Technology Adoption for Use in Instruction by Secondary Technology Education Teachers

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Introduction

We have come a long way from using just desktop PCs in the 1980s to using a wide variety of technology for instructional purposes such as the Internet, the iPod, blogging, laptop computers, podcasting, e-learning platforms (e.g., Moodle, Blackboard), interactive whiteboards with video-capture technology, streaming videos, and using iPod as a digital notebook. We have also moved from a local classroom to a global classroom via distance learning technology.

An example of a school system with a 21st century infrastructure is Saugus Union in California. Saugus Union has remained on the cutting edge of technology (THE 2006 innovators, 2006). Examples of their use of technology in instruction include PDAs and interactive whiteboards, podcast lesson reviews via students' MP3 players, and broadcasts streamed via the Internet. A key component to their success has been technology specialists who deliver ongoing professional development. Saugus Union's futuristic philosophy has allowed the district to improve communication and collaboration among students, staff, parents, and the community.

Unfortunately, this is not the norm. Not all school systems are operating with this innovative use of technology even though 99% of full-time teachers had access to computers or the Internet somewhere in their schools by 1999, according to a National Center for Education Statistics (NCES) study (Roward, 2000). Then, about the same time as the NCES report, Stanford University Professor Larry Cuban bemoaned the status of technology use in education by writing a book entitled, *Oversold and Underused: Computers in the Classroom* (2003). Recently, writing in the Phi Delta Kappan, Allen (2008) discussed one of the issues addressed by *A Nation at Risk*, namely, that schools were not adequately preparing students to address the country's needs for highly skilled workers in new and evolving fields. Allen implied that although education has spent large amounts of money on technology for instruction, perhaps education has not kept pace with the use of technology in schools over the last 25 years.

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Technology Adoption Research

Research could not be found that addressed how technology teachers are integrating technology in their instruction. However, several studies have been conducted in other areas of career and technical education. For example, Thomas, Adams, Meghani, and Smith (2002) conducted a national study of the effects and consequences of Internet usage in schools with career and technical education programs in which they concluded that the Internet was a transformative agent that enhanced teachers' professional development opportunities, equalized student opportunities, changed learning, altered social status, and modified teaching-learning systems. Studies related to technology adoption in career and technical education clearly indicate that career and technical education teachers should adopt technology for use in instruction (Chapman, 2006; Redmann & Kotrlik, 2004; Womble, Adams, & Stitt-Gohdes, 2000). Redmann and Kotrlik (2004) also found that agriscience, business, and marketing teachers were actively exploring the potential for uses of technology in teaching and learning, were adopting technology for regular use in instruction, but were not actively experimenting with technology.

Abbot and Fouts (2001) found that over half of the teachers they studied did not routinely use technology in teaching and learning. Cuban, Kirkpatrick, and Peck (2001) found in a study of high school teachers, administrators, and students that access to technology by itself ". . . seldom led to widespread teacher and student use" (p. 813). The lack of technology use in teaching and learning may be related to the adoption of innovations. How quickly individuals adopt change is related to whether they value the new approach when compared to their existing approach (Rogers, 2003). The adoption of technological change is usually accomplished in three stages: adoption, implementation, and continuation (Fullan, 2001). Fullan indicated that teachers need time to merge their improved knowledge into their instructional practice as a basis for the acceptance of innovations.

Variables Related to Technology Adoption

Technology Adoption Barriers

Brinkerhoff (2006) reported that teachers often fail to build on technology's instructional potential due to barriers such as institutional and administrative support, training and experience, attitudinal or personality factors, and resources. Barriers can be defined as ". . . any factor that prevents or restricts teachers' use of technology in the classroom" (The British Educational Communications and Technology Agency [BECTA], 2003, ¶1). BECTA reported that teacher-level barriers included lack of time, lack of necessary knowledge, and lack of self-confidence in using technology. Administrative-level barriers included access to equipment, technical support, availability of up-to-date software, and institutional support. BECTA (2003), Redmann and Kotrlik (2004), and Mumtaz (2000) concluded that technology unavailability was an important factor inhibiting the use of technology by teachers. Park and

Ertmer (2008) expanded on the barriers identified above by stating ". . . a lack of a clear, shared vision was the primary barrier. Additional barriers included lack of knowledge and skills, unclear expectations, and insufficient feedback" (p. 631).

