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Intrapersonal Factors Affecting Technological Pedagogical Content Knowledge of Agricultural Education Teachers

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Abstract

The focus of this exploratory study was to examine levels of technology integration, self-efficacy, and Technological Pedagogical Content Knowledge (TPACK) in preservice and inservice agricultural education teachers in Oklahoma. The findings of this study suggest that intrapersonal factors, such as self-efficacy, outcome expectations, and interest, interact with teacher motivation to integrate technology and influence their TPACK. Further, the results suggest that experienced inservice teachers view technology tools as a mechanism to engage students and achieve instructional gains, whereas novice and preservice teachers tend to perceive technology tools primarily as a mechanism for improving classroom management. Implications include continuing to support and enact a shift in preservice teacher education from direct lecture and modeling-based instruction to more hands-on, constructivist methods of teaching that incorporate a variety of mastery experiences.

Keywords: self-efficacy; outcome expectations; technology; inservice; preservice

The agricultural education classroom today features not only the *traditional* experiential learning situations and skills learned in livestock fitting and showing, FFA, and mechanical agricultural practices, but also 21st-century learning experiences involving interactive white boards, Web 2.0 and mobile applications, and video- and computer-based livestock judging simulation games. New technologies, practices, and products are emerging continually; as a result, an increased demand exists for information and technology processing and analysis. Technologies, tools, and practices comprise the second of six priorities of the American Association for Agricultural Education National Research Agenda, which is designed to provide a framework for defining the research priorities in agricultural education and promoting sound research within and across the human dimensions of the food and agricultural systems (Doerfert, 2011).

As educational researchers study effective applications of emerging educational technologies, K-12 teachers are being challenged to employ educational technology products and processes in their practice. At the forefront of this movement is a goal to engage students in learning experiences that make use of technologies in which today's learners are comfortable. At the same time, a *new* generation of educators is beginning to enter the teaching profession. Marc Prensky's digital native dichotomy suggests this generation, known as digital natives, is more effective at using technology than their older counterparts, known as digital immigrants (Prensky, 2001). Further, Prensky (2001) claimed that when digital natives dominate the teaching profession, integrating technology in the classroom will no longer be an issue due to natives' innovation abilities and familiarity with the digital world.

Recent research has examined some of these claims empirically and suggests that the dividing line between digital natives and digital immigrants may not be as distinct as initially thought (Guo, Dobson, & Petrina, 2008). For example, some studies have indicated that no statistically significant differences exist between natives and immigrants in regard to their use of information and communication technologies. Rather, a gap exists, regardless of the generation of the teacher, in understanding how to use technologies for teaching and learning (Chen, Lim, & Tan, 2010). Thus, the need for teachers to be technologically *fit* is imperative (Brown, Baker, Edwards, & Robinson, 2011).

Technology plays an important role in education if the teacher believes he or she is capable of teaching in a technology-enhanced learning environment. Preservice teacher education programs have spent a considerable amount of time focused on preparing future educators to use technology in their classrooms (Anderson & Maninger, 2007) and agricultural education is no exception. Inservice professional development training has also held technology in its spotlight, attempting to diffuse the confusion that surrounds instructional technology tools while also stressing its relevance to state standards. However, by Prensky's theory, instructional technology training and education programs should become increasingly rare as digital natives enter the workforce.

What the Prensky (2001) dichotomy fails to take into account is the complexity of non-generational factors that influence whether a teacher implements technology. Teacher decision to integrate technology has been shown to be influenced by a host of intrapersonal constructs, such as self-efficacy beliefs, interest, and outcome expectations (Tschannen-Moran, Woolfolk Hoy & Hoy, 1998; Niederhauser & Perkmen, 2008). For example, a recent study of agriculture teachers' self-efficacy, outcome expectation, and interest using Interactive Whiteboards (IWBs) demonstrated that those who used IWBs more frequently had higher levels of self-efficacy and outcome expectations (Bunch, Robinson, & Edwards, 2012). However, interest in using IWBs was not related to whether teachers were digital immigrants or natives (Bunch et al., 2012a). Yet, a similar study found that as agriculture teachers became older and more experienced, their level of innovativeness regarding the use and adoption of IWBs decreased (Bunch, Whisenhunt, Robinson, & Edwards, 2012).

