Extent of Technology Integration in Instruction by Adult Basic Education Teachers

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EXTENT OF TECHNOLOGY INTEGRATION IN INSTRUCTION BY ADULT BASIC EDUCATION TEACHERS

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This descriptive research study examined the extent of technology integration in instruction by adult basic education teachers. Teachers are in the earlier stages of integrating technology and are more active in the area of exploration. However, they are not experimenting with the use of technology at the same level and have not been innovative in integrating technology at the advanced level. Teachers feel some anxiety when it comes to technology integration; however, they perceive they are effective regardless of whether they have integrated technology, and they are encountering barriers. As teachers perceive an increase in barriers, their integration of technology decreases; also, as the availability of student e-mail and the number of computers with Internet connection in the classroom and/or lab increases, their integration of technology increases. Teachers' perceived technology anxiety and their self-perceptions of their teaching effectiveness do not explain the extent of technology integration.

Keywords: *technology integration; adult basic education; models; effectiveness; barriers; teachers*

The use of technology in our society has grown rapidly in recent years. This is especially true in the field of adult basic education (ABE). The microcomputer was introduced in the 1980s as a viable instructional tool and the Internet became another key instructional tool in the late 1990s. Today, instructors use computers, the Internet, CD-ROMs, interactive media, satellites, teleconferencing, and other technology to support, enhance, inspire, and create learning. Now that many types

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of technology are available to ABE teachers, how extensively is technology actually being used to facilitate instruction? In this study, ABE includes programs that provide instruction in reading, writing, math, communications, and other basic skills as it prepares these students to take the General Educational Development (GED) exam. This study was designed to determine the extent of technology integration in instruction by ABE teachers in programs operated by public school systems.

Several research studies have been conducted in attempts to determine whether the use of technology in the teaching-learning process has improved learner performance. Many studies document improvement (e.g., Khalili & Shashoani, 1994; Moore & Kearsley, 1996), and there are also many studies that have not found any significant differences between technologically based and traditional instructional approaches (e.g., Moore & Kearsley, 1996; Timmermann, 1998). The debate about the efficacy of technology integration continues, but one fact has been established. Organizational and political realities indicate that technology-based instruction is a viable alternative (Bower, 1998). Bower (1998) summarized the need for the integration of technology in the teaching-learning process in the following way: "Is computer based instruction popular with students and educators? Yes. Does it improve student performance? Maybe. Is it worth the cost? Probably. Must we continue to explore this innovative pathway to education? Definitely" (p. 65). Even if there is a lack of proof that the use of technology in instruction improves student performance, ABE teachers should model the use of technology because the use of technology continues to increase in educational, workplace, and personal environments.

The literature that follows addresses the impact of technology on adult learners and teachers, technology integration in the teaching-learning process, barriers to technology integration, and technology anxiety. The literature concludes with a discussion of technology integration and teaching effectiveness.

Impact of Technology on Adult Learners and Teachers

In the classroom, technology can help students perform at increased levels by promoting innovative approaches to teaching and learning (George, 2000). Technology also provides learners with additional ways to improve literacy and other areas of learning by going beyond the traditional textbook (George, 2000). In her discussion of learning strategies in adult education, Olgren (2000) stated,

> Using technology for education and training offers many challenges, but perhaps the greatest is to focus not on the technology itself but on the learner and learning. Technology invites a tools-first emphasis, but technology is only as good as our knowledge of how to use it to enhance learning. (p. 7)

For the learning environment, learners need to acquire lifelong-learning skills and the ability to cope with constantly changing workplaces. "Today's students need not only to know how to learn, but how to analyze and summarize data, make decisions, work in teams, plan solutions to complex problems, and be capable of adapting to the unexpected" (Dwyer, 1999, p. 300). Dwyer stated that technology-based learning environments could help students acquire the type of KSAs (knowledge, skills, attitudes) needed for success.

What progress has been made in creating technology-based learning environments? According to the Office of Technology Assessment's (OTA) 1995 report on teachers and technology, schools have made significant progress in implementing technology in helping teachers to use basic technology tools, but they still struggle with integrating technology into the curriculum. "As technology is assimilated into so many aspects of our lives and work, there arises an urgent cry for it to be adopted" in adult education settings as well (King, 2003, p. 50). In ABE programs, teachers function in an environment where they are compelled to integrate technology in the teaching-learning process. Technology must be used to support instruction, and adult learners should be able to use technology as an important tool to meet their learning needs. Because adult educators have received little preparation in integrating technology in teaching and learning, ABE teachers become learners themselves as they strive to integrate technology (King, 2003).

