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Teaching with Technology: North Carolina Agriculture Teachers' Knowledge Acquisition, Attitudes, and Identified Barriers

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Abstract

In order for agricultural education teachers to adapt to an ever-changing educational environment, they must possess the skills necessary to integrate technology into their classrooms. The purpose of this study was to examine the factors that influence North Carolina agriculture teachers' ability to integrate educational technology. This study examined the identification of sources contributing to agriculture teachers' technological knowledge, their attitudes towards technology integration, and barriers to the inclusion of technology in agriculture classrooms. Agriculture teachers acquired technology skills to a moderate extent from personal trial and error and interaction with other faculty/staff. Teachers felt technology allowed students to be creative, allowed students to access course materials easily, appealed to the learning styles of students, and provided opportunities for individualized instruction. The expense of technology was identified as the greatest barrier to technology integration.

Keywords: agricultural education, technology integration, instructional technology

Today, we find a new generation of learners in the agriculture classroom. Millennials, also called generation Y, refers to the generation born after 1980 and raised using digital technology. The millennials are commonly characterized as driven achievers who depend on technology to study and learn. Teachers must change their method of teaching to achieve academic success with this generation. Unlike their predecessors who expected teachers to deliver content, millennials desire instructors who facilitate rather than control instruction, encourage teamwork and cooperative learning, give prompt feedback, and provide clear expectations for success in their classrooms. Chalk, blackboards, and textbooks are still essential components for educating students today; however, these students want a classroom experience enhanced through technologies because they were born in the digital age. Therefore, in an effort to engage this generation, we must incorporate a greater level of technology into our schools (Jones, Ricketts, Ulmer, & Williams, 2008; Munro, 2012).

In order for agricultural education teachers to adapt to an ever-changing educational environment, they must possess the skills necessary to integrate technology into their classrooms. Several agricultural education studies have identified the need for professional development specific to technology. Garton and Chung (1996) conducted a needs assessment to determine inservice needs of beginning agriculture teachers. From a list of 50 professional competencies, the

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use of computers in teaching was included within the top ten inservice needs by novice teachers. More recent research found computer integration to be the greatest need for experienced agriculture teachers (Layfield & Dobbins, 2002) and a greater inservice need for traditionally certified teachers when compared to alternatively certified teachers (Roberts & Dyer, 2004).

Agriculture teachers have attributed their acquisition of technological skills to several different sources. In a study of Louisiana agriculture teachers, over 75% of the respondents had attended workshops or conferences or were self-taught. Other sources not as commonly used included colleagues and college courses (Kotrlik, Redmann, & Douglas, 2003). In another study of all Career and Technical Education teachers in Louisiana, 95.5% of agriculture teachers indicated the primary source of technology training was self-taught but they also frequently attended workshops and conferences (Kotrlik & Redmann, 2009a). Another study by Kotrlik and Redmann (2009b) produced similar findings regarding sources of technology training.

Positive attitudes toward technology (Cviko, McKenney, & Voogt, 2012; Ertmer & Ottenbreit-Leftwich, 2010; Faulder, 2011) and teacher motivation and determination (Cullen & Greene, 2011; Duran, Brunvand, & Fossum, 2009; Faulder, 2005) are two related variables commonly associated with technology integration practice. Positive technology attitudes have been found to predict both intrinsic and extrinsic motivation to use technology and uses of technology (Cullen & Greene, 2011; Inan & Lowther, 2010; Kanaya, Light, & McMillan-Culp, 2005; Teo, 2011). In 2002, a research study examined Utah secondary agricultural education teachers' attitudes towards computer use. Overall, teachers indicated a positive attitude towards computer use and felt it was important to know how to properly utilize computer technology (McKendrick, Straquadine, & Hubert, 2002).

Although technology may be available to teachers, some will refuse to utilize it due to their mindset and attitude or some may experience technology anxiety. For example, Wood, Mueller, Willoughby, Specht, and Deyoung (2005) reported schools are increasingly becoming well equipped with computers and internet; however, only one-half of the teachers used computers. The researchers also stated individual differences and attitudes towards technology, including computer anxiety, contributed to why teachers do not implement technology in the classroom despite the increased availability. Mueller, Wood, Willoughby, Ross, and Specht (2008) identified past experiences, beliefs, and attitudes of teachers as likely indicators of their views of using technology as an instructional tool.