In 2006 Mishra and Koehler introduced the notion of Technological Pedagogical Content Knowledge (TPACK), which provides a useful framework for understanding teacher perceptions and practices of technology integration into curriculum and pedagogy. To integrate technology into their pedagogy and curriculum successfully, teachers must develop confidence in their abilities to integrate technology in the classroom because the integration of technology affects how much students learn in the classroom (Bunch et al., 2012b). However, at present, the relationships between intrapersonal factors like general teacher self-efficacy, technology integration self-efficacy, and externalization of these factors through TPACK are not fully understood. Therefore, this study focused on assessing preservice and inservice agricultural education teacher TPACK, examining the intrapersonal factors of self-efficacy, interest, and outcome expectations, and determining whether intrapersonal factors predicted levels of TPACK in preservice and inservice agricultural education teachers in Oklahoma.

Theoretical Framework

The constructs used within this study are based largely on Bandura's social cognitive theory (1977), which deviated from traditional cognitive theories and integrated cognitive development into a social structure of influences. The social cognitive view of motivation suggests a complex interactive system of self-efficacy (SE) beliefs, achievement goals, interests, and attributions of success or failure (Schunk, Pintrich, & Meece, 2008).

Teacher SE and SE beliefs toward technology are essential variables when examining instructional technology integration and teachers' Technological Pedagogical Content Knowledge. Tschannen-Moran and colleagues (1998) defined teacher SE as "the teacher's belief in his or her capability to organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context" (p. 233).

Niederhauser and Perkmen (2008) suggested that internal factors including personal traits of self-confidence and willingness to change, social cognitive characteristics of SE, outcome expectations, and interest affect teachers' attitude toward using technology within instructional practice. Teacher technology integration and efficacy beliefs are intertwined with personal teacher beliefs about instruction style and previous instruction experiences (Niederhauser & Perkmen, 2008). The simple response to stronger efficacy beliefs toward technology may be to prepare teachers how to use technology. However, this premise makes the assumption teachers will take the leap from understanding how to use a technology post-training and integrate it into their instruction and curriculum, which are two separate tasks (Mishra & Koehler, 2006). It is within that leap where TPACK may offer insight into teacher knowledge of technology integration.

The TPACK framework focuses on the complexities of technology knowledge, highlighting "connections, interactions, affordances, and constraints between and among content, pedagogy, and technology" (Mishra & Koehler, 2006, p. 1025). The model does not treat technology knowledge as an individual construct, but rather emphasizes how the three are intertwined. As such, the framework looks at each construct individually as well as in pairs, suggesting Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technology Knowledge (TK), Technological Content Knowledge (TCK), and Technological Pedagogical Knowledge (TPK) result in TPACK (Mishra & Koehler, 2006).

Purpose and Objectives

The purpose of this study was to examine the Technological Pedagogical Content Knowledge and intrapersonal characteristics towards technology use reported by preservice and inservice teachers in Oklahoma. The conceptual frameworks of social cognitive theory (Lent et al., 1994, 2002), intrapersonal factors toward technology use (Niederhauser & Perkmen, 2008), and Technological Pedagogical Content Knowledge (Mishra & Koehler, 2006) informed this study. More specifically, this study was designed to address the following research questions.

1. What are agricultural education teachers' perceptions of Technological Pedagogical Content Knowledge?
2. What intrapersonal factors influence Technological Pedagogical Content Knowledge?
3. Is there a difference between preservice and inservice teacher self-efficacy beliefs toward technology use?
4. Do relationships exist between self-efficacy beliefs toward technology use and general teacher self-efficacy beliefs?