TECHNOLOGY INTEGRATION IN THE TEACHING-LEARNING PROCESS

As ABE teachers examine ways to integrate technology, they may wish to consider the four methods cited by Ginsburg (1998):

- Technology as a curriculum where students learn about technology as well as acquire technology knowledge and skills (e.g., courses to learn how to use Internet browsers, word processors, databases, etc.);
- Technology as an instructional delivery mechanism (e.g., individualized learning systems);
- Technology as a complement to instruction where the learner uses technology to practice skills or to extend learning (e.g., using software packages for drill and practice of routine computations or spelling); and
- Technology as an instructional tool used to support or enhance learning activities (e.g., using word processing software to write an essay or the Internet to conduct research for an essay).

Examples of these four methods of integration were provided by the National Center for Education Statistics (2000) when they studied the integration of various technologies in the teaching-learning process by all teachers. They reported the following examples: 44% reported using technology for classroom instruction, 42%

reported using computer applications, 12% reported using practice drills, 41% reported requiring research using the Internet, 20% required students to use technology to solve problems and analyze data, 27% had students conduct research using CD-ROMs, 27% assigned students to produce multimedia reports and projects, 23% assigned graphical presentations of materials, 21% assigned demonstrations or simulations, and 7% assigned students to correspond with others over the Internet. No data could be found that described technology use specifically by adult educators.

As teachers participate in the evolutionary process of technology integration, Sandholtz, Ringstaff, and Dwyer (1997) describe five phases of evolution: (1) Entry—teachers adapt to changes in physical environment created by technology; (2) adoption—teachers use technology to support text-based instruction; (3) adaptation—teachers integrate the use of word processing and databases into the teaching process; (4) appropriation—teachers change their personal attitudes toward technology, and (5) invention—teachers have mastered the technology and create novel learning environments. Sheingold and Hadley (1990) found that teachers needed 5 to 6 years of working with technology before they felt they had developed their expertise, and that once they were at this level, they modified instructional strategies and dramatically changed the classroom environment. For technology integration to occur, King (1999) found that adult teachers need to have hands-on technology training that will facilitate positive changes in teachers' perspectives and practice and unleash teachers' interest in exploring and using technology in teaching.

BARRIERS TO TECHNOLOGY INTEGRATION

The impact of the integration of technology may be affected by the barriers encountered by both the adult learner and the adult educator. These barriers include funding and cost, lack of training or expertise, lack of time, access to technology, resistance to change, teachers' attitude, and the organizational structure of the ABE program (Black, 1998; Budin, 1999; Fabry & Higgs, 1997; George, 2000; Ginsburg & Elmore, 2000; Glenn, 1997; Jaffee, 2001; King, 1999; OTA, 1993; Smerdon et al., 2000).

When the challenges faced by adult learners were examined, the OTA's (1993) report, *Adult Literacy and New Technologies: Tools for a Lifetime*, found that "adults with limited literacy skills are among the least affluent consumer groups. Many cannot afford technological devices" (p. 213). Adults with a lower level of schooling have fewer computers at home than adults with 4 or more years of college (OTA, 1993). Jaffee (2001) found similar issues. "Funding is a major issue in the adult learner's pursuit of technology. Many adult learners do not possess the necessary funds to acquire technological devices" (p. 115), nor do they use technology on their jobs and cannot learn to use technology when their ABE programs do not have the technology available (Jaffee, 2001). Adult learners are also challenged by

time-management issues as they attempt to juggle family, work, social life, and other outside forces. These forces place such great demands on adult learners that they can only devote a small amount of time to the development of their technology skills. "Those involved in the education of adults cannot forget the needs, demands, and challenges they and their learners face daily when working with technology" (Lawler & King, 2003, p. 89).

In addition to the barriers faced by students, teachers encounter their own set of barriers to technology integration. Hopey (1999) stated, "Adult educators usually are the last to access a new technology, whether a VCR or the Internet. This is principally due to lack of funding and training" (¶15). When one considers reasons why teachers have not integrated technology in the teaching and learning process, Ginsburg and Elmore (2000) point out that

> adult educators often do not have rich informal opportunities to learn from one another and to share questions about teaching-related issues. "Student teaching" is a luxury not found in adult education, and, with part-time schedules and off-site classes, it is rare that teachers can arrange opportunities to visit colleagues' classrooms and watch what's going on.
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> This situation is of particular concern when considering the issue of technology, because teachers cannot fall back on well-developed models from their own learning experiences. They may need support to effectively incorporate technologies into their instructional activities so as to enhance the quality of instruction while giving learners an opportunity to master the technology skills that are essential in our changing world. (pp. 5-6)

Other issues faced by teachers in the integration of technology were found in several meta-analyses conducted by Fabry and Higgs (1997) and supported by George (2000): resistance to change, teachers' attitudes, training, time, access, lack of expertise, and cost. Funding issues were also cited by King (1999) when she stated that "ABE programs are often not as well equipped with technology resources as other educational organizations because of limited funding resources" (p. 162). The work by Fabry and Higgs (1997) and George (2000) was supported by a study by Smerdon et al. (2000) for the National Center for Education Statistics in which they found that the barriers experienced by teachers in the use of the Internet and computers for instruction included lack of computers, lack of release time for teachers to learn how to use this technology, and lack of time for student computer use.