While instructional technology offers numerous possibilities for future improvement in agricultural education, a number of barriers could inhibit its implementation. Rogers (2000) found the lack of availability and accessibility of technology to teachers was one reason for the lack of use. Alston, Miller, and Williams (2003) identified cost of software and equipment as the greatest barriers to integrating technology. Other identified barriers include a lack of access to reliable technology (An & Reigeluth, 2011; Inan & Lowther, 2010; Petko, 2012), limited planning time (An & Reigeluth, 2011, Kotrlik & Redmann, 2009b), not enough technology to accommodate students, scheduling constraints, and lack of appropriate technical support (Kotrlik & Redmann, 2009a, Kotrlik & Redmann, 2009b).

In 2010, Inan and Lowther developed a path model to explain the effects of teachers' individual characteristics and perceptions of environmental factors influencing the integration of technology 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). This research study included several of the variables included in the path model that could either contribute to the utilization or pose a barrier to the integration of classroom technology. The variables are described in the table below (see Table 1).

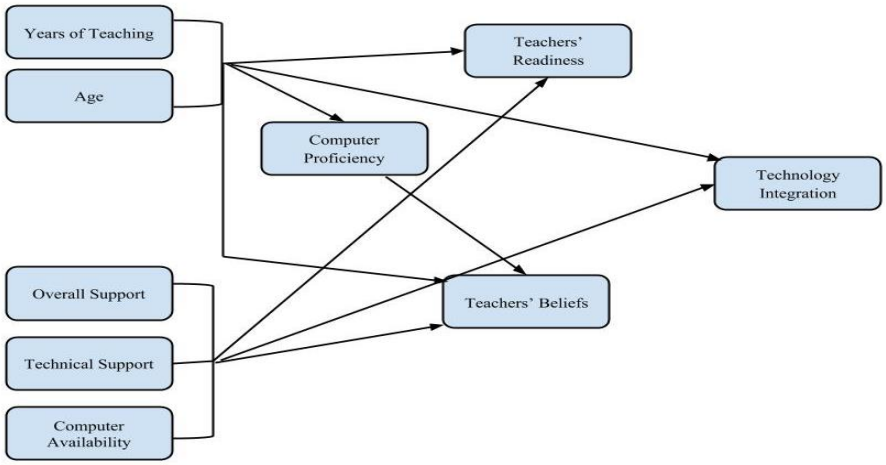

Figure 1. Hypothesized Path Model (Inan & Lowther, 2010)

Table 1

Description of Variables Included in Hypothesized Path Model (Inan & Lowther, 2010)

Variables	Description
Computer proficiency	Teachers' perception of their own computer ability level
Computer availability	The number of computers available in the classroom for students
Teachers' beliefs	Teachers' perception of technology's influence on student learning and achievement and impact on classroom instruction and learning activities
Teachers' readiness	Teacher perception of their capabilities and skills required to integrate technology into their classroom instruction
Overall support	Teachers' perception of support from administration, peers, parents, and community for technology integration in the school
Technical support	Teachers' perception on adequacy of technical support, availability of resources, and assistance with computer software and troubleshooting

Purpose and Objectives

While the importance of technology integration has been recognized on a national level (U.S. Department of Education, 2010), there is a lack of current research on technology usage in agricultural classrooms. Specific to agricultural education, research on engaged learning environments has been identified as a priority area in the National Research Agenda for Agricultural Education (Doerfert, 2011). Appropriate integration of educational technology can promote student engagement in agricultural education.

The purpose of this study was to identify factors influencing North Carolina agriculture teachers' ability to integrate technology in the classroom. The research objectives for this study were to:

1. Determine how agricultural education teachers acquire the knowledge to use educational technology for instruction.
2. Determine the attitudes of agricultural education teachers towards integrating technology in classroom instruction.
3. Determine the barriers that may inhibit agricultural education teachers from integrating technology into the classroom.

Methods and Procedures

This research was part of a larger study (Williams, Warner, Flowers, & Croom, 2014) conducted on technology integration by North Carolina agriculture teachers. This portion of the research study utilized survey research methodology to collect information from North Carolina agriculture teachers on their knowledge acquisition specific to instructional technology, their attitudes towards technology integration, and the barriers limiting the use of technology. The population for this study consisted of all North Carolina agricultural education teachers teaching at the middle or high school level (N = 420). The frame used to determine the population was a list of 2012-2013 agriculture teachers provided by the North Carolina Agricultural Education Regional Coordinators. The procedures used in the development and the implementation of the survey instrument was detailed in a previously published article by Williams et al. (2014). Three hundred and four teachers completed the survey instrument for a response rate of 72.4%.