Technology Anxiety

Technology anxiety has resulted from equipping teachers with technology but failing to provide appropriate teacher training or to consider curricular issues (Budin, 1999). Technology anxiety has been found to explain variation in technology adoption by career and technical education teachers (Redmann & Kotrlik, 2004). Redmann and Kotrlik concluded that technology adoption increased as technology anxiety decreased.

Technology Training and Availability

Vannatta and Fordham (2004) found that the amount of technology training was one of the best predictors of technology use. However, it is interesting to note that BECTA (2003) reported that training is focused on teaching basic skills rather than addressing the integration of technology in the classroom. Regarding technology availability, Mumtaz (2000) and BECTA (2003) found that a lack of technology availability was a key factor in preventing teachers from using technology in their instruction.

Gender

Anderson (1996) reported in his analysis of studies of computer anxiety and performance that several studies concluded gender was a significant factor in explaining differences in computer anxiety and attitudes toward computers, while other studies found that no relationships existed. Kotrlik, Redmann, Harrison, and Handley (2000) found that gender did not explain any variance in the value placed on information technology by agriscience teachers.

Age and Teaching Experience

Waugh (2004) concluded that technology adoption decreased as age increased. In regard to teaching experience, Mumtaz (2000) reported that a lack of teaching experience with technology was a factor that resulted in teachers avoiding the use of technology and an NCES study (Smerdon et al., 2000) reported that more experienced teachers were less likely to utilize technology than less experienced teachers.

Need for the Study

Organizational and political realities support the need for technology-based instruction (Bower, 1998; *No Child Left Behind Act*, 2001) and technology educators must continue to explore the incorporation of technology in instruction. This study addressed technology education teachers' use of technology in their instruction. The results should contribute to efforts to enable the instructional use of technology to achieve its maximum possible impact.

Purpose and Research Questions

This study addressed secondary technology education teachers' use of technology in instruction. The research questions were:

1. What are selected demographic and personal characteristics of technology education teachers?
2. To what extent have teachers adopted technology for use in their instruction?
3. What barriers exist that may prevent teachers from using technology in their teaching?
4. Do teachers experience technology anxiety when attempting to use technology in instruction?
5. Do selected variables explain a significant proportion of the variance in teachers' technology adoption? The variables used in the regression analysis were the teachers' technology anxiety level, perceived barriers to technology adoption, technology resources available to the teacher, training sources used, age, years teaching experience, and gender.

For the purposes of this study, technology was defined as "high-tech media utilized in instruction such as computers, e-mail, Internet, list-serves, CD-ROMs, software, laser disc players, interactive CDs, digital cameras, scanners, digital camcorders, etc."

Method

The population for the study consisted of all secondary technology education teachers in Louisiana. Each mailing consisted of a questionnaire, cover letter, and stamped, addressed, return envelope. The sample size was based on Cochran's formula (Snedecor & Cochran, 1989). Three data collection efforts were used - two mailings of the questionnaire and a telephone follow-up of non-respondents in which a random sample of non-respondents were asked to complete and return the questionnaire. Sixty-seven out of 134 teachers returned their surveys for a 50.0% response rate.

To determine if the responses were representative of the population and to control for non-response error, inferential t-tests were used to compare the scale means of the technology adoption, barriers to technology integration, and technology anxiety scales for those responses received during the phone follow-up to those received by mail as recommended by Gall, Gall, and Borg (2002). These scales are described in the instrumentation section below and these scales were selected for non-response analysis because they were the primary variables of interest in the study. No statistically significant differences were found between the means by response mode for these variables (see Table 1); therefore, the data were considered representative of the population and the mail and phone follow-up responses were combined for further analyses.

Instrumentation

The instrument contained three scales: technology adoption for use in instruction (15 items), barriers to technology integration in instruction (7 items), and technology anxiety experienced while attempting to use technology in instruction (9 items). All scales and other items used in the instrument were developed by the researchers after a review of related research literature. The face and content validity of the instruments were evaluated by an expert panel of university faculty and teachers enrolled in doctoral programs. The instruments were pilot tested with career and technical education teachers enrolled in a comprehensive graduate program in career and technical education. The reliability of the three scales was calculated using Cronbach's *alpha*: technology adoption, $\alpha = .98$, barriers, $\alpha = .84$, and technology anxiety, $\alpha = .98$. All scales possessed exemplary reliability according to the standards for instrument reliability for Cronbach's alpha by Robinson, Shaver and Wrightsman (1991).