These barriers have not gone unnoticed by researchers, and the professional development needs of adult teachers were partially addressed by Black's (1998) baseline needs assessment. This study addressed teachers' needs in the area of computers and did not address other types of technology. The findings emphasized the need for computer technology training: Even though the teachers had access to computers, they wanted to know the advantages of computer-facilitated training

and, due to time constraints, did not want to work with complex computer applications. Another type of barrier studied has been the structure of the educational environment. Glenn (1997) indicated that the organizational structure inhibits teachers' efforts to learn about new technologies and resists innovation. Budin (1999) pointed out that until recently, educational institutions had their priorities backwards. They were more concerned with acquiring equipment and software than emphasizing teacher development and planning for the integration of technology. Budin questioned what will happen to support for technology integration in the future if the results of funding technology integration in terms of test scores, students' writing, and other measures fail to live up to expectations. The use of technology needs to be reconceptualized in areas such as students' and teachers' roles in using technology, how technology fits into the curriculum, what teachers should know and how teachers will learn about technology, and how we should assess the impact of technology (Budin, 1999). According to the OTA (1995), "A majority of teachers reported feeling inadequately trained to use technology resources" (p. 3).

TECHNOLOGY ANXIETY

Technology anxiety may be one unique type of anxiety. Budin (1999) stated that the placement of technology into classrooms without teacher preparation and curriculum considerations has produced high levels of anxiety among teachers. Although most educators would agree with Budin, no research could be found that documents teachers' anxiety relative to implementing technology, other than just computers. Most of the research on technology-related anxiety has been conducted in the area of computer anxiety and using computers as program or instructional management tools (word processors, grade books, databases, presentations, etc.).

Technology anxiety may be reduced when learners have knowledge of the phases through which they will progress as they learn to use technology. Russell (1995) identified six stages that naive adult users go through when learning to use technology: awareness, learning the process, understanding an application of the process, familiarity and competence, adaptation to other contexts, and creative application to new contexts. Also, teachers' understanding of these stages may assist them to pass through the stages more rapidly. King (2003) cited four stages indicated by research that educators go through as they learn to use technology, and she also indicated that these stages are consistent with the needs of educators of adults: "1) fear and uncertainty, 2) testing and exploring, 3) affirming and connecting current knowledge, and finally, 4) a new perspective of the impact of using technology in educative processes" (p. 54). Technology and psychological support are important because early successful encounters with technology will create enthusiasm and build teachers' confidence (Hardy, 1998; Russell, 1995).

TECHNOLOGY INTEGRATION AND TEACHING EFFECTIVENESS

How does the teachers' integration of technology relate to their perceptions of their own teaching effectiveness? Lu and Molstad (1999) listed ways that technology can improve instructional effectiveness: (a) multimedia packages allow teachers to interact with large groups, lead discussions, individualize instruction, and direct student attention to key details in the presentation; (b) telecommunication tools allow teachers to communicate with students and other teachers, encouraging articulation of ideas and collaboration; (c) technology enhances students' problem-solving ability; and (d) technology motivates students to learn.

In a critical review of the literature on the effectiveness of computers in adult literacy and basic education classrooms, Berger (2001) found that almost half of the studies found significant improvements in reading scores. However, many of the studies had flawed research designs, research procedures, or data analysis procedures. Even with the flaws cited, Berger concluded that computers were effective in promoting learning.

However, teachers do not see computers as part of the normal classroom process and often use them for ancillary activities (Bosch, 1993). Bosch (1993) recommended that administrators look beyond the number of computers provided and determine whether real integration across the curriculum had occurred. Integration may not be possible due to shortcomings related to teacher effectiveness such as the lack of faculty training on the use in instructional technology, classrooms that were not designed to support the use of technology, teachers' doubts about whether technology would improve their performance, and teachers' concerns about whether technology enhances or detracts from teaching and learning (Byron, 1995).

Yet, Lang (1998) indicated the effectiveness of technology integration in adult basic and literacy education is not a technology issue. Rather, it is an educational issue requiring systemic change and a commitment to staff development to facilitate ABE teachers' progress through the technology integration stages. Motivation and readiness are important factors related to ABE teachers' learning technology (King, 1999). Findings from King's study of ABE in-service and preservice teachers transformational learning revealed that teachers who participate in professional development that includes hands-on experience, critical reflections, and dialogue experienced gains in self-confidence, expertise, and enthusiasm in using technology in the classroom. Also, teachers who use technology in their classrooms seem to change their instructional methods and attitudes (Jordan & Follman, 1993).

