Journal of Agricultural Education
Volume 50, Number2, pp. 62 – 74
DOI: 10.5032/jae.2009.02062

A TREND STUDY: TECHNOLOGY ADOPTION IN THE TEACHING-LEARNING PROCESS BY SECONDARY AGRISCIENCE TEACHERS—2002 AND 2007

Joe W. Kotrlik, Professor
Donna H. Redmann, Professor
Louisiana State University

Abstract

This study was designed to determine agriscience teachers' adoption of technology for use in instruction and to determine if their technology adoption and perceived barriers to technology adoption had changed since the 2002 benchmark study. This study was part of a larger study of technology adoption by secondary career and technical education teachers. Data were collected with a mailed questionnaire with telephone follow-up to a random sample of secondary agriscience teachers in Louisiana. Teachers have increased their technology adoption for use in instruction over the past 5 years, although they still do not have access to the technology they need to use technology fully in their instruction. They continue to perceive that moderate barriers exist that prevent them from integrating technology into their teaching, with no change over the past 5 years. Agriscience teachers were experiencing some technology. Teachers continue to use traditional sources for their technology training. The availability of technology and gender are strong predictors of the extent to which agriscience teachers had adopted technology in their teaching.

Introduction

"Technologies change so quickly that it is difficult to build a body of findings over time on any given application" (Roblyer, 2005, p. 193). How long did it take American consumers to adopt radio? Television? The Internet? The iPod? Rogers (2003) described a change process in which individuals adopt innovations if they see benefits of the new strategy relative to what they are using. Rogers further elaborates that rate of adoption of technology may be influenced by perceived attributes of innovations: relative advantage, compatibility, complexity, trialability, and observability.

In his discussion of challenges to changing educational practice, Fullan (2001) articulated a difficult and complex process that included three stages: adoption, implementation, and continuation. Fullan indicated that teachers need time to improve their knowledge and merge this knowledge with their instructional knowledge and actions. "The resistance of teachers to converting from traditional teaching methods to computer-based ones is a fundamental reason for the lack of technological progress in schools. A degree of resistance is understandable and expected because such a conversion requires change" (Dawson & Rakes, 2003, p. 29).

Technology Adoption

The Enhancing Education Through Technology Act of 2001 is an initiative designed to enhance the use of technology in education and is part of the No Child Left Behind Act of 2001. This Act provides grants and resources to integrate technology in instruction. The purpose of this law is to improve student academic achievement through the use of technology (II. D. Sec. 2402, b, 1). Another ongoing initiative is the National Educational Technology Standards (NETS) for teachers, which were originally published in 2000 (International Society for Technology in Education, 2004). As of 2004, "…49 of the 51 states had adopted, adapted, aligned with, or otherwise referenced at least one set of standards in their state technology plans, certification, licensure, curriculum plans, assessment plans, or other official state documents" (50 states plus District of Columbia) (International Society for Technology in Education, ¶ 1). Concurrently, schools are investing more in instructional technology for teachers' use. The most significant change in the classroom today is the availability of Internet in the classroom (Liu & Huang, 2005). According to the National Center for Education Statistics, the percentage of public school classrooms with Internet access has increased from 3% in 1994 to 94% in 2005, and the ratio of students to instructional computers with Internet access has dropped from 12.1:1 in 1998 to 3.8:1 in 2005 (Wells & Lewis, 2006).

Although trend studies of the use of technology in agriscience education have not been conducted, several studies of technology use in secondary instruction have been published. For example, Vannatta and Fordham (2004) found that the commitment of time to teaching, willingness to change, and the amount of technology training are the best predictors of technology use. Other studies have targeted selected types of technology. 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.