Method

Participants and Sampling Procedures

An online link for the questionnaire was emailed to 426 secondary agricultural education inservice teachers in Oklahoma and was distributed as a web link, through email, and as a paper copy to approximately 130 preservice agricultural education preservice teachers in the Oklahoma State University agricultural education program. Specifically, the web link for preservice teachers was submitted through the Oklahoma State University Agricultural Education listserv, which is sent to all undergraduate Agricultural Education majors at OSU. A total of 10 inservice teachers had incorrect or otherwise unreliable electronic mail addresses; thus, they were removed from the study. As a result, the original sample of 556 preservice and inservice teachers was adjusted to an accessible sample of 546 teachers. The researcher received a total of 131 responses.

After examining responses for incomplete answers, the resulting sample size used in this research study was (N = 103). To address non-response error, a method of comparing of early to late respondents was performed. Lindner, Murphy, and Briers (2001) defined *late respondent* as "those who respond in the last wave of respondents in successive follow-ups to a questionnaire" (p. 52). The researcher conducted *t*-tests on early and late respondents on primary variables of interest. No differences were found, either practically or statistically; as such, results may be generalized to the target population (Lindner et al., 2001). Non-probability, or non-random, sampling was used in this study, which involved non-random selection. The preservice and inservice teachers volunteered to participate in this study; as such, the selection process was a matter of convenience. As with most research conducted in education, this study relied on a non-random sample and used inferential statistics to explore the data. Inferential statistical tests were used as an additional level of analysis that was not permitted through descriptive statistics. The reader should interpret the results relative to the characteristics of the study's sample and should refrain from generalizing our findings to larger populations.

Instrumentation

This exploratory study (Babbie, 1989) employed a combination of three instruments to collect data. The Intrapersonal Technology Integration Scale (ITIS) instrument, developed and validated by Niederhauser and Perkmen (2008) provided items to measure teacher levels of intrapersonal factors in technology integration. All items from the ITIS were used to measure the intrapersonal factors of preservice and inservice teachers in this study. Niederhauser and Perkmen (2008) established factorial validity to ensure subscales developed in the ITIS formed distinct constructs. They found factor loadings ranged from 0.73 to 0.85 for the SE subscale, 0.71 to .075 for the Interest subscale, and .071 to 0.93 for the OE subscale (Niederhauser & Perkmen, 2008, p. 106). Further, confirmatory factor analysis indices indicated acceptable fit. Cronbach's alpha was .90 for the SE subscale, 0.93 for the OE subscale, and 0.89 for the INT subscale (Niederhauser & Perkmen, 2008). Cronbach's alpha for the total scale was 0.96, indicating high internal consistency for each of the subscales and for the total scale (Cronbach, 1951).

The Teachers' Sense of Teacher Efficacy Scale (TSTES) instrument, developed and validated by Tschannen-Moran and Woolfolk Hoy (1998) provided items to measure teachers' levels of efficacy toward factors in a teacher/classroom setting. The long form, 24-question version of the instrument, was selected by recommendation from Tschannen-Moran and Woolfolk Hoy (2001), who noted that with preservice teachers, the long form is suggested due to factor structure being less distinct within the preservice group. Tschannen-Moran and Woolfolk Hoy (2001) found a Cronbach's alpha of .94 for the overall instrument using the long form; subscale Engagement indicated an alpha of .87; subscale Instruction indicated an alpha of .91; and subscale Management indicated an alpha of .90.

The Technological Pedagogical Content Knowledge (TPACK) instrument, developed and validated by Schmidt, Baran, Thompson, Mishra, Koehler and Shin (2009) provided items in the study to measure teachers' Technological Pedagogical Content Knowledge and its associated components. These components included technological knowledge, content knowledge, pedagogical knowledge, pedagogical content knowledge, technological content knowledge, and technological pedagogical knowledge. Internal consistency for the TPACK instrument ranged from Cronbach's alpha of .78 to .93.