Table 1

Analysis of Scale Means for Responses Received from Technology Education Teachers via Mail versus Responses Received via Telephone Follow-up

Scale	Mail Respondents	Telephone Follow-up Respondents	Levene's Test for Equality of Variances				
	m (n/sd)	*m (n/sd)*	*F*	*p*	*t*	*df*	*p*
Technology Adoption[a]	3.67 (44/1.13)	3.78[b] (22/.99)	.95	.33	-.39	47.45	.70
Barriers to Technology Integration	2.03 (42/.67)	2.06[c] (22/.60)	.65	.42	-.19	62	.85
Technology Anxiety	1.91 (43/1.01)	2.07[d] (22/.85)	.77	.38	-.64	63	.52

Notes: [a] Equal variances were not assumed for the *t*-test for technology adoption because the Levene's Test for Equality of Variances resulted in a statistically significant *F* value.
[b] Technology Adoption Scale: 1 = Not Like Me, 2 = Very Little Like Me, 3 = Some Like Me, 4 = Very Much Like Me, 5 = Just Like Me.
[c] Barriers to Technology Integration Scale: 1 = Not a Barrier, 2 = Minor Barrier, 3 = Moderate Barrier, 4 = Major Barrier.
[d] Technology Anxiety Scale: 1 = No Anxiety, 2 = Some Anxiety, 3 = Moderate Anxiety, 4 = High Anxiety, 5 = Very High Anxiety.

Data Analyses

Descriptive statistics were used to analyze the data for research questions 1-4. Forward multiple regression was used to analyze the data for research question 5. The effect sizes for the correlation and multiple regression analyses were interpreted according to Cohen's (1988) guidelines.

Results

Research Question 1 – Personal and Demographic Characteristics

The ages of the technology teachers ranged from 29 to 71 years and averaged 48.70 years (*SD* = 8.73). Most (57 out of 67) of the teachers were male (57 or 85.1%) while only 10 were female (14.9%). The number of years teaching experience ranged from 2 to 35 years with the average teacher having 21 years (*M* = 21.15, *SD* =9.72). The main source of technology training used by the teachers was 'self-taught' followed by workshops/conferences (Table 2).

Table 2
Sources of Technology Training Used by Technology Education Teachers

Source	#	%
Self-taught	64	95.5
Workshops/conferences	61	91.0
Colleagues	55	82.1
College courses	35	52.2

Note: *N* = 67. The teachers were asked to place a check mark (Y) beside each type of technology training they had used.

The technology available to teachers presented in Table 3 shows that over two-thirds had a school email account (97.0%), a computer with an Internet connection both at school (94.0%) and at home (82.1%), and a videocassette, CD or DVD recorder (68.7%). Almost one half had a digital video camera (46.3%) while fewer than one-third had students with school email accounts (28.4%), GPS (Global Positioning System) (19.4%), or a PDA (personal digital assistant) (4.5%).

Research Question 2 – Technology Adoption

The teachers' adoption of technology for use in instruction was measured using the authors' Technology Adoption Scale. The teachers responded to 15 items using an anchored scale: 1 = Not Like Me At All, 2 = Very Little Like Me, 3 = Somewhat Like Me, 4 = Very Much Like Me, and 5 = Just Like Me. The means and standard deviations for the items in the technology adoption scale, along with the interpretation scale, are presented in Table 4.

The highest rated item in this scale was "I have made physical changes to accommodate technology in my classroom or laboratory," which they indicated was "Very Much Like Me" (*M* = 4.25, *SD* = .98). The second highest rated item was "I emphasize the use of technology as a learning tool in my classroom or laboratory," which they also indicated was "Very Much Like Me" (*M* = 4.06, *SD* = 1.10). The lowest rated item was "I use technology based games or simulations on a regular basis in my classroom or laboratory," which they indicted was "Somewhat Like Me" (*M* = 2.78, *SD* = 1.43). The mean for the scale was 3.71 (*SD* = 1.08), indicating that the teachers perceived the items in the scale overall to be "Very Much Like Me." The scale mean also indicates that technology education teachers had not adopted technology for use in instruction at the highest level, "Just Like Me".