NEED FOR THE STUDY

Little theoretical groundwork for technology planning in adult basic and literacy education has emerged. Most studies and resources focus on educational technology in K-12 settings. Those which evaluate technology's potential in adult education usually

> concentrate on the technology itself—the hardware and software—and not on effective integration. (Lang, 1998, ¶11)

No research could be found regarding the extent of technology integration in the teaching-learning process by ABE teachers. This information is critical to ensure that technology integration achieves maximum effectiveness and impact. This study was designed to determine the extent of technology integration in instruction by ABE teachers in programs operated by public school systems. This information is critical to the design and delivery of a professional development program for ABE teachers.

PURPOSE AND OBJECTIVES

The purpose was to determine the extent of technology integration in instruction by ABE teachers in programs operated by public school systems. The objectives were to determine

(a) the extent to which technology has been integrated into the teaching-learning process based on the four levels of the Kotrlik-Redmann Technology Integration Model (© 2002);
(b) the magnitude of barriers that may prevent teachers from integrating technology into the teaching/learning process;
(c) the technology anxiety of teachers;
(d) teachers' perceptions of their teaching effectiveness;
(e) the sources of technology training and types of technology used by teachers; and
(f) whether selected variables explain a significant proportion of the variance in advanced technology integration scores. The potential explanatory variables used in this analysis were the number of technology training sources used, barriers to technology integration, teachers' technology anxiety level, perceived teaching effectiveness, and six types of technology available for use by the teacher in instruction.

For this study, technology was defined as "employing the Internet, computers, CD-ROMs, interactive media, satellites, teleconferencing, and other technological means to support, enhance, inspire and create learning."

RESEARCH METHOD AND PROCEDURES

Population and Sample

The population included 311 ABE teachers employed by public secondary school systems in Louisiana as listed in the directory of ABE teachers obtained from the Louisiana Department of Education. These teachers work with learners in ABE programs to obtain the GED diploma. These teachers work with ABE students who range in age from 16 to older than 60, although the average age is 19, and includes adult students who will eventually earn their GED as well as those who

will never earn the GED. Most are full-time K-12 teachers of math, English, or other subjects and earn extra income by working part-time as ABE teachers, although some school systems employ full-time ABE teachers. Most teach their classes at night in K-12 school buildings, although some teach in industrial settings and community organization buildings. All of the ABE teachers in this study were supervised by the school system's adult education supervisor.

A complete listing of the population was obtained by securing a list of ABE teachers from every public school system in the state. To determine the random sample size needed for this study, Cochran's (1977) sample size formula was used. Based on an alpha level of .05, a standard error estimate of .03, and the primary variables reported on a 5-point scale, a minimum returned sample size of 85 was required. Because a response rate of approximately 50% was anticipated, a research sample size of 172 was used for this study.

Instrumentation

The instrument was based on the Kotrlik-Redmann Technology Integration Model (2002). The four levels of the model are

(1) Exploration—thinking about using technology. Teachers seek to learn about technology and how to use it.
(2) Experimentation—beginning to use technology. Physical changes start to occur in classrooms and laboratories. Instructors focus more on using technology in instruction by presenting information using presentation software and doing a *few* instructional exercises using spreadsheets, databases, word processors, games, simulations, the Internet, and/or other computer tools.
(3) Adoption—using technology regularly. Physical changes are very evident in the classroom and/or laboratory with the computers becoming a focal point in the classroom and/or laboratory organization. Instructors employ presentation software and technology-based instructional exercises using games, simulations, spreadsheets, databases, word processors, the Internet, or other technology tools as a regular and normal feature of instructional activities. Students shared responsibility for learning emerges as a major instructional theme.
(4) Advanced integration—using technology innovatively. Instructors pursue innovative ways to use technology to improve learning. Students take on new challenges beyond traditional assignments and activities. Learners use technology to collaborate with others from various disciplines to gather and analyze information for student learning projects. The integration of technology into the teaching-learning process has led to a higher level of learning.

The instrument contained three multi-item scales: the Technology Integration Scale (which included four subscales, namely, Exploration, Experimentation, Adoption, and Advanced Integration), the Barriers to the Integration of Technology Scale, and the Perceived Teaching Effectiveness Scale. In addition, several questions and items were used to collect data on personal and demographic variables

such as gender, age, years teaching experience, sources of technology training, types of technology available for the teachers' use, and level of technology anxiety.