Data Analysis

All data were imported and coded in PASW 19™, a statistical analysis software package. The data collected were analyzed using descriptive statistics and correlational analyses. Descriptive statistics were used to summarize and categorize the data. As Miller (1994) indicated, "correlations are an important tool to help us understand whether or not two (or more) variables vary, together, i.e., they help us describe and explain" (p. 7). In this study, correlational analyses were used to describe and explain agricultural beliefs relative to technology integration beyond what the descriptive measures of central tendency and dispersion may suggest. One-way analysis of variance was used to compare preservice and inservice teachers' self-efficacy beliefs toward using technology. A stepwise multiple regression was performed to examine intrapersonal predictors of the participants' TPACK, and a two-tailed Pearson correlation was computed to assess the relationship between participants' technology integration self-efficacy and general teacher self-efficacy. Although non-random sampling is an obvious limitation, survey researchers also note that conclusions derived from survey data tested with inferential statistics are still more likely to be accurate in reflecting the characteristics of the entire sample population than those not tested, even when the sample is not random (Hightower & Scott, 2012).

Findings

Preservice agricultural education teachers composed 40.8% of the sample (*n* = 42), while inservice agricultural education teachers composed 59.2% of the sample (*n* = 61). Inservice teachers were predominantly male (87%), whereas preservice teacher gender exhibited a more even ratio of males to females (57% male). Of the 61 inservice teachers, 82% taught in rural schools, 16.4% taught in suburban schools, and 1.6% taught in urban or mixed-classification schools. Table 1 summarizes the sample's personal and professional characteristics.

Table 1

Descriptive Profile of Participants

	Preservice *(n = 42)*	Inservice *(n = 61)*
Mean Age	20.4	37.5
Gender		
Male	57.1%	86.9%
Female	42.9%	13.1%
Education Level		
Bachelor's Degree	-	73.8%
Master's Degree	-	26.2%
Teaching Experience	< 1 year	12.4 years
School Characteristics		
Rural	-	82%
Suburban	-	16.4%
Urban	-	1.6%

Perceived Knowledge of Technological Pedagogical Content Knowledge

To answer research question one, descriptive statistical analysis was performed using total TPACK score of each group. Individual TPACK items were also examined. The results indicated 71% of preservice agricultural education teachers (*n* = 42) perceived themselves as knowledgeable in teaching lessons that combined technologies and teaching approaches in social studies, science, mathematics, and literacy in agricultural education. Of the inservice agricultural education teachers 63.9% (*n* = 61) agreed they could teach lessons that appropriately combined instructional technologies and teaching approaches in mathematics, science, social studies, and literacy, as it related to agricultural education. Preservice teacher respondents also reported higher levels of TPACK in the areas of mathematics, literacy, and social studies as compared to inservice teacher respondents. Table 2 provides responses received from preservice and inservice groups regarding their self-reported technological pedagogical content knowledge as it relates to teaching lessons that combine content area with technologies and teaching approaches in agricultural education.

Table 2

Perceived Technological Pedagogical Content Knowledge

	Preservice *(n = 42)*	Inservice *(n = 61)*
Mathematics		
Strongly Agree	23.8%	13.1%
Agree	57.1%	72.1%
Neither Agree nor Disagree	14.3%	9.8%
Disagree	4.8%	4.9%
Strongly Disagree	0.0%	0.0%
Literacy		
Strongly Agree	26.2%	14.8%
Agree	47.6%	57.4%
Neither Agree nor Disagree	21.4%	23.0%
Disagree	4.8%	4.9%
Strongly Disagree	0.0%	0.0%
Science		
Strongly Agree	23.8%	24.6%
Agree	57.1%	65.6%
Neither Agree nor Disagree	14.3%	8.2%
Disagree	4.8%	1.6%
Strongly Disagree	0.0%	0.0%
Social Studies		
Strongly Agree	26.2%	13.1%
Agree	57.1%	57.4%
Neither Agree nor Disagree	14.3%	24.6%
Disagree	2.4%	4.9%
Strongly Disagree	0.0%	0.0%

