# WHY ARE TEACHERS RESISTANT TO CHANGE? KEY ISSUES AND CHALLENGES IN TECHNOLOGY INTEGRATION

## *"Öğretmenler Değişime Niçin Direnç Gösterirler? Teknoloji Entegrasyonunda Temel Problemler ve Zorluklar"*

*İlhan VARANK*[*]
*Doğan TOZOĞLU*[**]

**ABSTRACT**

The technology adoption in education is a very complex process that includes different components and variables such as quality of teacher training in technology, quality of technology hardware and software, and student and teacher attitudes toward technology. Even though technology can be an effective tool when used properly in teaching and learning, teachers still show resistance to integrate technology into their classrooms. The purpose of this article is to investigate key issues and challenges concerning technology integration into the classroom.

**Key words:** Computer-Based Education, Technology Integration, Teacher Training, Teacher Attitude.

**ÖZET**

Eğitimde teknoloji adaptasyonu, hizmet içi teknoloji eğitiminin kalitesi, kullanılan donanım ve yazılımın kalitesi, öğrenci ve öğretmenlerin teknolojiye karşı tutumları gibi farklı ve çok yönlü değişkenler içeren kompleks bir işlemdir. Teknolojinin, eğitim ve öğretimde uygun bir şekilde kullanıldığında, çok etkili bir araç olabileceği bilinmesine rağmen, öğretmenler halen daha teknolojiyi derslerine entegre etmede direnç göstermektedirler. Bu makalede teknoloji entegrasyonunda karşılaşılan temel problemler ve zorluklar incelenmektedir.

**Anahtar kelimeler:** Bilgisayar Destekli Eğitim, Teknoloji Entegrasyonu, Hizmet İçi Öğretmen Eğitimi, Öğretmen Tutumu.

***

[*] Ph.D., Afyon Kocatepe University, Collage of Education, Computer Education and Instructional Technology, (ivarank@aku.edu.tr)

[**] M.S, Florida State University, Collage of Education, Instructional Systems, (dtt0212@garnet.acns.fsu.edu)

## KEY ISSUES AND CHALLENGES IN TECHNOLOGY ADOPTION

The technology integration into the classroom is perceived as a complex and challenging procedure by teachers. However, as educators become more experienced on educational technology competencies they see the ease and usefulness of the technology integration into the classroom (Scrogan, 1989). Computers are promising educational tools facilitating teachers' tasks and improving students' performance. Moreover, technology plays a central role in educational change (Sudzina, 1993). However, educators still exhibit reluctance to integrate computers into their practiceses (Dunn & Ridgway, 1991).

Researchers have been investigating why educators at all levels, i.e. school teachers and university professors, show unwillingness and lack of enthusiasm about the technology. Several reasons have been discussed in the literature. However, it is very hard to put those reasons into an accurate categorization because they are not clearly separated from each other. For the purpose of this article, the following categorization of the reasons will be used: environmental (extrinsic) factors and personal (intrinsic) factors (Dusic, 1998; Ertmer & Hruskochy, 1999).

Intrinsic factors are those caused by the setting or situation in which the technology is implemented. Extrinsic factors are coming from teachers' personalities and understanding of the technology integration. Before discussing these issues, we should be able to understand roles of computers in classrooms and roles of teachers, and teachers' levels of computer use.

### Roles of Computers in Classroom

Computers have different roles and functions in the classroom. Seven major functions of computers in education have been commonly discussed in the literature: drill-and-practice function, tutorial function, problem solving function, simulation function, inquiry function, testing function and programming function (Hackbarth, 1996). In the drill-and-practice, students are introduced new concepts and skills, and then the computer gives practices in using those concepts and skills. Basically drill-and-practice programs present questions and provide feedback. A Spanish teacher, for example, may spend one lesson explaining the use of the imperfect tense and for the next lesson may design computerized practices in handling this tense. In the tutorial, the computer introduces and explains concepts and skills in which it gives practice. Similar to a programmed instructional text and teaching machines, the tutorial presents informational frames and asks questions about them. Tutorial programs provide the user with information prior to practice and feedback. In the problem solving, students are expected