Participants responded to the survey and agreed to the informed consent through an online survey program called Qualtrics. The first section of the instrument was an introduction to the survey. This section included one 5-point Likert scale question regarding the extent various sources had prepared participants to make effective use of educational technology. The next section of the instrument asked teachers to identify barriers to integrating technology in the agriculture classroom. Statements related to using educational technology in the instructional program such as "Technology is a priority for the district administration and statements describing teachers' attitudes towards instructional technology such as "Technology allows students to be creative" utilized a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) with a 3 meaning *neither agree nor disagree*. Furthermore, a 4-point Likert scale ranging from 1 (*not a barrier*) to 4 (*major barrier*) was used to evaluate the extent of barriers such as "Technology is expensive." The final section of the instrument was made up of eight background and demographic questions. The demographic questions included age, gender, years of teaching experience, number of agriculture teachers at the school, and teaching region. The background questions consisted of one short answer question concerning the number of hours teachers participated in professional development activities for educational technology and one 4-point Likert scale question on how teachers perceived the professional development activities. The final question of the instrument was an open-ended question regarding any other information that should be considered in the study as it related to technology integration for agriculture teachers in North Carolina.

Results and Findings

The population of North Carolina agriculture teachers was comprised of 57% male teachers (n = 173) and 43% female teachers (n = 131). The average agriculture teacher was approximately 37 years old and had been teaching for 11 years. Teachers were representative of all eight regions in North Carolina. There were 50 from the Southeast Region (16%), 49 teachers from the East Central Region (16%), 45 from the South Central Region (15%), 41 from the West Central Region (13%), 40 from the Southwest Region (13%), 33 from the Northwest Region (11%), 27 from the West Region (9%), and 19 from the Northeast Region (6%). There was considerable variation in the number of agriculture teachers per program. One hundred twenty-seven of the teachers taught in a one-teacher program (42%), 121 taught in a two-teacher program (40%), 41 taught in a three-teacher program (13%), 9 taught in a four-teacher program (3%), and 6 taught in a program with five or more teachers (2%).

The first objective of this study was to determine how agricultural education teachers acquire the knowledge to use educational technology for instruction. Teachers acquired technology skills to a moderate extent from personal trial and error and interaction with other faculty/staff. Approximately 47% of the teachers (n = 143) reported personal trial and error was the source they acquired technology skills to a major extent. For all of the teachers, personal trial and error contributed at least a minor extent to the acquisition of technology skills. Undergraduate teacher education programs only contributed to a minor extent and from the students provided the most minimal contribution to the acquisition of technology skills. Another source of technology training identified by teachers was past work experience. Table 1 lists the sources of teachers' technology acquisition.

Agriculture teachers spent approximately 16 hours on average in professional development activities for educational technology with a range of 0 to 150 hours during the last 12 months. Teachers agreed these professional development activities in educational technology supported the goals and standards of the state, district, and school. Another statement teachers agreed with was the professional development activities applied to technology available at the school. Teachers somewhat disagreed that professional development activities met teachers' goals and needs and were available at convenient times and places. Table 2 shows how teachers perceive professional development activities in educational technology.

Table 1

Sources of Teachers' Technological Knowledge/Preparedness

Source	Not applicable		Not at all		Minor extent		Moderate extent		Major extent	
	N	%	N	%	N	%	N	%	N	%
Personal trial and error	2	0.66	0	0.00	44	14.47	115	37.83	143	47.04
Interaction with other faculty/staff	4	1.32	9	2.96	61	20.07	125	41.12	105	34.54
Training provided by staff responsible for technology support and/or integration at your school	6	1.97	18	5.92	85	27.96	118	38.82	77	25.33
Independent learning (e.g., online tutorials or books, help menus)	13	4.28	26	8.55	90	29.61	108	35.53	67	22.04
Professional development activities (in-service courses/workshops)	9	2.96	9	2.96	82	26.97	140	46.05	64	21.05
Undergraduate teacher education program	58	19.08	35	11.51	71	23.36	97	31.91	43	14.14
Graduate teacher education program	125	41.12	18	5.92	60	19.74	61	20.07	40	13.16
From the students you teach	4	1.32	35	11.51	116	38.16	109	35.86	40	13.16
Other (please specify)	275	90.46	7	2.30	7	2.30	6	1.97	9	2.96

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Table 2

Professional Development in Educational Technology

Statement	N	M	SD
It supported the goals and standards of my state, district, and school	270	3.03	0.63
It applied to technology available in my school	270	3.01	0.76
It met my goals and needs	270	2.81	0.68
It was available at convenient times and places	267	2.76	0.79

Note. 1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree, 4 = strongly agree.