Technological Knowledge

Another variable of interest within TPACK was Technological Knowledge (TK). Mishra and Koehler (2008) suggested TK is in a continual state of flux, especially as compared to pedagogy and content. Further, their view on TK is that it requires a deeper understanding of information processing, communication, and problem solving than the traditional definition of computer literacy (Mishra & Koehler, 2008). The inservice group had a greater percentage of respondents indicating they strongly agreed with the TK-related statements as compared to the preservice group. Further, inservice teachers indicated stronger agreement in the areas of technology troubleshooting, ability to learn technology, knowledge about different technologies, and technical skill ability. Although the majority of preservice teachers indicated they could learn technology easily and had the technical skills necessary to use technology, less than half agreed they knew about different technologies. It is important to note the inservice group sample average age was 37.5 and average years of teaching experience were 12.4. The TK results may differ significantly within different age groups and years of experience. Table 3 indicates TK responses for preservice and inservice groups.

Table 3

Technology Knowledge Responses

Statement	Preservice *(n = 42)*	Inservice *(n = 61)*
I know how to solve my own technical problems.		
Strongly Agree	4.8%	11.5%
Agree	50.0%	47.5%
Neither Agree nor Disagree	28.6%	27.9%
Disagree	11.9%	13.1%
Strongly Disagree	4.8%	0.0%
I can learn technology easily.		
Strongly Agree	9.5%	19.7%
Agree	69.0%	57.4%
Neither Agree nor Disagree	16.7%	19.7%
Disagree	4.8%	3.3%
Strongly Disagree	0.0%	0.0%
I keep up with important new technologies.		
Strongly Agree	4.8%	13.1%
Agree	64.3%	44.3%
Neither Agree nor Disagree	23.8%	31.1%
Disagree	7.1%	11.5%
Strongly Disagree	0.0%	0.0%
I frequently play around with technology.		
Strongly Agree	7.1%	21.3%
Agree	54.8%	55.7%
Neither Agree nor Disagree	21.4%	19.7%
Disagree	16.7%	3.3%
Strongly Disagree	0.0%	0.0%
I know about a lot of different technologies.		
Strongly Agree	7.1%	13.1%
Agree	40.5%	42.6%
Neither Agree Nor Disagree	33.3%	34.4%
Disagree	14.3%	9.8%
Strongly Disagree	4.8%	0.0%
I have the technical skills I need to use technology.		
Strongly Agree	9.5%	11.5%
Agree	64.3%	59.0%
Neither Agree nor Disagree	23.8%	19.7%
Disagree	2.4%	9.8%
Strongly Disagree	0.0%	0.0%

Predictors of Technological Pedagogical Content Knowledge

Research question two sought to determine what intrapersonal factors were predictors of TPACK score. Stepwise multiple regression was performed using total TPACK score as the dependent variable and the independent variables of efficacy in student engagement, efficacy in instructional strategies, efficacy in classroom management from the Teachers' Sense of Efficacy Scale (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Self-efficacy, performance outcome expectations, self-evaluative outcome expectations, social outcome expectations and interest from the Intrapersonal Technology Integration Scale (Niederhauser & Perkmen, 2008) were also independent variables of interest.

Multiple regression models for preservice teachers revealed a best-fit model of Adjusted $R^2 = .094$, $F(1, 40) = 5.234$, $p = .028$, $d = .629$, using the stepwise method and a statistically significant variable of Social Outcome Expectations ($B = .377$, $p = .028$). Cohen's effect size value ($d = .629$) suggested a moderate to high practical significance. Multiple regression models for inservice teachers revealed a best-fit model of Adjusted $R^2 = .374$; $F(2, 58) = 18.937$, $p = .000$, $d = 1.53$, using the stepwise method. Statistically significant variables included Self-Efficacy in Instructional Strategy ($B = .233$, $p = .000$) and Self-Efficacy Toward Technology ($B = .244$, $p = .014$). Cohen's effect size value ($d = 1.53$) suggested high practical significance. Statistically significant variables included Self-Efficacy in Instructional Strategy ($B = .233$, $p = .000$) and Self-Efficacy Toward Technology ($B = .244$, $p = .014$).