Variables Related to Technology Adoption

Barriers to Technology Adoption

Teachers frequently fail to build on the potential offered by technology because of several barriers (Brinkerhoff, 2006). These barriers include institutional and administrative support, attitudinal or personality factors, resources, and training and experience. The British Educational Communications and Technology Agency (BECTA; 2003) defined barriers to the use of information and communications technology in teaching as "…any factor that prevents or restricts teachers' use of technology in the classroom" (¶ 1). They reported that teacher-level barriers included lack of time, lack of the knowledge necessary, and lack of self-confidence in using technology. Administrative-level barriers that were identified included lack of equipment, lack of access to equipment, lack of technical support, availability of up-to-date software, and lack of institutional support. Mumtaz (2000) and BECTA found that a lack of technology availability was a key factor in preventing teachers from using technology in their instruction.

Technology Anxiety. Technology anxiety may influence technology adoption. The placement of technology into classrooms without teacher preparation and consideration of curricular issues has produced high levels of anxiety among teachers (Budin, 1999). Redmann and Kotrlik (2004) found that technology anxiety explained a statistically significant amount of the variance in technology experimentation, technology adoption, and technology integration of career and technical education teachers.

Technology Training. "Spending on hardware and software generally dominates K-12 technology budgets, while money for support, training and professional development does not keep pace" (Hofer, Chamberlin, & Scot, 2004, ¶ 9). Vannatta and Fordham (2004) found that the amount of technology training was one of the best predictors of technology use. BECTA (2003) also reported that there was a lack of training focused on integrating technology in the classroom rather than simply teaching basic skills. Furthermore, there was a lack of training differentiated according to teachers' existing skill levels (BECTA).

Gender. Anderson (1996) reported in his analysis of studies of computer anxiety and performance that the research was mixed regarding gender. Anderson cited several studies that found that gender was not a significant factor in explaining differences in computer anxiety and attitudes toward computers, but other studies found that 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.

Teaching Experience. Mumtaz (2000) stated that a lack of teaching experience was a factor that prevented teachers from using technology. A National Center for Education Statistics study (Smerdon, Cronen, Lanahan, Anderson, Iannotti, & Angeles, 2000) reported that teaching experience was related to the extent to which technology was integrated into schools.

Need for the Study

The benchmark study of technology adoption by agriscience teachers was conducted in 2002 (Kotrlik, Redmann, & Douglas, 2003). At that time, agriscience teachers were functioning at a moderate level in their adoption of technology for use in instruction. They were experiencing moderate barriers that hindered their adoption of technology for use in instruction and they were experiencing a moderate level of technology anxiety. Their major source of technology training was workshops and conferences. The results of the 2002 study were communicated to state program leaders in the department of education, professional association officers, the five universities that prepare agriscience teachers in the state, and others involved in leading the agriscience education program in Louisiana.

A trend study was needed to determine if the adoption of technology had progressed beyond the level documented in 2002. In their article addressing technology integration in P-12 schools and the challenges to implementation and impact of scientifically-based research, Schrum and Glassett (2006) recommend an "…increase in studies on impact of technology on teaching, learning, student outcomes, instruction, and pedagogy…" (p. 53). Thomas et al. (2002) conducted a national study of the use of the Internet in high schools with career and technical education programs. They concluded, "Longitudinal and time-series studies are needed to determine how the impact of the Internet on the teaching-learning system evolves over time" (p. xiii). These studies address the need to study the variables that may explain teachers' continued adoption of technology.

This trend study was conducted to determine agriscience education teachers' technology adoption and if teachers were adopting technology for use in instruction at a higher level than in 2002, with technology adoption defined in the instrument as, "Instructors have adopted the regular use of technology in the instructional process." This study will also ascertain if selected training sources were still being used by the teachers as found in the previous study.