An expert panel of university faculty and doctoral-level graduate students with expertise in andragogy, instrument design, research methodology, electronic (e)-learning, and technology integration evaluated the face and content validity of the instrument. The instrument was field tested with 29 teachers. Changes indicated by the validation panel and field test were made, which included wording of items and the instructions for completing the instrument. The standards for instrument reliability for Cronbach's alpha by Robinson, Shaver, and Wrightsman (1991) were used to judge the quality of the three scales in the instrument: .80-1.00 = exemplary reliability, .70-.79 = extensive reliability, .60-.69 = moderate reliability, and <.60 = minimal reliability. Using these standards, all scales possessed exemplary reliability. Internal consistency coefficients for the scales in the instrument were as follows (Cronbach's alpha): Technology Integration Scale = .95; Exploration subscale = .84, Experimentation subscale = .93, Adoption subscale = .95, Integration subscale = .92, barriers scale = .85, and effectiveness scale = .91. A single item was used to assess the teachers' level of technology anxiety using a 4-point response scale for Objective 3.

An attempt was made to construct standard 5-point scales to measure barriers to technology integration (Objective 2) and technology anxiety (Objective 3). However, 4-point scales were used because it was determined that 5 points could not be identified that would precisely measure the targeted constructs while also limiting confusion on the part of the respondents. Only one item was used to measure technology anxiety because the wording of the item was clearly understood by the respondents and clearly measured technology anxiety. The expert panel agreed with this assessment. The test-retest correlation with a 2-week interval was .81, which indicates exemplary reliability according to the standards for reliability by Robinson et al. (1991).

Data Analysis

The data were analyzed using descriptive statistics for Objectives 1 through 5 and forward regression analysis was used for Objective 6. For Objective 1, the means, grand means, and standard deviations for the four subscales of the Kotrlik-Redmann Technology Integration Scale (2002) were used to describe the extent to which technology had been integrated in the teaching-learning process in ABE programs. For Objective 2, the Barriers to Technology Integration Scale was developed and item means, the grand mean, and standard deviations were used to describe this variable. The item mean and standard deviation were used to describe technology anxiety for Objective 3. For Objective 4, item means, the scale grand mean, and standard deviations were used to describe teachers' Self-Perceived Teaching Effectiveness Scale. Numbers, percentages, means, and standard devia-

tions were used to describe the sources of training and type of technology for Objective 5.

Forward multiple regression analysis was used for Objective 6. The dependent variable in this analysis was the grand mean of the Advanced Technology Integration Scale. Ten potential explanatory variables were identified for use in this analysis; these variables are discussed in the findings for Objective 6. The alpha level was set a priori at .05.

Data Collection

The responses were collected using two mailings and a systematic follow-up of a random sample of nonrespondents. A response rate of 59.3% (102 out of 172) was attained after the two mailings and the telephone follow-up.

To determine if the sample was representative of the population and to control for nonresponse error, inferential *t* tests were used to compare the grand means of the Anxiety, Technology Integration, Barriers, and Teaching Effectiveness scales of those questionnaires received by mail to those received during the phone follow-up, as recommended by Borg (1987) and Miller and Smith (1983). The grand means of these scales were selected because they were primary variables of interest in the study. There were no statistically significant differences found between the means by response mode for the primary scales in the instrument. It was concluded that no differences existed by response mode and the data were representative of the population. The mail and phone follow-up responses were combined for further analyses.

FINDINGS

The respondents to this study ($N = 102$) were ABE teachers employed by public secondary school systems in Louisiana. Their ages ranged from 27 to 72 years ($M = 54.1$, $SD = 8.8$), and almost two thirds were women (65.7%, $n = 67$). The number of years of teaching experience ranged from 2 to 49 years ($M = 25.4$, $SD = 10.1$).

Objective 1, technology integration. The four subscales of the Kotrlik-Redmann Technology Integration Scale (2002) were used to determine the extent to which technology had been integrated into the teaching-learning process in ABE programs. The teachers responded to 33 items using the following Likert-type scale: 1 = *not like me at all*, 2 = *very little like me*, 3 = *some like me*, 4 = *very much like me*, and 5 = *just like me*. Examples of the items from the four subscales are presented in Table 1. All items from the four subscales are not included in this article to protect the copyrighted status of the instrument.

Analysis of the grand means for two constructs, experimentation—beginning to use technology ($M = 2.39$, $SD = 1.07$), and advanced integration—using technology innovatively ($M = 1.98$, $SD = .99$), revealed that the teachers perceived the

TABLE 1
Examples of Items in the Four Subscales in the Technology Integration Scale (Kotrlik & Redmann, 2002)

Subscale and Example of Statements	*Grand* M	SD
Subscale: Exploration (5 statements in subscale)	3.53	0.92
I want to take a course to learn how to use technology in the teaching/learning process.		
I talk with my principal or fellow teachers about using technology in my instruction.		
Subscale: Experimentation (9 statements in subscale)	2.39	1.07
I am just beginning to use instructional exercises that require students to use the Internet or other computer programs.		
I am just beginning to experiment with ways to use technology in the classroom.		
Subscale: Adoption (15 statements in subscale)	3.14	1.00
I emphasize the use of technology as a learning tool in my classroom or laboratory.		
I assign students to use the computer to do content-related activities on a regular basis.		
Subscale: Integration (4 statements in subscale)	1.98	0.96
I encourage students to design their own technology-based learning activities.		
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.		