Table 3
Types of Technology Available to Technology Teachers for Use in Instruction

Technology Available for Use in Instruction	#	%
Teacher has school email account	65	97.0
Teacher has computer with Internet connection at school[a]	63	94.0
Teacher has computer with Internet connection at home[a]	55	82.1
Video Cassette, CD, or DVD Recorder[a]	46	68.7
Interactive DVDs or CDs[a]	40	59.7
Teacher has access to enough computers in a classroom or lab for all students to work by themselves or with one other student	38	56.7
Laser disc player or standalone DVD or CD players[a]	35	52.2
Digital video camera[a]	31	46.3
Students have a school email account	19	28.4
GPS (Global Positioning System)[a]	13	19.4
Personal Digital Assistant (e.g., Palm, IPAQ, Blackberry)[a]	3	4.5

Notes: *N* = 67. The teachers were asked to place a check mark (Y) beside each type of technology that was available for their use in instruction.
[a]The number of technologies available to each teacher ranged from 0 to 9 and was totaled to create an available technology score for use in the regression analysis for research question 5.

Research Question 3 – Barriers to Integrating Technology in Instruction

The Barriers to Integrating Technology in Instruction Scale was developed by the researchers and used to determine the magnitude of barriers that may prevent technology education teachers from integrating technology in their instruction. The teachers responded to seven items using the following anchored scale: 1 = Not a Barrier, 2 = Minor Barrier, 3 = Moderate Barrier, and 4 = Major Barrier. The means and standard deviations for the items in the Barriers to Integrating Technology in Instruction Scale, along with the interpretation scale, are presented in Table 5.

Overall, the teachers were experiencing minor barriers as they integrated technology in instruction (Scale *M* = 2.04, *SD* = .64). They experienced moderate barriers with "Availability of technology for the number of students in my classes" (*M* = 2.64, *SD* = 1.14), with the "Availability of technical support to effectively use instructional technology in the teaching/learning process" (*M* = 2.59, *SD* = 1.02), and with having "Enough time to develop lessons that use technology" (*M* = 2.55, *SD* = 1.13). The statement with the lowest rating was "Administrative support for integration of technology in the teaching/learning process" (*M* = 1.83, *SD* = 1.01), which indicated they were only experiencing minor barriers.

Table 4
Responses to the Items in the Technology Adoption Scale

Item	*N*	*M*	*SD*
1. I have made physical changes to accommodate technology in my classroom or laboratory.	67	4.25	0.98
2. I emphasize the use of technology as a learning tool in my classroom or laboratory.	67	4.06	1.10
3. I expect my students to use technology so they can take on new challenges beyond traditional assignments and activities.	67	3.97	1.28
4. I expect my students to fully understand the unique role that technology plays in their education.	67	3.97	1.13
5. I discuss with students how they can use technology as a learning tool.	67	3.88	0.90
6. I expect my students to use technology to enable them to be self-directed learners.	67	3.81	1.22
7. I design learning activities that result in my students being comfortable using technology in their learning.	67	3.81	1.30
8. I expect students to use technology to such an extent that they develop projects that are of a higher quality level than would be possible without them using technology.	67	3.81	1.22
9. I regularly pursue innovative ways to incorporate technology into the learning process for my students.	67	3.70	1.33
10. I incorporate technology in my teaching to such an extent that it has become a standard learning tool for my students.	66	3.68	1.43
11. I am more of a facilitator of learning than the source of all information because my students use technology.	66	3.59	1.36
12. I assign students to use the computer to do content related activities on a regular basis.	67	3.57	1.32
13. I use technology to encourage students to share the responsibility for their own learning.	67	3.43	1.26
14. I incorporate technology in my teaching to such an extent that my students use technology to collaborate with other students in my class during the learning process.	66	3.35	1.43
15. I use technology based games or simulations on a regular basis in my classroom or laboratory.	67	2.78	1.43

Note: *N* = 67. Scale interpretation ranges for the scale means: 1 = Not Like Me at All (1.00-1.49), 2 = Very Little Like Me (1.50-2.49), 3 = Somewhat Like Me (2.50-3.49), 4 = Very Much Like Me (3.50-4.49), and 5 = Just Like Me (4.50-5.00). Scale *M* = 2.78 (*SD* = 1.43).