Purpose

The study's purposes were to determine: (a) agriscience teachers' adoption of technology for use in instruction and (b) if technology adoption and perceived barriers to technology adoption as reported in 2007 differed from the 2002 benchmark study. The research presented in this article was part of a larger study of technology adoption by secondary career and technical education teachers. In this trend study, different people from the same population were surveyed at different times (5 years apart) (Ary, Jacobs, & Razavieh, 2002; Fraenkel & Wallen, 2000). The objectives were to determine:

1. Personal and demographic characteristics of secondary agriscience teachers;
2. The extent to which technology has been adopted in teaching-learning as measured by the Kotrlik-Redmann Technology Adoption Scale (2002a);
3. Agriscience teachers' perceptions of barriers to technology adoption as measured by the Kotrlik-Redmann Barriers to Technology Integration Scale (2002b);
4. Agriscience teachers technology anxiety levels as measured by the Kotrlik-Redmann Technology Anxiety Scale (2006); and
5. If teachers' adoption of technology and perceived barriers to technology adoption in instruction had changed over the last 5 years and if selected variables explain technology adoption levels.

Methods and Procedures

Population and Sample

The study used random samples of secondary agriscience educators in taken from the *Louisiana Agriscience Teacher Directory* (Louisiana FFA Association, 2002, 2007). The return rates for 2002 and 2007 were 57% and 71%, respectively. The information on the populations, samples and return rates are presented in Table 1. The sample sizes were based on Cochran's (1977) formula. A smaller sample size was used in 2007 because the population of agriscience teachers is smaller than in 2002 and the estimated standard deviation was overestimated when the sample size was calculated in 2002.

Table 1
Return Rates for the 2002 and 2007 Studies

Year	Population	Sample size	Number returned	Return rate
2002	268	203	115	56.7%
2007	233	154	111	72.1%

Instrumentation

The summated rating scales and items were developed by the researchers. The face/content validity of the instrument was evaluated by an expert panel of university faculty and doctoral graduate students and was pilot tested with teachers in 2002 and 2007. Cronbach's alpha coefficients for the 2002/2007 data collections revealed that all scales possessed exemplary reliability: Technology Adoption Scale (Kotrlik & Redmann, 2002a) – .97/.95, Barriers to Technology Integration Scale (Kotrlik & Redmann, 2002b) – .76/.78, and Technology Anxiety Scale (Kotrlik & Redmann, 2006) – .94. It should be noted that the Technology Anxiety Scale was not included in the 2002 study.

Data Collection

Identical procedures were used for data collection in 2002 and 2007. Two mailings, a telephone follow-up of a random nonrespondent sample, and a second telephone call to those in the follow-up sample who did not respond after the first telephone follow-up call were used (Dillman, 2000). The data analyses used descriptive statistics for the 2007 descriptive objectives, *t*-tests to compare the 2002 with the 2007 scale means, and forward multiple regression to develop an explanatory model for the 2007 data. The alpha level was set *a priori* at .05.

Findings

Personal Characteristics

Most of the teachers were male in 2007 (n = 90, 81.1%). When asked about technology training, most of the teachers reported they were self-taught (n = 106, 95.5%), used workshops (n = 98, 88.3%) and used peers (n = 92, 82.9%) to develop their instructional technology skills. More than one-half (n = 67, 60.4%) used courses to develop their technology skills.

All of the teachers (N = 111, 100.0%) had a school e-mail account, and less than one fifth (n = 21, 18.9%) indicated their students had school email accounts. They were using a variety of technologies including interactive DVDs or CDs (n = 100, 90.1%), digital cameras (n = 88, 79.3%), video cassette/CD/DVD players (n = 78, 70.3%), laser disc players or stand-alone DVD or CD players (n = 68, 61.3%), digital video cameras (n = 49, 44.1%), global positioning systems (n = 37, 33.3%), and personal digital assistants (n = 18, 16.2%). Most had Internet connections at school (n = 110, 99.1%) and at home (n = 98, 88.3%), with both areas showing an increase since 2002, when fewer teachers had Internet access at school (n = 75, 66.4%) or home (n = 95, 84.1%). Over half (n = 56, 50.5%) had access to enough computers in a classroom or lab for all students to work by themselves or with one other student.