to solve problems posed by the computer. The computer structures the problems in a way that students identify the solution step by step and at the end of each successful step the computer provides scheduled rewards. Students' behaviors are shaped towards thinking about and tackling with problem solving. In the simulation, students confront an environment that operates under certain rules. Their role is to act within this environment and then observe the results. Simulation programs are often used when a real situation is not available or if it is too dangerous, too time consuming, or too expensive. It is a very effective way of having students learn by doing. For example, in a geography course, students can create their own trip across the Atlantic and make adjustments along the way accounting changes in wind and currents or, a dangerous chemical experiment can be performed by students using a computer simulation. Students also may use computers to retrieve information from disks, CDs, remote data sources to reach information from books and periodicals or the product of electronic publications that appear in no other form. The most common application of the computers' inquiry function would be searching the World Wide Web pages to gather data to solve a problem. Computers are also ideal for presenting and scoring tests. They are able to automatically adjust the difficulty levels of test items based on students' responses so that students' performance are measured more precisely in less time. On the other hand, computers are able to improve students' learning performance by providing instant feedback based on students' answers. Computers are programmable tools. There are sets of instructions written one of several codes called programming languages. Although students need to know how to program to benefit from computer technology, gaining such a skill gives them greater control of the medium and opens opportunities for later employment.

**Change in Teachers' Role**

Technology has changed the teachers' classical role and expectations in classroom. Hadley and Sheingold (1993) indicate that with technology, classrooms have been changed from a teacher-centered educational environment to a student-centered environment. Teachers see themselves as learning facilitators or tutors providing students with help when they come across difficulties in the learning process rather than as an expert who is doing direct teaching. Facilitating learning can be done by either directly giving students information or helping them to find information for themselves. Current theories emphasize the role of a teacher as a facilitator helping students to create their own knowledge (Mandell, Sorge & Russel, 2002; Driscoll, 2000). By providing students with opportunities to discover and create knowledge, technology permits the teacher to take on the role of facilitator.

The current studies illustrate that teachers who are successfully employing computers change their classical roles in the classroom, which are organizing, presenting and evaluating information. They prefer to become a mentor directing and motivating students to create questions, explore and manipulate information, and create solutions by themselves for the questions (Diem, 1996).

**Teachers' Level of Computer Use**

It should not be expected from every teacher to use the technology at the same level due to their varying levels of enthusiasm, knowledge and competencies. Hardy (1998) describes five different types of teachers using technology at different levels. The first type, enthusiastic beginners, prefers very basic computer applications to support their direct instruction. The second type, supported integrators, employs computers for the following purposes: enabling students to create their own products and helping them demonstrate their skills and ideas during the class. Supported integrators use varieties of computer programs and allow student explore those programs by themselves. High school naturals, which is the third type, are concentrating on quantitative and analytic functions of the computer and they mostly use computers' programming function. Unsupported achievers employ computers for remediation purposes and they do not make much use of sophisticated applications. Finally, struggling aspires make very limited use of computers for their direct instruction.

Moersch (1995) describes seven levels of computer integration. At the first, nonuse, level, teachers do not use any electronic technology. The technology they use is text-based, such as chalkboard and overhead projector. The second level teachers do not use computers directly in classrooms. Students use computers outside of class to perform some tasks, such as writing papers with word processors and creating data sheets with spreadsheet software. In this case, there is very little relevance to the teachers' instructional activities. The third level application is using computers as a supplementary tool. Tutorial, game or simulation programs are used to extent class activities or provide enrichment. Infusion level, which is the fourth level, varieties of software programs are used, such as databases, graphing packages and multimedia applications in classroom. However, those applications are isolated from instructional events. As an example, communication tools are used among people to just share data. The forth level uses of technology by teachers are more teaching and learning oriented. Computers are used for presenting information in a meaningful way to students so that students are put in a real-like environment for authentic learning. At the expansion stage, technology goes beyond classroom. Students use computers outside of class to perform class related

tasks. The final stage is refinement. In this stage, the problems are authentic. The computer is the major medium to search and process data for the problems and to bring the authentic solutions.