NOTE: *N*s for the four subscales range from 98 to 99. Scale: 1 = *not like me at all*, 2 = *very little like me*, 3 = *some like me*, 4 = *very much like me*, and 5 = *just like me*. The Kotrlik-Redmann Technology Integration Scale© is based on the Kotrlik-Redmann technology integration model (2002). All items from the four subscales are not included in this article to protect the copyrighted status of the instrument.

descriptions of these two constructs as "very little like me." Analysis of the grand mean for the exploration—beginning to use technology ($M = 3.53$, $SD = .92$) construct revealed that the teachers perceived this construct as "very much like me." Analysis of the grand mean for the adoption—using technology regularly ($M = 3.14$, $SD = 1.00$) construct revealed that the teachers perceived this construct as "some like me." These analyses indicated that teachers have explored the use of technology in instruction rather extensively but are just beginning to experiment with technology. The analyses also revealed that teachers are not integrating technology at the advanced integration level.

Objective 2, barriers to technology integration. A researcher-developed scale was used to determine the magnitude of barriers that may prevent teachers from integrating technology into the teaching-learning process (see Table 2). The

TABLE 2

Statements Included in the Scale Measuring Barriers That May Prevent Adult Basic Education Teachers From Integrating Technology Into the Teaching-Learning Process

Statement	M	SD
1. Scheduling enough time for students to use the Internet, computers, or other technology in the teaching/learning process.	2.60	1.23
2. Enough time to develop lessons that use technology.	2.48	1.16
3. Availability of technology for the number of students in my class.	2.42	1.23
4. Availability of technical support to effectively use instructional technology in the teaching-learning process.	2.38	1.12
5. Reliability of the Internet at my school.	2.29	1.30
6. Access to the Internet at my school.	2.29	1.29
7. Availability of effective instructional software for the courses I teach.	2.15	1.12
8. My students' ability to use technology in the teaching-learning process.	2.13	0.88
9. My ability to integrate technology in the teaching-learning process.	2.12	0.93
10. Type of courses I teach.	1.94	0.98
11. Administrative support for integration of technology in the teaching-learning process.	1.75	0.97

NOTE: $N = 102$. Scale grand $M = 2.23$ ($SD = 0.70$). Scale: 1 = *not a barrier*, 2 = *minor barrier*, 3 = *moderate barrier*, and 4 = *major barrier*.

teachers responded using this scale: 1 = *not a barrier*, 2 = *minor barrier*, 3 = *moderate barrier*, and 4 = *major barrier*. The 11 items included statements such as "Having enough time to develop lessons that use technology" and "My ability to integrate technology in the teaching/learning process." The grand mean revealed that teachers perceive that minor barriers exist that prevent them from integrating technology into the teaching-learning process ($M = 2.23$, $SD = .70$).

Objective 3, teachers' technology anxiety. A single item was used to assess the teachers' level of technology anxiety: "How much anxiety do you feel when you think about using technology in your instruction?" The teachers responded using this scale: 1 = *no anxiety*, 2 = *some anxiety*, 3 = *moderate anxiety*, and 4 = *high anxiety*. The analysis of the data revealed that teachers feel some anxiety ($M = 1.85$, $SD = .80$) when they think about using technology in their instruction.

Objective 4, teacher's self-perceived teaching effectiveness. A researcher-developed scale was used to determine the teachers' perceptions of their own teaching effectiveness. The teachers responded using this scale: 1 = *strongly disagree*, 2 = *disagree*, 3 = *undecided*, 4 = *agree*, and 5 = *strongly agree*. All seven items in this scale were worded in superlative language so that strongly agreeing with the statements in this scale indicated teachers perceived they were excellent in their teaching effectiveness (see Table 3). The items included statements such as "I am among the very best teachers at my school" and "My students would rate me as one

TABLE 3
Statements in the Teachers' Perceptions of Their Own Teaching Effectiveness Scale

Statement	M	SD
1. I am highly effective in teaching the content in my courses.	4.25	0.74
2. I am among the very best teachers at my school.	4.14	0.77
3. My principal would say that I am one of the best teachers at this school.	4.07	0.73
4. My students would rate me as one of the very best teachers they have ever had.	3.86	0.75
5. The other teachers in my school would say that I am one of the best teachers at this school.	3.81	0.87
6. I am a role model for other teachers in my school.	3.77	0.82
7. All of my students would evaluate my courses as excellent.	3.58	0.81

NOTE: $N = 100$. Scale grand $M = 3.93$ ($SD = 0.63$). Scale: 1 = *strongly disagree*, 2 = *disagree*, 3 = *undecided*, 4 = *agree*, and 5 = *strongly agree*.

of the very best teachers they have ever had." The grand mean of $M = 3.93$ ($SD = .63$) revealed that teachers agreed with the construct measured by this scale, which indicates that they perceive they are effective teachers.