Technology Adoption

Teachers responded to the Technology Adoption Scale using 15 statements describing their adoption of technology. The scale ranged from 1 = *not like me* to 5 = *just like me*. See Table 2 for scale interpretation ranges. The scale reliability was excellent (a = .95) (Robinson, Shaver, & Wrightsman, 1991). The technology adoption mean was 3.54 (SD = .77), which indicated that the statements describing technology adoption in the scale were very much like the agriscience teachers; however, technology had not been adopted for use in instruction at the highest level. The highest mean was recorded for the statement, "I have made physical changes to accommodate technology in my classroom or laboratory" (M = 4.15, SD = .78). The lowest mean was recorded for the statement, "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" (M = 2.86, SD = 1.07). These data are presented in Table 2.

Table 2
Technology Adoption by Agriscience Education Teachers

Statement	*N*	*M*	*SD*
I have made physical changes to accommodate technology in my classroom or laboratory.	111	4.15	.78
I emphasize the use of technology as a learning tool in my classroom or laboratory.	111	4.09	.82
I discuss with students how they can use technology as a learning tool.	111	3.83	.80
I expect my students to fully understand the unique role that technology plays in their education.	110	3.78	1.02
I regularly pursue innovative ways to incorporate technology into the learning process for my students.	111	3.62	.99
I expect my students to use technology so they can take on new challenges beyond traditional assignments and activities.	111	3.60	1.02
I expect my students to use technology to enable them to be self-directed learners.	111	3.54	1.12
I design learning activities that result in my students being comfortable using technology in their learning.	111	3.52	.94
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.	111	3.52	1.09

Statement	*N*	*M*	*SD*
I incorporate technology in my teaching to such an extent that it has become a standard learning tool for my students.	111	3.51	1.04
I use technology to encourage students to share the responsibility for their own learning.	111	3.43	1.02
I assign students to use the computer to do content related activities on a regular basis.	109	3.35	1.09
I am more of a facilitator of learning than the source of all information because my students use technology.	111	3.30	1.01
I use technology based games or simulations on a regular basis in my classroom or laboratory.	111	2.89	1.06
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.	111	2.86	1.07
Technology Adoption Scale	108	3.54	.77

Note. Scale: 1 = not like me, 2 = very little like me, 3 = some like me, 4 = very much like me, and 5 = just like me. Scale interpretation: 1–1.49 = not like me, 1.50–2.49 = very little like me, 2.50–3.49 = some like me, 3.50–4.49 = very much like me, and 4.50–5.00 = just like me. The Kotrlik-Redmann Technology Adoption Scale (2002a) is based on the Kotrlik-Redmann Technology Integration Model (2002). Cronbach's alpha = .95.

Barriers

Teachers responded to seven statements in the Barriers to Technology Integration Scale that described the "magnitude of barriers that may prevent you from integrating technology into the teaching/learning process." The perceived barriers were rated on a scale that ranged from 1 = *not a barrier* to 4 = *major barrier*. Scale reliability was excellent (*a* = .80) (Robinson et al., 1991). See Table 3 for scale interpretation ranges. The technology integration barriers mean was 2.54 (*SD* = .62), which indicated the agriscience teachers were experiencing moderate barriers to integrating technology in their instruction. Teachers reported their highest barrier with the "Availability of technology for the number of students in my classes" (*M* = 3.14, *SD* = .97) and reported their lowest barrier with "Administrative support for integration of technology in the teaching/learning process" (*M* = 1.89, *SD* = .98). These data are presented in Table 3.

Table 3
Barriers That May Prevent Agriscience Teachers from Integrating Technology in the Teaching/Learning Process

Statement	*N*	*M*	*SD*
Availability of technology for the number of students in my classes	111	3.14	.97
Enough time to develop lessons that use technology	111	2.91	.88
Scheduling enough time for students to use the Internet, computers, or other technology in the teaching/learning process	111	2.91	.89
Availability of technical support to effectively use instructional technology in the teaching/learning process	111	2.53	1.01
Availability of effective instructional software for the courses I teach	109	2.37	.90
My ability to integrate technology in the teaching/learning process	111	1.95	.78
Administrative support for integration of technology in the teaching/learning process	111	1.89	.98
Barriers to Technology Integration Scale	109	2.54	.62

Note. Scale: 1 = not a barrier, 2 = minor barrier, 3 = moderate barrier, and 4 = major barrier. Scale interpretation: 1–1.49 = not a barrier, 1.50–2.49 = minor barrier, 2.50–3.49 = moderate barrier, and 3.50–4.00 = major barrier. Cronbach's alpha = .80.