In another classification, three types of integration are discussed: disjointed instructional use, integrated instructional use and transparent instructional use. In the integrated instructional use, teachers apply a design model to create lessons for cross-curricular and student centered projects. Transparent instructional use, on the one hand, is similar to previous one because the focus is on group works and thematic project-based learning. On the other hand, they are different due to the role of technology. The use of technology tool is automatic, like the current use of chalkboard. Technology is no longer visible as a separate element of planning. Teachers no longer search for place to insert technology nor do they search for and construct instructional meaning for a given technology (Polin, 1992).

## ENVIRONMENTAL FACTORS PREVENTING TEACHERS FROM USING THE COMPUTER

There are several environmental factors that can be considered as the causes for inadequate technology integration. First of all providing adequate hardware and software is an important factor in promoting technology integration (Zammit, 1992). If computers are not available during convenient times and/or software is unavailable in sufficient quantities or at an adequate level of quality one should not expect high levels of usage regardless of the level of interest (Stieglitz & Costa, 1988). School teachers and university professors indicate that the quality and quantity of hardware and software is insufficient (Hoffman, 1998, Mandell, Sorge & Russell, 2002). Schools and departments need more computers and computer peripherals, such as scanners and data projectors. The locations that are fortunate enough to have adequate supplies of computers and peripherals should continuously upgrade them to keep up with the rapid change in technology. Additionally, software is not satisfying educators' needs. Teachers generally evaluate software as being pedagogically weak or inappropriate and think it is not worth the effort to use it (Zammit, 1992). What are generally needed are well-designed, adaptable, user-friendly and uncomplicated computer programs (Hardy, 1998; Downes, 1993; Ritchie, 1996; Cafolla & Knee, 1995; Sheingold & Hadley, 1990; Dunn & Ridgway, 1991).

Support also plays an important role in technology diffusion in education. The support may be in three different forms: technical support, pedagogical support and management support. Technical support is important because teachers and faculty members always need help with the

equipment in classrooms. Most of the time, they are not able to overcome technical problems occurring during instruction and need to call a support person (Dusic, 1998; Hardy, 1998).

Pedagogical support is related to technology planning, development, implementation and teacher consulting. Pedagogical support should be provided by technology coordinators (Zammit, 1992). Technology coordinators are generally responsible for informing teachers of how to use certain equipment and programs. Equipment use is not necessarily only limited to physical use but related to how that piece of technology is integrated into instruction, how to plan for its use, and how to improve students learning performance and motivation. Also, technology coordinators should enlighten teachers with concurrent educational technology innovations and learning theories/models (Ritchie, 1996). Hoffman (1998) claims that the pedagogical support provided by the coordinators leads to a greater use of software that promotes higher order thinking skills, and a greater use of computers as tools in academic activities rather than as mere drill-and-practice.

Teachers' teaching beliefs are mostly formed through their personal experience starting as a student and later as a teacher. They are lack of opportunities observing alternative classroom practices because of their work load and environment. Therefore, their teaching beliefs are resistance to chance. They need to be provided with alternative visions of what teaching with technology looks like and opportunities to experience alternative approaches in supporting context. Teachers need opportunities to observe peers working with technology and access to mentors or coaching support as they implement changes in their own teaching (Albion & Ertmer, 2002).

School boards, districts, and school management are not providing adequate administrative support for technology infusion (Cafolla & Knee, 1995). Administrators from different management levels are key people making strategic and executive decisions within schools or school systems and universities. With those decisions, administrators may provide teachers with directions about educational technology use, involve teachers in the technology adaptation process, provide necessary hardware and software, provide incentives that can encourage and motivate teachers to start and continue integrating technology into their lessons (Hoffman, 1998; Knupfer, 1989; Dupagne & Krendl, 1992). One possible solution to overcome this problem and to increase the technology use in schools is to train administrators on educational technology and make them comfortable computer users so that their attitude towards technology is improved and

they provide more help teachers integrate technology in their lessons (Ritchie, 1996).