Self-Efficacy Beliefs Toward Technology Use in Pre and Inservice Groups

Research question three sought to explore differences in self-efficacy beliefs toward technology in both groups. A one-way analysis of variance of variable ITIS SE, or self-efficacy belief toward technology use, yielded no statistically significant differences between preservice ($N = 42$) and inservice ($N = 61$) teachers in regard to perceived efficacy, $F(1,101) = p > .05$.

Individual ITIS variables were further examined using ANOVAs due to variations in means between the two groups. However, subsequent ANOVA tests revealed no significant differences between preservice and inservice groups. The means and standard deviations of the technology integration self-efficacy scores are indicated in Table 5.

Table 5

Preservice and Inservice Technology Integration Scale Mean Scores

Statement	**Preservice** (*n = 42*)		**Inservice** (*n = 61*)	
	M	***SD***	***M***	***SD***
I feel confident that I have the necessary skills to use instructional technology for instruction.	4.05	.73	4.21	.64
Using instructional technology in the classroom will make it easier for me to teach.	4.12	.77	4.02	.83
I have an interest in reading articles or books about instructional technology.	3.02	.90	3.21	1.00
Using instructional technology in the classroom will increase my effectiveness as a teacher.	3.86	.81	3.97	.77
I am interested in working with instructional technology tools.	4.00	.73	4.20	.68
Using instructional technology in the classroom will make my teaching more exciting.	4.19	.77	4.20	.75
I feel confident that I can effectively use instructional technology in my teaching.	4.02	.60	4.20	.65
Effectively using instructional technology in the classroom will increase my sense of accomplishment.	3.62	.91	3.59	.97
Using instructional technology in the classroom will make my teaching more satisfying.	3.71	.89	3.59	.92
I feel confident that I can regularly incorporate appropriate instructional technologies into my lessons to enhance student learning.	4.00	.66	4.13	.59
Effectively using instructional technology in the classroom will increase my colleagues' respect of my teaching ability.	3.52	1.04	3.36	.90
My colleagues will see me as competent if I effectively use instructional technology in the classroom.	3.55	.83	3.43	.81
I feel confident that I can select appropriate instructional technology for instruction-based or curriculum standards-based pedagogy.	3.90	.62	3.82	.72
I have an interest in working on a project involving instructional technology concepts.	3.62	.62	3.57	.94
Using instructional technology in the classroom will increase my productivity.	3.74	.77	3.89	.82
I feel confident that I can teach relevant subject matter with appropriate use of instructional technology.	3.93	.60	4.03	.60
I am interested in learning about new educational software.	4.00	.66	4.03	.71
I feel confident that I can help students when they have difficulty with instructional technology.	3.81	.74	3.92	.61
I have an interest in listening to a famous instructional technologist speaking about effective use of instructional technology in the classroom.	3.21	.81	3.15	.98
Effectively using instructional technology in the classroom will increase my status among my colleagues.	3.31	.90	3.13	.92
I have an interest in attending instructional technology workshops during my teaching career.	3.50	.74	3.75	.83

Note: 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree

Relationship Between General Teacher Self-Efficacy and Self-Efficacy Belief Toward Technology

Research question four sought to find whether a relationship existed between general teacher self-efficacy and self-efficacy belief toward technology. A two-tailed Pearson correlation was computed to assess the level and directionality of the association between technology integration self-efficacy and general teacher self-efficacy. Variables of total self-efficacy score and technology integration self-efficacy score were used to complete the correlation. A positive correlation existed between the variables ITIS SE and general teacher SE within the preservice teacher group, $r = 0.499$, $n = 42$, $p = 0.001$. The inservice teacher group also indicated a positive correlation of $r = 0.499$, $n = 61$, $p = 0.001$ between variables ITIS SE and general teacher SE. Both *r* values of 0.499 indicate moderate correlation between the two variables in each teacher group, suggesting general self-efficacy beliefs may move positively or negatively depending on self-efficacy belief toward technology and vice versa. The Pearson *r* value (.499) indicates moderate to high practical significance (Cohen, 1988).