Technology Anxiety

The teachers were asked to respond to the Technology Anxiety Scale (12 statements) that described technology anxiety on a 5-point scale that ranged from 1 = *no anxiety* to 5 = *very high anxiety*. See Table 4 for scale interpretation ranges. The scale reliability was excellent (*a* = .94) (Robinson et al., 1991). The technology anxiety mean was 2.06 (*SD* = .73), which indicated that teachers were experiencing "some anxiety." Teachers indicated they experienced their highest level of anxiety on the item, "How anxious do you feel when you cannot keep up with important technological advances?" (*M* = 2.37, *SD* = .98), and they reported their lowest level of anxiety on the item, "How anxious do you feel when you think about using technology in instruction? (*M* = 1,73, *SD* = .76). The technology anxiety data is presented in Table 4.

Table 4
Agriscience Education Teachers' Perceptions of Their Technology Anxiety

How anxious do you feel when	*N*	*M*	*SD*
…you cannot keep up with important technological advances?	111	2.37	.98
…you are not certain what the options on various technology will do?	111	2.21	.92
…you hesitate to use technology for fear of making mistakes you cannot correct?	111	2.17	.98
…you are faced with using new technology?	111	2.14	1.00
…you try to understand new technology?	111	2.11	.89
…someone uses a technology term that you do not understand?	111	2.09	1.00
…you avoid using unfamiliar technology?	111	2.06	.86
…you try to learn technology related skills?	111	1.97	.86
…you try to use technology?	111	1.96	.82
…you think about your technology skills compared to the skills of other teachers?	111	1.95	1.06
…you fear you may break or damage the technology you are using?	111	1.92	.94
…you think about using technology in instruction?	111	1.73	.76
Technology Anxiety Scale	111	2.06	.73

Note. Scale: 1 = no anxiety, 2 = some anxiety, 3 = moderate anxiety, 4 = high anxiety, and 5 = very high anxiety. Scale interpretation: 1–1.49 = no anxiety, 1.50–2.49 = some anxiety, 2.50–3.49 = moderate anxiety, 3.50–4.49 = high anxiety, and 4.50–5.00 = very high anxiety. Cronbach's alpha = .94.

Changes in Technology Adoption and Perceived Barriers

Independent *t*-tests were used to compare the level of technology adoption in 2002 (M = 2.80, SD = .95, n = 113) with the level reported in 2007 (M = 3.54, SD = .77, n = 108). Technology adoption by agriscience teachers was significantly higher in 2007 than in 2002 (t = 6.38, $P < .001$, d = .86). The Cohen's *d* value of .86 indicates that the difference represents a large effect size (Cohen, 1988). Independent *t*-tests were also used to compare the barriers to technology integration experienced by agriscience teachers in 2002 (M = 2.62, SD = .56, n = 113) with the barriers to technology integration reported in 2007 (M = 2.54, SD = .62, n = 109). No differences existed in the barriers to technology integration between the 2002 and 2007 samples. (t = 1.01, P >.05).

Explaining Technology Adoption

Forward regression was used to determine if selected variables explained variance in technology adoption (Hair, Black, Babin, Anderson, & Tatham, 2006). The dependent variable was the mean of the Technology Adoption Scale. Potential explanatory variables included: the means of the technology adoption, barriers to technology integration, and technology anxiety scales; gender; years of teaching experience; technology availability; and training sources used. The technology availability variable was constructed by summing the types of technology available to the teacher for use in instruction; one point was given for each of nine types of technology. The technology available and the training sources were discussed previously under the subheading, "Personal Characteristics."