Some researches state that with the current educational system, integrating technology is difficult per se (Sheingold & Hadley, 1990). They advocate that the current instructional design tactics are not useful and practical, and there is lack of appropriate and efficient approaches to plan technology integration. The following factors are also considered to be related to teachers' educational computer use: risk of using technology, sharing of technology resources between teachers (Dusic, 1998), discouraging climate to use computer within schools, lack of use of computers for personal purposes and not having a computer at home (Downes,1993).

**Technology Teacher Training**

Teacher training is frequently mentioned as an important environmental obstacle (Hardy, 1998; Dusic, 1998). Significant number of teachers had very little in-service training about educational technology (Zammit, 1992). This might be the reason that one of the major concerns teachers and faculties have is "hows" of using technology in the classroom (Dupagne & Krendl, 1992). Instructional computer applications require new competencies and knowledge. Not having those competencies and knowledge, teachers should not be expected to adopt technology in the classroom (Marcinkiewicz, 1995). Teachers who are successfully using technology indicate that they acquired their technology skills thorough both formal and in-formal training; such as workshops, courses at local colleges, in-service training offered by their districts, in-service training at their school site and non-in-service courses offered by districts (Hoffman, 1998).

Although teachers have positive attitudes towards technology and want to improve their teaching performance through technology implementations, they are not able to accomplish the successful technology integration. They are either lacking the knowledge to use the machine, and/or do not have any kind of familiarity with computer based or computer managed instruction (Onika, 1992). The reason is that experienced teachers have not had appropriate training on how to effectively use the computer in the classroom and on technology, skills, ideas and ways to integrate instructional technology into the curriculum (Dunn & Ridgway, 1991). In addition, new teachers have very limited (if any) knowledge about educational computer use. Teacher students do not have adequate exposure to instructional technology because many educational institutions and faculties within those institutions have not adopted technology. The more teachers have exposure to and experience with computers the better they can integrate computers into their teaching (Hardy, 1998).

Comprehensive staff technology teacher development models and programs are needed. These programs should provide clear directions for teachers on integrating technology in classroom and help them construct the purpose and meaning of educational technology (Hardy, 1998). The training should be designed in a way so that it contributes to teachers' continuous development. Therefore, new adopters or new teachers should be encouraged to try out their developing IT skills early in their carriers, and not wait until their theoretical knowledge is highly developed (Dunn & Ridgway, 1991).

Successful technology adaptation requires careful planning which demands plenty of time. However, teachers already undergo time shortage with their current tasks (Knupfer, 1995; Hardy, 1998). Time necessary for technology adaptation is not just limited to the planning. Teachers also have to commit some time to learn how to plan the technology integration into curriculum and develop appropriate materials. After all, they will need classroom time to implement the technology. In the current education system, besides other necessary classroom events, not enough time is provided for teachers to carry out instructionally sound and proper computer activities (Dupagne & Krendl, 1992). The literature confirms that teachers who are motivated to use the computer technology in their teaching are more likely to do so if time is provided to develop materials (Hardy, 1998).

## PERSONAL FACTORS PREVENTING TEACHERS FROM USING THE COMPUTER

Besides environmental factors, psychological factors or variables, such as confidence, fear, will and motivation may determine teachers' use of technology in classroom. Hardy (1998) indicates that between 40-50 percent of teachers avoid using computers because they lacked confidence, felt uncomfortable, and were frightened, threatened and intimidated by computers. Sometimes teachers' or faculty members' belief about technology and education may determine their behavior towards technology use. They think computers are complicated machines to use and master. Also, some think it is a temporary movement within current schooling system rather than a useful trend. Teachers' traditional belief and experience with schooling inhibits them from taking instructional risks and implementing technological innovations in the classroom (Sudzina, 1993).

Teachers show resistance to educational change in which they should use educational computing. Among several others, two concerns are critical for teachers exhibiting the resistance: concerns about their machine skills and concerns about taking a risk (Andris, 1996). Teachers are supposed to be competent about computer skills for classroom and lab activities at least at

the elementary level. Though, usually teachers learn those skills through, if possible, school or district supported training and peer tutoring after for a while they do not value their computer skills. Although these teachers agree that their computer skills improve over time as they operate computers, they distinguish those skills from other teaching skills and do not recognize them as relevant to their teaching job and they do not think operating computers make them a better teacher (Andris, 1996).