Objective 5, sources of training and type of technology. The teachers were asked to indicate the sources of their technology training. Five sources were listed, and the teachers were instructed to check all that applied to them. More than three fourths of the teachers had participated in workshops or conferences ($n = 90$, or 88.21%) and almost three fourths were self-taught ($n = 70$, or 73.5%). Smaller numbers learned from colleagues ($n = 57$, or 55.9%) or had taken college courses ($n = 32$, or 31.4%). Few ($n = 15$, or 14.7%) reported that they had used other sources for their technology training. The mean number of technology training sources used by teachers ranged from 0 to 5 and the mean was 2.6 ($SD = 1.2$).

The teachers were asked about the technology that was available for use in the teaching-learning process. The number of computers available to each teacher in the classroom and/or lab ranged from 0 to 75 with a mean of 11.0 ($SD = 10.5$). The number of computers with Internet connection available to each teacher in the classroom and/or lab also ranged from 0 to 75 with a mean of 5.5 ($SD = 9.9$). Almost one half had e-mail accounts ($n = 48$, or 47.1%), whereas smaller numbers had interactive CDs ($n = 34$, or 33.3%), laser disc players, or stand-alone CD players ($n = 14$, or 13.7%), other types of technology available ($n = 14$, or 13.7%), or student e-mail accounts ($n = 7$, or 6.9%). More than three fourths (79, or 77.5%) had a home computer and 75 (73.5%) had Internet access at home. Almost half (48, or 47.1%) reported they had an office at school and 47, or 46.1%, had a computer in their office, whereas 38 (37.3%) reported having a computer with Internet connection in their office.

Objective 6, variables that explain variance in technology integration. Forward multiple regression analysis was used to determine if selected variables explained a significant proportion of the variance in the advanced technology integration scores. The grand mean of the Advanced Integration scale was used as the dependent variable. Ten variables were used as potential explanatory variables: the grand mean of the Barriers to the Integration of Technology Scale, the grand mean of the teachers' perceptions of their own teaching effectiveness scale, the teachers' technology anxiety level, number of sources of technology training (0-5), and technology available for use in instruction (six variables: number of computers in classroom and/or lab, number of computers with Internet connection in classroom and/or lab, interactive CD [0, 1], student e-mail [0, 1], teacher e-mail [0, 1], and interactive CDs/laser discs [0, 1]). Dichotomous variables were dummy coded for use in the regression analysis (0 = no, 1 = yes). The use of 10 potential explanatory variables in this forward multiple regression analysis is supported by Hair, Anderson, Tatham, and Black (1998), who indicated that the ratio of observations per independent variable should never fall below 5 to 1.

Multicollinearity did not exist in the regression analysis. Hair et al. (1998) indicated that "The presence of high correlations (generally, .90 and above) is the first indication of substantial collinearity" (p. 191). The highest correlation between any two independent variables was $r = .35$, which is substantially lower than the .90 criterion. Hair et al. (1998) also indicated that

> two of the more common measures for assessing both pair wise and multiple variable collinearity are (1) the tolerance value and (2) its inverse—the variance inflation factor (VIF). . . . Thus any variables with tolerance values below .19 (or above a VIF of 5.3) would have a correlation of more than .90. (pp. 191, 193)

The lowest tolerance value observed was .44 and the highest VIF value was 2.30.

Three variables explained 19% of the variance in the grand mean of the advanced technology integration scores, namely, the grand mean of the Barriers to the Integration of Technology Scale ($R^2 = .086$, $B = –0.293$), whether students had e-mail accounts (additional $R^2 = .060$, $B = 1.104$), and number of computers with Internet connection in the classroom and/or lab (additional $R^2 = .044$, $B = 0.021$). As the beta values show, the teachers' perceptions of the existence of barriers had a negative impact on the integration of technology in the teaching-learning process, whereas the other two variables have a positive impact on integration (see Table 4). The other variables did not explain a significant proportion of the variance. Based on Cohen's (1988) standards for interpreting effect sizes in multiple regression, the R^2 of .19 for the explanatory variables in this regression model represents a moderate effect size.