The data were examined for multicollinearity. 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. also stated,"The two most common measures for assessing both pairwise and multiple variable collinearity are tolerance and its inverse, the variance inflation factor" (p. 227). An examination of the tolerance values and the variance inflation factors revealed that multicollinearity did not exist.

Two variables explained significant amounts of the variance in technology adoption (Total R^2 = .22): technology availability (R^2 = .12), and gender (additional R^2 = .10). Barriers to technology integration, technology anxiety, number of training sources used, and years teaching experience did not enter the model. Technology adoption increased as technology availability increased and female teachers had higher levels of technology adoption than male teachers. The ANOVA table for the regression analysis is presented in Table 5, the model summary is presented in Table 6, and information on the variables excluded from the regression model is presented in Table 7.

Table 5
ANOVA Table for Forward Multiple Regression Analysis of Technology Adoption Scale Scores

	SS	*df*	*MS*	*F*	*P*
Regression	11.45	2	5.73	13.81	<.001
Residual	41.47	100	.42		
Total	52.92	102			

Note. Dependent variable: mean of the Technology Adoption Scale. Predictor variables: technology availability and gender.

Table 6
Model Summary for Forward Multiple Regression Analysis of Technology Adoption Scale Scores

					Change statistics				
Model	*R*	R^2	Adjusted R^2	Std. error of the estimate	R^2 Change	*F* Change	df1	df2	*P* (*F* Change)
1[a]	.35	.12	.12	.68	.12	14.36	1	101	<.001
2[b]	.47	.22	.20	.64	.09	11.73	1	100	.001

Note. Dependent variable: mean of the Technology Adoption Scale. The standardized beta coefficient for technology availability was .35, whereas the standardized beta coefficient for gender was .30. Gender was dummy coded with 1 = male and 2 = female.
[a]Predictor variable: technology availability.
[b]Predictor variables: technology availability and gender.

Table 7
Variables Excluded from the Forward Multiple Regression Analysis Model for the Technology Adoption Scale Scores

					Collinearity statistics		
Variable	Beta in	*t*	*P*	Partial correlation	Tolerance	VIF	Minimum tolerance
Barriers to technology integration	-.01	-.05	.96	-.01	.76	1.31	.76
Technology anxiety	-.10	-1.12	.26	-.11	.94	1.06	.94
Number of training sources used	<.01	.02	.98	<.01	.77	1.29	.77
Years of teaching experience	.03	.28	.78	.03	.86	1.17	.86

Note. Dependent Variable: mean of the Technology Adoption Scale. Predictor variables: technology availability and gender.

Conclusions

Agriscience teachers have adopted technology for use in instruction, but not at the highest level. Agriscience teachers have had a large increase in their technology adoption for use in instruction over the past 5 years. According to Rogers (2003), it may be that trialability, observability, and compatibility may have increased the adoption of technology use in the classroom. The teachers still do not perceive they have access to the technology they need to fully use technology in their instruction. They continue to perceive that moderate barriers exist that prevent them from integrating technology into their teaching, with no change occurring over the past 5 years. Agriscience teachers were experiencing some technology anxiety.

The availability of technology and gender are predictors of the extent to which agriscience teachers had adopted technology in their teaching, with female teachers and teachers with higher levels of available technology being more likely to adopting technology for use in instruction. The conclusion related to gender may conflict with the conclusions of a previous study conducted by Kotrlik et al. (2000), in which gender did not explain any variance in the value placed on information technology by teachers. This conclusion also conflicts with another study conducted by Kotrlik et al. (2003), in which gender did not explain any significant variance in technology adoption by agriscience teachers. These conclusions lead to several questions. Why does gender now explain significant variance in technology adoption when previous research found that gender was not a factor? Why are women agriscience education teachers more likely to use technology than men? Do women do a better job of implementing and continuing the use of technology than men, thereby exhibiting less resistance to new technology (Dawson & Rakes, 2003; Fullan, 2001)?