The second objective was to determine the attitudes of North Carolina agricultural education teachers towards integrating technology in classroom instruction. The statement teachers most strongly agreed with was technology allows students to be creative. Other statements teachers agreed with included technology allows students to access course materials easily, appeals to the learning styles of students, and provides opportunities for individualized instruction. None of the teachers strongly disagreed that technology allows students to be creative, appeals to the learning styles of students, and provides opportunities for individualized instruction. Table 3 shows the attitudes of teachers towards instructional technology.

Table 3

Teachers' Attitudes Towards Instructional Technology

Statement	N	M	SD
Technology allows students to be creative	304	4.01	0.70
Technology allows students to access course materials easily	304	3.92	0.73
Technology appeals to the learning styles of students	304	3.92	0.69
Technology provides opportunities for individualized instruction	304	3.92	0.67
Technology enhances student learning	304	3.84	0.73
Technology improves students' attitudes toward learning	304	3.76	0.84
Technology implementation in the classroom is time consuming	304	3.71	0.92
Technology makes teaching easier	304	3.65	1.02
Technology increases student motivation to learn	304	3.65	0.89
Technology promotes the development of personalized learning plans	304	3.61	0.89
Technology improves student mastery of content	304	3.55	0.84
Technology closes learning gaps between students	304	3.52	0.86
Technology is easy to use	304	3.44	0.89
Technology increases VoCATS exam scores	304	3.39	0.93

Note. 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree.

When asked on the instrument if there were any additional comments they felt were applicable to general technology in education or instructional technology use in agriculture, 122 teachers chose to respond. More than half of those who responded to the question reflected on their personal struggles, failures, and successes when it came to technology integration. Several teachers commented on the lack of up-to-date technologies, the lack of time to learn how to use technology, and the difficulty to manage student behavior when utilizing technology. Teachers expressed, "students, educators, and administrators need to realize that technology is one of many teaching/learning tools" and "Computers are not the fix all for education." Several teachers viewed instructional technology to include agricultural technology instead of only devices that can be attached to computers, computer software, and web based applications. "Expand your view of instructional technology, beyond the traditional use of computers to teach. Include machine and equipment operation, service, maintenace, and etc. that you would find in modern industry today," reported one teacher. Another teacher commented on the leadership by stating, "Our state is lacking in leadership in development of curriculum course content that could be used through the technology. We are still a pencil and paper organization."

The third objective was to identify barriers that may inhibit North Carolina agricultural education teachers from integrating technology into the classroom including sources of teachers' technological knowledge/preparedness, school districts with policies restricting specific technology use, integration of educational technology in school districts, various barriers identified from the literature review, and effectiveness of professional development activities in educational technology.

Over 80% of the teachers' school districts had written policies restricting the use of social networking sites (N = 269), cell phones (N = 263), and MP3 players/iPods (N = 252) by students. YouTube (N = 237) and Wikis and/or blogs (N = 163) had written policies restricting use by students over 50%. Email had the fewest written policies restricting use by students (47.70%).

Teachers reported districts also had written policies restricting the use of games, music sites such as Pandora, and photo sharing sites such as Pinterest. One teacher reported, "they block everything, even teachers can not connect their devices to the Internet." Table 4 lists technologies school districts have written policies restricting their use by students.

Table 4

School Districts with Policies Restricting Technology Use

Technology Type	N	%
Social networking websites	269	88.49%
Cell phones	263	86.51%
MP3 players/iPods	252	82.89%
YouTube	237	77.96%
Wikis and/or blogs	163	53.62%
Email	145	47.70%
Other	108	35.53%

Teachers agreed most strongly with the statement that technology is a priority for the district administration. Therefore, teachers did not identify district administration as a barrier to technology integration. Other statements teachers strongly agreed with included teachers are interested in using technology in classroom instruction. Teachers disagreed funding for educational technology is being spent in the most appropriate ways and funding for educational technology is adequate. Table 5 shows how teachers perceive integration of educational technology in the school districts.