Table 5
Responses to Barriers to Integrating Technology in Instruction Scale

Item	*N*	*M*	*SD*
1. Availability of technology for the number of students in my classes.	67	2.64	1.14
2. Availability of technical support to effectively use instructional technology in the teaching/ learning process.	66	2.59	1.02
3. Enough time to develop lessons that use technology.	67	2.55	1.13
4. Scheduling enough time for students to use the Internet, computers, or other technology in the teaching/learning process.	67	2.43	1.05
5. Availability of effective instructional software for the courses I teach.	67	2.37	0.97
6. My ability to integrate technology in the teaching/learning process.	67	2.09	0.87
7. Administrative support for integration of technology in the teaching/learning process.	65	1.83	1.01

Note: *N* = 67. Scale interpretation ranges for the scale means: 1 = Not a Barrier (1.00-1.49), 2 = Minor Barrier (1.50-2.49), 3 = Moderate Barrier (2.50-3.49), 4 = Major Barrier (3.50-4.00). Scale *M* = 2.04 (*SD* = .64).

Research Question 4 – Teachers Perceived Technology Anxiety

A researcher-developed scale, the Technology Anxiety Scale, was used to determine the anxiety technology teachers feel when they think about using technology in their instruction. The teachers responded to 12 items using the following anchored scale: 1 = No Anxiety, 2 = Some Anxiety, 3 = Moderate Anxiety, and 4 = High Anxiety, and 5 = Very High Anxiety. The means and standard deviations for the items in the Technology Anxiety Scale, along with the interpretation scale, are presented in Table 6.

The technology teachers were experiencing some anxiety as they integrated technology in their instruction. The scale mean (Scale *M* = 1.97, *SD* = .95) and all item means were in the “Some Anxiety” range. They were experiencing their highest anxiety level with the question, “How anxious do you feel when you cannot keep up with important technological advances?” (*M* = 2.15, *SD* = 1.09). They reported their lowest anxiety level when asked, “How anxious do you feel when you think about using technology in instruction?” (*M* = 1.75, *SD* = 1.06).

Research Question 5 – Explanation of Variance in Technology Adoption

Forward multiple regression was used to determine if selected variables explained a substantial proportion of the variance in the adoption of technology for use in instruction. The Technology Adoption Scale mean was the dependent variable in this analysis. Based on the review of literature, six teacher demographic or personal variables were identified as potential explanatory variables: age, gender, years of teaching experience, perceived barriers to integrating technology in instruction, technology anxiety, training sources used, and technology available for use in instruction. The training sources used by the teachers are presented in Table 2. The training sources score was calculated by

Table 6
Technology Education Teachers' Responses to Technology Anxiety Scale

Item	*N*	*M*	*SD*
1. How anxious do you feel when you cannot keep up with important technological advances?	67	2.15	1.09
2. How anxious do you feel when you are not certain what the options on various technologies will do?	67	2.10	0.99
3. How anxious do you feel when you think about your technology skills compared to the skills of other teachers?	66	2.05	1.27
4. How anxious do you feel when someone uses a technology term that you do not understand?	67	2.04	1.04
5. How anxious do you feel when you hesitate to use technology for fear of making mistakes you cannot correct?	67	2.03	1.06
6. How anxious do you feel when you are faced with using new technology?	66	1.98	1.06
7. How anxious do you feel when you try to understand new technology?	67	1.97	0.98
8. How anxious do you feel when you try to use technology?	67	1.91	1.00
9. How anxious do you feel when you try to learn technology related skills?	67	1.88	0.99
10. How anxious do you feel when you avoid using unfamiliar technology?	67	1.87	0.95
11. How anxious do you feel when you fear you may break or damage the technology you are using?	67	1.76	1.10
12. How anxious do you feel when you think about using technology in instruction?	65	1.75	1.06

Note: *N* = 67. Scale interpretation ranges for the scale means: 1 = No Anxiety (1.00-1.49), 2 = Some Anxiety (1.50-2.49), 3 = Moderate Anxiety (2.50-3.49), 4 = High Anxiety (3.50-4.00), 5 = Very High Anxiety (4.50-5.00). Scale *M* = 1.97 (*SD* = .95).

assigning one point for each of the four training sources. The technology types included in the technology available for instruction variable are shown in Table 3. The score was computed by assigning one point for each of nine types of technology.

The correlations of the seven demographic and personal variables with the Technology Adoption Scale score are shown in Table 7. Due to the minimum number of observations needed per variable for the regression analysis, it had been determined *a priori* that only those variables that were significantly correlated with the adoption scale score would be utilized in the regression analysis.