Conclusions

Preservice and inservice teachers' self-reported Technological Pedagogical Content Knowledge suggests that both groups perceive themselves as knowledgeable in combining curriculum areas with technologies and teaching approaches. However, in the areas of mathematics, literacy, and social studies, a greater percentage of preservice teachers indicated that they strongly agreed they were capable of teaching lessons that appropriately combined content with teaching approaches and technologies. This could be explained by student preparation programs that expose students to better integration of content areas within agricultural education. This is consistent with research suggesting agricultural programs are becoming more interdisciplinary, combining both academic and vocational curriculum using a variety of models (Roberson, Flowers, & Moore, 2000).

Mastery or vicarious experiences are influential upon self-perception of teaching competence (Tschannen-Moran, et. al., 1998). Researchers suggested mastery experiences as the most direct influence (Tschannen-Moran et al., 1998). Inservice teacher technology self-efficacy (SE) is posited to be a result of actual teaching experience and the strengths and weaknesses each teacher experienced as they managed and instructed a group of students. Based on responses, this particular inservice teacher group has experienced not only increased technology SE beliefs, but also increased instructional strategy SE beliefs, as a result of actual teaching situations and mastery of the teaching task.

Conversely, preservice teachers may develop technology integration SE as a result of vicarious experiences, which leads to positive or negative efficacy belief. Tschannen-Moran et al. (1998) proposed that vicarious experience–watching others teach–provides information and impressions regarding the teaching task. These vicarious experiences, whether experienced during teacher education, from professional literature, or from peers, influence preservice and novice teacher decisions regarding learning ability, responsibility, and teacher influence. Beginning teachers tend to base their SE and competence beliefs on those whom they observe. Observation of successful teachers using technology is critical in developing future agricultural education teachers who are comfortable and competent in using technology in the classroom (Bandura, 1997; Tschannen-Moran et al., 1998). Although it may be assumed that observing teacher failure regarding technology integration may provide a learning opportunity for preservice or beginning teachers, Tschannen-Moran et al. (1998) posited that observing failure, combined with perceived strong effort of the observed teacher, will reduce efficacy belief, as the conclusion is made that the task is unmanageable.

Self-efficacy, particularly in the case of teacher efficacy, tends to be context-specific (Tschannen-Moran et al., 1998). This is evident with results suggesting SE in instructional strategy and in student engagement influence TPACK positively for inservice teachers. Those who are highly efficacious as it relates to instructional strategy may be more comfortable with technology integration in the classroom. High instructional strategy SE is indicative of ability and willingness to innovate teaching strategy and experiment with instruction. High student engagement SE is indicative of teacher enthusiasm and motivation for teaching, which may influence teacher openness to technology integration in the classroom and experimentation with instructional technology tools to further active learning.

Inservice teacher technology SE has a stronger relationship with student engagement SE. Teachers who attribute student engagement to implementation of instructional technology will increase both areas of SE through their mastery experiences, and further development of SE will continue in both areas.

Preservice teacher classroom management and instructional strategy SE were noted as having the most direct relationship with technology integration SE. Research (Tschannen-Moran et al., 1998) has suggested efficacy beliefs of preservice teachers are linked to attitudes toward children and control. Classroom management SE therefore may affect technology integration SE. As the preservice or novice teacher becomes satisfied with his or her classroom management competence, perceived ability to change instructional strategies rises, and it is perceived that technology integration can exist with positive social outcome expectation results. Low correlation of student engagement SE to technology integration SE may indicate preservice teachers do not consider instructional technology tools to contribute to student engagement in the classroom.

Analysis of the TPACK data suggests a relationship exists between preservice and inservice technology integration intrapersonal factors and TPACK, and predictor variables vary for each group. Although TPACK total scores were similar in both preservice and inservice groups, different constructs predicted TPACK in each group. Whereas preservice TPACK total score was predicted by social outcome expectations (OE), inservice TPACK total score was predicted by instructional strategy self-efficacy SE and technology integration SE. Preservice teacher TPACK was predicted by social OE (about 10 percent of the total variance) most strongly, which is constituted by feedback from others and perceived competence as viewed by colleagues. This finding supports previous research by Niederhauser and Perkmen (2008).