Table 5

Integration of Educational Technology in School Districts

Statement	N	M	SD
Technology is a priority for the district administration	304	4.08	0.84
Teachers are interested in using technology in classroom instruction	304	4.02	0.71
Use of educational technology is adversely affected by competing priorities in the classroom	304	3.48	0.89
Teachers are sufficiently trained to integrate technology into classroom instruction	304	3.32	0.97
Technology infrastructure is adequate (e.g., adequate Internet speeds)	304	3.28	1.14
Technical support for educational technology is adequate	304	3.26	1.12
Funding for educational technology is being spent in the most appropriate ways	304	2.93	1.05
Funding for educational technology is adequate	304	2.79	1.19

Note. 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree.

The expense of technology was identified as the greatest barrier to technology integration. Other factors that served as moderate barriers included cost of implementing new technologies, time to develop lessons that use technology, availability of technology for the number of students, availability of effective instructional software for the courses taught, availability of technical support to effectively use instructional technology in the teacher/learning process, shared technology throughout the school, and the teacher's ability to integrate technology in the teaching/learning process. Student interest in technology, administrative support for integration of technology in the teaching/learning process, and student knowledge of existing technology were identified as minimal barriers to technology integration in the classroom. Other barriers identified by teachers included technology is a distraction to students instead of an encouragement to learn and reliability of technology. Table 6 lists barriers to technology integration.

Table 6

Barriers to Technology Integration

	Not a barrier		Minor barrier		Moderate barrier		Major barrier	
Barrier	N	%	N	%	N	%	N	%
Technology is expensive	24	7.89	56	18.42	93	30.59	131	43.09
Cost of implementing new technologies	21	6.91	67	22.04	109	35.86	107	35.20
Enough time to develop lessons that use technology	27	8.88	69	22.70	109	35.86	99	32.57
Availability of technology for the number of students in my classes	61	20.07	72	23.68	90	29.61	81	26.64
Availability of effective instructional software for the courses I teach	41	13.49	104	34.21	108	35.53	51	16.78
Shared technology throughout my school	73	24.01	73	24.01	107	35.20	51	16.78
Availability of technical support to effectively use instructional technology in the teacher/learning process	40	13.16	124	40.79	96	31.58	44	14.47
My ability to integrate technology in the teaching/learning process	61	20.07	123	40.46	85	27.96	35	11.51
Administrative support for integration of technology in the teaching/learning process	126	41.45	106	34.87	53	17.43	19	6.25
Student knowledge of existing technology	109	35.86	130	42.76	51	16.78	14	4.61
Student interest in technology	149	49.01	104	34.21	43	14.14	8	2.63

Conclusion, Recommendations and Implications

Over 75% of agriculture teachers acquired much of their technological knowledge from personal trial and error or interaction with other faculty and staff. The interaction with other faculty and staff can be considered a learning community that commonly addresses shared community interests, encourages collaborative activities and discussions, and produces resources representative of shared interest (Jones, Fox, & Levin, 2011). In the path model proposed by Inan and Lowther (2010), overall support was recognized as a variable contributing to technology integration. Support from peers can encourage the utilization of technology. Most teachers reported training provided by technology staff at the school, independent learning, professional development, and an undergraduate teacher education program only helped them acquire minimal technological knowledge. Undergraduate teacher education programs may not be a major source of technological knowledge because most programs use standalone educational technology

courses, rather than integrating technology more systematically in methods courses and field experiences (Gronseth et al., 2010).

With the primary contribution of personal trial and error to technology acquisition of agriculture teachers, a bank of resources and tutorial videos should be developed and housed on a website or through the NAAE Communities of Practice. This would allow agriculture teachers to gain additional instruction on technology tools and usage and obtain assistance when troubleshooting technology problems. The online format would allow agriculture teachers to take a self-directed approach to the acquisition of technological skills. Teachers could select the topics of primary interest and utilize the resources at a time convenient for them. Interaction with other faculty and staff was also identified as an important contributor to the development of technology skills. Teachers recognized as technology savvy could be encouraged to serve as mentors to other teachers.

The limited contribution of undergraduate teacher education programs to technology acquisition is an area that merits additional investigation. The technology courses included as part of undergraduate coursework should be reviewed to assess the linkages between course content and teaching practice. Are there specific technological concepts that should be introduced in a stand-alone technology course and reinforced in other teacher preparation courses? How is technology integration reinforced in teacher preparation courses such as curriculum planning and teaching methods? Also, do students have the opportunity to integrate technology during their student teaching experiences?