Teachers continue to use traditional sources for their technology training. Almost all of the teachers have Internet connections at home and at school and laboratories with enough computers with Internet connections to allow all students to work by themselves or in pairs. Substantial increases have occurred in the number of teachers with

Internet connections at home and school, the percentage of schools with classrooms or labs with Internet connections, and the percentage of schools possessing other teaching technologies. This supports the findings of the National Center for Education Statistics (Wells & Lewis, 2006). More teachers are using the available technology training sources available than in 2002 (Kotrlik et al., 2003).

Recommendations and Implications

Technology continues to be used as the basis of an enriched instructional environment. The use of technology has become the norm, which has resulted in agriscience education being better equipped to deliver quality career training. However, many programs still do not have access to some of the newer technologies and teachers continue to experience moderate barriers. The instructional use of technology continues to change to an environment where technology is commonly used as a component of agriscience education. Today's use of technology includes the use of computers and the Internet as in the past, plus many other technologies including personal digital assistants, global positioning systems, digital video and photo cameras, and interactive DVDs. Agriscience education teachers must continue to improve their programs, and technology continues to be an important tool in their professional arsenal. Teachers should continue to use their peers as a training source. In fact, Thomas et al. (2002) recommend that mentor training should be provided for teachers who have technology expertise so that they can better assist their colleagues. Thomas et al. also recommended that mentor teachers' workload should be adjusted so that they can mentor other teachers without being overburdened. More research is needed to understand the best sources or methods of training as well as the real or perceived barriers being experienced by agriscience teachers.

Several additional studies relating to technology use in instruction are needed. First, the culture of the school environment should be examined to see if it is conducive to further improvements in the use of technology in instruction. The relationship between teachers' pedagogical beliefs and their use of technology in instruction should be studied. School principals' practices related to supporting technology use in instruction are also a rich area for further research. Research is needed to determine how technology can be used to improve learning and the learning environment, especially from the learner's perspective. Future studies should also address the "real" or "practical" value of using technology in instruction. Last, but certainly not least, additional research is needed to determine why women are now adopting technology at a higher rate than men in agriscience education.

References

Anderson, A. A. (1996). Predictors of computer anxiety and performance in information systems. *Computers in Human Behavior, 12*(1), 61-77.

Ary, D, Jacobs, L. C., & Razavieh, A. (2002). *Introduction to research in education* (6th ed.). Belmont, CA: Wadsworth/Thomson.

Brinkerhoff, J. (2006). Effects of a long-duration, professional development academy on technology skills, computer self-efficacy, and technology integration and beliefs. *Journal of Research on Technology in Education, 39*(1), 22-43.

British Educational Communications and Technology Agency (BECTA). (2003). *What the research says about barriers to the use of ICT in teaching*. Retrieved January 27, 2007, from http://www.becta.org.uk/ research/ictrn/

Budin, H. (1999). The computer enters the classroom. *Teachers College Record, 100*(3), 656-669.

Cochran, W. G. (1977). *Sampling techniques* (3rd ed.). New York: Wiley.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Dawson, C., & Rakes, G. C. (2003). The influence of principals' technology training on the integration of technology into schools. *Journal of Research on Technology in Education, 36*(1), 29-49.

Dillman, D. A. (2000). *Mail and Internet surveys: The tailored design method* (2nd ed.). New York: Wiley.

Fraenkel, J. R., & Wallen, N. E. (2000). *How to design and evaluate in education* (4th ed.). Boston, MA: McGraw-Hill.

Fullan, M. (2001). *The new meaning of educational change* (3rd ed.). New York: Teachers College Press.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). Upper Saddle River, NJ: Pearson/Prentice Hall.

Hofer, M., Chamberlin, B., & Scot, T. (2004). Fulfilling the need for a technology integration specialist. *T.H.E. Journal, 32*(3). Retrieved January 28, 2007, from http://www.thejournal.com/the/printarticle/?id=16981

International Society for Technology in Education. (2004). *National educational technology standards (NETS) and the states: Use of NETS by state.* Washington, DC: Author. Retrieved April 23, 2007, from http://cnets.iste.org/docs/states_using_nets.pdf

Kotrlik, J. W., & Redmann, D. H. (2002a). *Kotrlik-Redmann Technology Adoption Scale©*. Baton Rouge, LA: Author.