Recommendations for Practice

Addressing faulty philosophical foundations of instructional technology use is a challenge that continues to exist (Littrell, Zagumny, & Zagumny, 2005). Technology is presented as an end-goal, rather than as a tool to improve the emotional, metacognitive, and behavioral engagement in students (Fredricks, Blumenfeld, & Paris, 2004). As a result, instructional technology is not infused into the curricula, as Littrel and colleagues (2005) recommended. SE plays a strong role in technology integration in the classroom, and this study suggests that TPACK and technology integration may be stronger within those who perceive high instructional strategy efficacy and student engagement efficacy. This implies that professional development in technology use in the classroom may need to incorporate more of an emphasis on technology integration through those two channels of SE, building on the competency beliefs of inservice teachers and providing additional modeling and vicarious experience situations to continue efficacy development and foster technology integration.

Preservice teacher education should continue its track toward hands-on, constructivist teaching that incorporates a variety of mastery experiences (Bunch et al., 2012b). Bandura (1997) suggested mastery experiences were the most influential on perceived self-confidence. Increased mastery experiences with instructional technology would allow preservice teachers to not only perceive themselves as self-confident but also as self-competent, resulting in successful integration into the professional classroom.

Recommendations for Future Research

While this study suggests preservice and inservice teacher technology knowledge and efficacy beliefs are similar, additional studies with larger sample sizes are needed to validate and potentially expand on the research findings presented here. Further, current research could benefit from an in-depth, qualitative examination of the preservice group and the inservice group to explore the characteristics of vicarious and mastery experiences on targeted groups and technology integration SE. Stability of technology SE perceptions and TPACK in both groups may also reveal important indicators to assist in answering questions related to technology integration and infusion.

The differences that exist in TPACK predictors between preservice and inservice teacher groups suggest further examination of age groups is detrimental in understanding when in the teacher's career the SE factor becomes more influential to TPACK than OE, and what factors make a contribution to that transition. Further study on the number of perceived mastery experiences and TPACK score may also be beneficial in understanding the role of SE belief in technology integration. Mastery experiences are purported as the most significant experiences influencing SE beliefs (Bandura, 1986), which in turn affect motivation not only of the teacher but also the students in addition to influencing engagement and technology integration.

Lastly, a longitudinal study of preservice and inservice teacher levels of technology integration SE and TPACK could be beneficial in isolating occurrences and experiences that both hinder and encourage technology integration into the agricultural education classroom.

Discussion

The results of this study contribute to the growing area of research indicating that a complex system of interrelated intrapersonal variables contributes to technology integration and TPACK. Although external factors such as funding, lack of IT support, and lack of technology skills training continue to be external barriers to technology integration in agricultural education classrooms (Bunch et al., 2012a; Bunch et al., 2012b), this study suggests the intrapersonal factors of self-efficacy, outcome expectations, and interest not only have a relationship with technology integration self-efficacy, but may also serve as predictors of TPACK.

The importance of teacher beliefs and values cannot be ignored in the research of instructional technology decision-making. Further study regarding the formation and dynamics of teacher beliefs toward technology integration and motivation to integrate is crucial in determining *best practices* for education and professional development programs for preservice and inservice teachers. Differences in predictors for TPACK in the preservice and inservice groups suggest approaches to education regarding technology use must be differentiated to be effective in engaging teachers to implement technology.

The research presented here suggests experienced inservice teachers view technology tools as a mechanism to engage students and achieve instructional gains, whereas novice and preservice teachers tend to see technology tools as a mechanism for improving classroom management. Viewing technology only as a classroom management tool, and as one that distracts and provides temporary student pacification within the learning environment will not result in instructional technology infusion into content and curriculum (Koehler & Mishra, 2008; Littrell, et al., 2005). Rather, technology tools will be seen as novelties to satiate an uninterested classroom.

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