analysis of technology integration in the teaching-learning process in selected career and technical education programs. *Journal of Vocational Education Research, 29*(1), 3 – 25. doi:10.5328/JVER29.1.3

Saavedra, A. R., & Opfer, V. D. (2012). Learning 21st-century skills requires 21st-century teaching. *Phi Delta Kappan, 94*(2), 8 – 13.

U.S. Department of Education, Office of Educational Technology. (2010). *Transforming American education: Learning powered by technology.* Retrieved from http://www.ed.gov/sites/default/files/netp2010-execsumm.pdf