The data in Table 7 show that the adoption scale score is moderately correlated with four of the ten variables, namely, barriers to technology integration (r = -.32), technology anxiety (r = -.42, technology availability (r = .43), and the use of colleagues as a training source (r = -.31). Therefore, these four variables were utilized in the forward multiple regression analysis. The sample size was adequate for this analysis. According to Hair, Black, Babin, Anderson, and Tatham (2006), a minimum of 5 observations per variable was required, but 15-20 observations for each potential explanatory variable were desirable in a forward regression analysis.

Table 7
Correlations of Selected Variables with Teachers' Technology Adoption Scores

Variable	*r*	*p*	*N*
Age	.04[a]	.793	60
Gender	.06[a]	.619	67
Years Teaching Experience	.02[a]	.859	67
Barriers to Technology Integration	-.32[b]	.011	64
Technology Anxiety	-.42[b]	<.001	65
Technology Available	.33[b]	.006	67
Training Sources:			
Self –taught	-.02[a]	.853	66
Workshops/conferences	.19[a]	.122	66
College courses	-.04[a]	.751	66
Colleagues	-.31[b]	.012	66

Notes: $N = 67$
[a]Negligible association according to Cohen (1988).
[b]Moderate association according to Cohen (1988).

Multicollinearity did not exist in the regression analysis (see Table 8). Hair et al. (2006) stated, "The presence of high correlations (generally, .90 and above) is the first indication of substantial collinearity" (p. 227). None of the independent variables had a high correlation with any other independent variable. Hair et al. (2006) also stated, "The two most common measures for assessing both pairwise and multiple variable collinearity are tolerance and its inverse, the variance inflation factor [VIF]. … Moreover, a multiple correlation of .90 between one independent variable and all others …would result in a tolerance value of .19. Thus, any variables with tolerance values below .19 (or above a VIF of 5.3) would have a correlation of more than .90" (Hair et al., 2006, pp. 227, 230). None of the tolerance values observed was lower than .19 and none of the VIF values exceeded 5.3.The three variables entered into the forward multiple regression analysis combined to explain 37% of the variance (R^2) in technology adoption in instruction. The variable "technology anxiety" entered the model first and accounted for 17% of the variance, followed by "technology available for instruction" which accounted for an additional 13% of the variance. Colleagues as a training source entered the model last, explaining an additional 7% of the variance. Technology adoption increases as technology available (Standardized b =.35) increases, as technology anxiety decreases (Standardized b = -.40), and when teachers use colleagues as a training sources (Standardized b = -.27). A regression model that explains 37% of the variance represents a large effect size (Cohen, 1988). "Barriers to technology integration" did not explain additional variance in technology adoption. The multiple regression analysis is presented in Table 8.

Table 8
Forward Regression Analysis Model Explaining Variance in Technology Adoption in Instruction Scale Mean

	S	*df*	*MS*	*F*	*p*
Regression	27.57	3	9.19	11.43	<.001
Residual	46.66	58	.80		
Total	74.23	61			

					Change Statistics		
Explanatory Variables in Model	***R***	R^2	**Adjusted** R^2	***SE***	R^2 **Change**	***F* Change**	***P* of *F* Change**
Technology anxiety	.41	.17	.15	1.02	.17	12.01	.001
Technology anxiety, technology availability	.55	.30	.28	.94	.13	11.13	.001
Technology anxiety, technology availability, training source: colleagues	.61	.37	.34	.90	.07	6.68	.012

Excluded variable

Variable	**Beta In**	***t***	***p***	**Partial *r***
Barriers to technology adoption	.02	.20	.843	.03

Notes: *N* = 67
Dependent variable: technology adoption. Technology Adoption Scale: 1 = Not Like Me at All, 2 = Very Little Like Me, 3 = Somewhat Like Me, 4 = Very Much Like Me, and 5 = Just Like Me.
Technology Anxiety Scale: 1 = No Anxiety, 2 = Some Anxiety, 3 = Moderate Anxiety, 4 = High Anxiety, 5 = Very High Anxiety.
Technology Available variable potentially ranged from 0 to 9 points, but the actual range was 0 to 8 points since none of the respondents had all nine types of technology.
Barriers to Integration Scale: 1 = Not a Barrier, 2 = Minor Barrier, 3 = Moderate Barrier, 4 = Major Barrier.
The combined variables included in the multiple regression model represent a large effect size according to Cohen (1988): $R^2 > .0196$ - small effect size, $R^2 > .13$ - moderate effect size, and $R^2 > .26$ - large effect size.