TABLE 4
Forward Multiple Regression Analysis of the Advanced Technology Integration Scale Scores

Source	SS	df	MS	F	p
Regression	16.49	3	5.50	7.04	< .001
Residual	70.29	90	0.78		
Total	86.78	93			

Variables in the equation	B	R^2	*Cumulative* R^2
Barriers	–0.293	.086	.086
Whether students had e-mail accounts	1.014	.060	.146
Number of computers with Internet connection in the classroom and/or lab	0.021	.044	.190

Variables not in the equation	t	p
Perceived teaching effectiveness	1.63	.11
Technology anxiety	–1.26	.21
Availability of interactive CDs	–1.28	.20
Teacher has e-mail accounts	1.24	.22
Availability of laser disc player or stand-alone CD players	0.64	.53
Number of computers in classroom and/or lab	–1.47	.15
Number of sources of training	–0.06	.95

CONCLUSIONS AND DISCUSSION

ABE teachers are in the earlier stages of integrating technology in their instruction. They are more active in the area of exploration with using technology in the teaching-learning process. However, they are not experimenting with the use of technology at the same level, and they have not been innovative in integrating technology at the advanced level. This lack of strong integration of technology may be reflective of how technology fits into the curriculum, what teachers should know, and how the impact of technology should be assessed (Budin, 1999). This also indicates that the situation remains basically the same today as was reported in the OTA's 1995 report on teachers and technology in which it was concluded that teachers have made significant progress in implementing technology but still struggle with integrating technology into the curriculum.

ABE teachers are experiencing minor barriers in their efforts to integrate technology. This conclusion directly supports the meta-analysis conducted by Fabry and Higgs (1997), the national study conducted by the National Center for Education Statistics (Smerdon et al., 2000), and work by other researchers (Black, 1998; George, 2000; Ginsburg & Elmore, 2000; Glenn, 1997; OTA, 1993), in which it

was concluded that barriers to technology integration do exist for teachers, even if these barriers are minor.

ABE teachers perceive they are effective regardless of whether they have integrated technology. However, they do feel some anxiety when it comes to the integration of technology. Although no previous research could be found that documents overall technology anxiety of teachers, this conclusion does support previous studies that addressed only computer anxiety (Fletcher & Deeds, 1994; Kotrlik & Smith, 1989).

ABE teachers continue to use traditional sources for technology training such as workshops and conferences, college courses, colleagues, and self-directed learning (Kotrlik, Harrison, & Redmann, 2000). From this study, it is evident that teachers are using workshops and conferences and self-directed learning as sources of technology training at higher levels than they are using college courses or colleagues.

As ABE teachers perceive an increase in barriers to the integration of technology, their integration of technology decreases; also, as the availability of student e-mail and the number of computers with Internet connection in the classroom and/or lab increases, their integration of technology increases. These three variables compose an explanatory multiple regression model that partially explains the extent to which teachers have reached the advanced technology integration level. Previous studies also indicated that access to technology and barriers to the integration of technology (Black, 1998; Fabry & Higgs, 1997; George, 2000; Ginsburg & Elmore, 2000; Glenn, 1997; Hopey, 1999; Jaffee, 2001; King, 1999; OTA, 1993; Smerdon et al., 2000) support the inclusion of these variables in this explanatory regression model.

Recommendations and Implications for Practice

There is still much more that needs to be done to encourage and support ABE teachers in their integration of technology. The existing teacher preparation system and the teachers' own self-development efforts are not resulting in strong technology integration by ABE teachers. ABE personnel at the local level, ABE personnel in the Louisiana Department of Education, and university ABE faculty have a vital role and a definite responsibility in this effort. These leaders must devise ways to improve technology integration by teachers, and teachers must be encouraged by these leaders to expand their use of self-directed learning to support their efforts to integrate technology into their own instruction. Leaders should use the findings from this study relative to barriers to technology integration, technology anxiety, perceived teaching effectiveness, sources of training, and the teachers' personal and demographic characteristics as a basis for designing and implementing these efforts. Just as delivery of university courses continues to change to various technology-based formats, leaders must develop new models that will result in faster and better integration of technology.

Additional research beyond this study is warranted on factors related to technology integration. Even though a moderately effective model explaining 19% of the variance in advanced technology integration was identified, the remaining variance (81%) in advanced technology integration has not been explained. Other explanatory variables should be identified and examined in future research. Also, additional research is needed to determine whether teachers are being adequately prepared to integrate technology.

A single item was used to measure technology anxiety in this study. Although this item did not explain significant variance in advanced technology integration, in retrospect a multi-item scale may have been more valuable in describing the technology anxiety of adult basic educators and may have the potential of explaining variance in advanced technology integration by adult basic educators. Future research should include the development of a scale to measure the technology anxiety of teachers.

Research on the impact of individual barriers on technology integration is needed and research is also needed on the impact of the integration of various types of technology on student learning. Research will be the key to determining the specific contributions made by technology integration.

All ABE stakeholders must participate in this effort to clarify the contributions made by technology integration. How teachers integrate technology in their instruction is a complex process and worthy of further research.

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