Kotrlik, J. W., & Redmann, D. H. (2002b). *Kotrlik-Redmann Barriers to Technology Integration Scale©*. Baton Rouge, LA: Author.

Kotrlik, J. W., & Redmann, D. H. (2006). *Kotrlik-Redmann Technology Anxiety Scale©*. Baton Rouge, LA: Author.

Kotrlik, J. W., Redmann, D. H., & Douglas, B. B. (2003). The relationship of selected teacher and program characteristics to technology adoption in agriscience education programs. *Journal of Southern Agricultural Education Research, 53*(1), 70-83.

Kotrlik, J. W., Redmann, D. H., Harrison, B. C., & Handley, C. H. (2000). Information technology related professional development needs of Louisiana agriscience teachers. *Journal of Agricultural Education, 41*(1), 18-29.

Liu, Y., & Huang, C. (2005). Concerns of teachers about technology integration in the USA. *European Journal of Teacher Education, 28*(1), 35-47.

Louisiana Department of Education. (2002). *Louisiana agriscience teachers directory*. Baton Rouge, LA: Author.

Louisiana Department of Education. (2007). *Louisiana agriscience teachers directory*. Baton Rouge, LA: Author.

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: A review of the literature. *Journal of Information Technology for Teacher Education, 9*(3), 319-342.

No Child Left Behind Act of 2001, Pub L. No. 107-1105. Washington, DC: U. S. Congress.

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

Robinson, J. P., Shaver, P. R., & Wrightsman, L. S. (1991). Criteria for scale selection and evaluation. In J. P. Robinson, P. R. Shaver, & L. S. Wrightsman (Eds.). *Measures of personality and social psychological attitudes* (pp. 1-16). New York: Academic Press.

Roblyer, M. D. (2005). Educational technology research that makes a difference: Series introduction. *Contemporary Issues in*

Technology and Teacher Education, 5(2), 192-201.

Rogers, E. (2003). *Diffusion of innovations* (5th ed.). New York: The Free Press.

Schrum, L., & Glassett, K. F. (2006). Technology integration in P-12 schools: Challenges to implementation and impact of scientifically-based research. *Journal of Thought, 41*(1), 41-58.

Smerdon, B., Cronen, S., Lanahan, L., Anderson, J., Iannotti, N., & Angeles, J. (2000). *Teachers' tools for the 21st century: A report on teachers' use of technology.* Washington, DC: National Center for Education Statistics, U.S. Department of Education.

Thomas, R., Adams, M., Meghani, N., & Smith, M. (2002). *Internet integration in high schools: Patterns, opportunities, and barriers*. St. Paul, MN: National Research Center for Career and Technical Education. (ERIC Document Accession No. ED 476034). Retrieved May 24, 2007, from http://www.nccte.org/publications/infosynthesis/r&dreport/Internet_Integration.pdf

Vannatta, R. A., & Fordham, N. (2004). Teacher dispositions as predictors of classroom technology use. *Journal of Research on Technology in Education, 36*(3), 253-271.

Wells, J., & Lewis, L. (2006). *Internet access in U.S. public schools and classrooms: 1994-2005 (NCES 2007-020)*. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Retrieved April 1, 2007, from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2007020

JOE W. KOTRLIK is a Professor in the School of Human Resource Education and Workforce Development at Louisiana State University, 142 Old Forestry Building, South Stadium Drive, Baton Rouge, LA 70803-5477. E-mail: kotrlik@lsu.edu. Phone: 225-578-5753.

DONNA H. REDMANN is a Professor in the School of Human Resource Education and Workforce Development at Louisiana State University, 142 Old Forestry Building, South Stadium Drive, Baton Rouge, LA 70803-5477. E-mail: redmann@lsu.edu. Phone: 225-578-2465.