Conclusions, Recommendations and Discussion

Just over half of technology education teachers use college courses for technology training purposes while most use self-taught, colleagues and workshops/conferences as technology training sources. These conclusions are similar to those by Redmann and Kotrlik (2004), with one exception: technology education teachers utilized colleagues as a training source at a much lower level than the secondary career and technical education teachers.

Most teachers have a school e-mail account, a computer with Internet connection at school, a computer with Internet connection at home, and a VCR, CD, or DVD Recorder. Over half have interactive DVD or CD players, access to enough computers in a classroom or lab for all students to work by themselves or with another student, and laser disc or standalone DVD or CD players.

Technology education teachers have substantially adopted technology for use in instruction, but they are not making the maximum use of technology. This conclusion is supported by the scale mean for the technology adoption scale being at the "Very Much Like Me" level, but not up to the "Just Like Me" level. This level of technology adoption may be related to the availability of technology for use in instruction. Some technology teachers have not had access to the latest technology for use in their classrooms and labs, while others have and are using many types of technology. The adoption of technology for use in instruction at this level could be reflective of the concerns voiced by Budin (1999) who indicated that teachers should question how technology should be utilized in the curriculum, what teachers should know about the use of technology in teaching, and how the impact of technology adoption should be assessed.

Technology education teachers are experiencing minor barriers to technology integration and some technology anxiety as they strived to integrate technology in their instruction. This agrees with the results of the national study conducted by the National Center for Education Statistics in which it was concluded that teachers were encountering barriers in their efforts to integrate technology in instruction (Smerdon et al., 2000).

Individually, perceived barriers to technology integration and technology anxiety have moderate negative associations with technology adoption, while technology availability and using colleagues as a training source have a moderate positive relationship with technology adoption. As perceived barriers and technology anxiety increase, technology adoption in instruction by technology education teachers decreases; as technology availability increases and as technology teachers use colleagues as training sources, technology adoption increases. However, only three of these variables, barriers to technology integration, technology anxiety, and the use of colleagues as a training source combine to explain a large proportion of the variance in technology adoption. Technology adoption increases as barriers and technology anxiety decrease, and as technology teachers use colleagues as a training source. The conclusion regarding using colleagues as a training source is supported by

Park and Ertmer (2008) who found, in their study of the barriers that middle-school teachers faced when implementing technology-enhanced problem-based learning, that one of the differences between typical and expert teachers was collaboration with other teachers. These conclusions also support the research reported by Redmann and Kotrlik (2004) in which technology adoption was related to barriers to technology integration and technology anxiety; however, technology availability did not contribute to the explanation of variance in technology adoption in their study. These conclusions partially support the research by Smerdon, et al. (2000), in which they found that the major issues in integrating technology into instruction included access to technology and barriers to the integration of technology.

Efforts must be made to encourage and support technology teachers as they work to integrate technology in the teaching/learning process. Local school districts, the state department of education, and college faculty must continue to take responsibility for leading the efforts needed to implement these improvements successfully. This may involve developing a shared vision among these stakeholders as recommended by Park and Ertmer (2008).

Technology teachers must proactively embrace learning opportunities. Teachers must use knowledgeable colleagues to assist them in developing the skills needed to integrate technology in their instruction and continue to use conferences, workshops, college courses, and self-directed learning to stay current. These efforts on the part of teachers should result in increased technology adoption. Major responsibility for leadership, training, technology, and technical support must be taken by school systems as they work to reduce or eliminate barriers to technology integration. These recommendations may also have implications for state departments of education and university teacher education programs.

Technology education research should explore factors that may impact teachers' individual or collective learning in a technology supported learning environment, e.g., the efficacy of specific technologies, a shared vision by stakeholders, learning task types, instructional approaches, interdisciplinary activities/learning communities, technology anxiety, and technology barriers. Researchers should seek to identify optimal approaches for teacher training for technology education.

In the future, several questions should be addressed. What should the future structure of technology teacher education look like? What impact do philosophical, organizational, political, and other local realities have on technology adoption and how the technology education profession should address these realities? The answers to these questions should help create and support a productive future for technology education, and ultimately, the preparation of students for a more technologically complex work environment.

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