Over half of the teachers' school districts had written policies restricting the use of social networking sites, cell phones, MP3 players/iPods by students, YouTube, and Wikis and/or blogs. Based on these results, leadership and policies are major external barriers. Robinson, Brown, and Green (2007) also identified a barrier indicating teachers could not teach with technology in legitimate ways due to restrictive technology practices. If districts restrict the use of technology, teachers cannot integrate that technology in the classroom. However, teachers agreed most strongly with the statement that technology is a priority for the district administration and did not identify administrative support for integration of technology in the teaching/learning process as a barrier. The research suggests district administration encourages teachers to use technology but restricts students' use of the technology. Due to the large number of school districts with written policies restricting technology use, there is a strong need to find a proper balance between protection and open access to tools and resources. Document analysis could be used to analyze school policies to examine specifically how they restrict access to technology and how this might hinder technology usage. As well, professional development facilitators need to be informed of the written polices of school districts to avoid potential restrictions of technology usage. Professional development should reflect the technologies teachers have available on a regular basis.

The expense of technology was identified as the greatest barrier to technology integration. Almost half (43.09%) of teachers identified this factor as a major barrier. Similarly, 71.06% of teachers reported the cost of implementing new technologies as a major barrier or moderate barrier. Additionally, teachers disagreed with the statement, "Funding for educational technology is adequate." These findings are similar to the findings of other research. Rogers (2000) found the lack of availability and accessibility of technology to teachers was one reason for the lack of use. McKendrick, Straquadine, and Hubert (2002) and Alston, Miller, & Williams (2003) both identified inadequate funding as a major barrier to integrating technology. Another moderate to major barrier to technology integration identified by 68.43% of teachers was time to develop lessons that use technology. These results are somewhat higher than the findings of An & Reigeluth's (2011) survey in which about 57% of teachers perceived lack of time as a barrier to integration. Even teachers who have the technological skills necessary to effectively utilize technology in their classrooms may lack the time to develop courseware or create new teaching materials. Additionally, if teachers do not have technological skills, they may not have time to develop new skills in order to integrate technology.

To help address these identified barriers, workshops could be developed to inform teachers of various sources of grant funding for technology and also assist with the development and submission of grant proposals. While it is impossible to generate more time, the creation of sample lessons and activities using technology may at least introduce agriculture teachers to new technologies and ideas for classroom integration. A comparison study could be conducted between teachers who have achieved successful technology integration and teachers who struggle with the inclusion of technology. This study might reveal further connections among teachers' barriers and how these barriers influence technology integration efforts.

Teachers attended a high number of professional development events in educational technology but rated the quality of professional development somewhat low. To better meet teachers' goals and needs, professional development should be provided to assist with the integration of technology with the curriculum, implementation of new technology tools, and basic skills with technology. Additionally, administrators should be encouraged to improve technology skills, and online learning resources should be provided for staff. Inan and Lowther (2010) recognized the importance of positive support from the community and administration and the need for technical support to assist teachers with technology integration.

Documentation of teaching strategies using technology could also increase the implementation and use of technology in the classroom. When teachers know how to use technology, they are more likely to utilize it in the classroom. Therefore, professional development plays a crucial role in the technology implementation process. If teachers do not have the understanding or the skills to use technology, then technology integration will have little impact. Professional development activities can help overcome the technological knowledge/preparedness internal barrier by improving teachers' technological knowledge.

Moreover, agriculture teachers in this study were interested in using technology in classroom instruction and believed technology allows students to be creative. This finding is especially important as Inan and Lowther (2010) identified teachers' readiness to integrate technology as the most influential factor contributing the utilization of technology in the classroom. None of the teachers strongly disagreed that technology allows students to be creative, appeals to the learning styles of students, and provides opportunities for individualized instruction. Student knowledge of existing technology was viewed as not a barrier or as a minimal barrier by almost 80% of teachers. Although teachers seemed to recognize technology as a valuable instructional tool, teachers disagreed with the statement, "technology increases VoCATS exam scores." An and Reigeluth (2011) and Liu (2011) reported teachers may hold a learner-centered philosophy but implement teacher-centered classrooms. Liu (2011) also found teachers had concerns over student achievement and associated teacher-centered practice with higher test scores. To overcome this barrier, teachers need more training on specific learner-centered technology related instructional strategies. If teachers do not allow students to use technology in the classroom, agricultural education students may not gain the technological skills needed in the 21st century.

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