There are three major personal variables or factors: anxiety about technology, teachers' or faculties' personalities, and attitudes towards technology integration. The major indicator of computer anxiety is avoiding from or not interacting with computers (Dusic, 1998). Hardy (1998) indicates in a study investigating computer aversion, it was found that teachers are very hesitant about computer related tasks, which includes using computer and related peripherals in teaching, helping fellow teachers when they have trouble with computers and applying to a job requiring an initial computer training.

Some reasons for computer anxiety include inadequate planning and applications of technology-based educational change and ineffective communication between instructors and administrators (George, 1996). Jordan and Follman (1993) adds the following three reasons: teachers, trained to master the traditional tools and materials of their profession, fear that their lack of expertise with computers will be embarrassing and undermine their classroom authority; some teachers may be uncomfortable with the ways that classroom roles and relationships between teacher and student change when computers are introduced into the classroom; teacher productivity and student success can be monitored with computers easily, but many teachers worry about accountability since the problem solving skills they try to teach may not be measurable through assessment instruments they have been using. Improving self-efficacy would be a useful method to decrease teachers' anxiety. Self-efficacy is achieved through helping teachers use computers effectively, having them observe other successful users, mentoring teachers on the educational technology and creating anxiety-free environments or situations (Dusic, 1998).

Psychologists classify people according to their personalities. Some empirical research data shows that there are connections between educators' types of personalities and use of educational technology. Smith (1995) attributes the features of being creative, analytical, logical and imaginative to institutive/thinking types of educators and says they are more open to educational technology than sensory types of people who are practical, realistic and sociable. On the other hand, comparing the other personality traits, sensory/feeling types of people show very reluctant behavior towards

adapting technology in the classroom. In a similar study, the personality types were classified as follow: extraversion/introversion, sensing/intuition, thinking/feeling, judging/perceptive and it was found that those personality variables may determine the amount of technology training taken, perceived adequacy of the training, perceived support from management and perceived factors or barriers to adapt computers in curriculum (Knupper, 1989).

**Teacher Attitude**

Teacher attitude describes practitioners' appealing to educational computing. For instance while some teachers perceived that computers did not provide a distinct advantages over traditional methods of teaching (McCormak, 1995), some others value them as a useful tool to support meaningful learning. Attitude is defined as an evaluative disposition based on cognition, effective reactions and behavior intentions and determines future behavior as using the computer as a professional tool and integrating technology in the classroom (Dusic, 1998). Attitude is used interchangeably with motivation and anxiety. As a matter of fact, attitude scales are created based on other psychological states. For instance, Loyd & Loyd (1985) created a computer attitude scales derived from computer anxiety, computer confidence, computer liking and computer usefulness. Computer anxiety is related to fear of computer, computer confidence is about self-reliance to learn and use computers, computer liking is enjoyment from working with computers and computer usefulness is related to perceived effectiveness of computer.

Significant attitudinal difference towards educational computing is found among teachers who are technology users and those who are non-users (Galowich, 1999). The more teachers are willing to use computers in the classroom, the more their attitudes are favorable toward computers (Dupagne & Krendl, 1992). Additionally, the teacher attitude is significantly related to computer literacy knowledge. It is expected that there is a connection between using computer outside of work and the attitude (Galowich, 1999).

Gender difference is another aspect of teachers' attitude toward technology. In general, females exhibit more negative attitudes toward computers, have fewer expectations to use computers and show lover level acceptance of innovative behavior. Male teachers attend more training programs than female teachers (Zammit, 1992). However, male-female distinction is a controversial issue. Not all studies found similar results. Sheingold and Hadley (1990) found equal distribution of computer use between male and female teachers. However, exemplary computer using teachers are usually males (Chiero, 1997).

Attitude is not a clear indicator of teachers' disposition towards technology, such as high/good attitude and low/bad attitude. Teachers having different experiences, varying support and different incentives and barriers may exhibit different attitudes. Hardy (1998) classifies computer users into five categories; enthusiastic beginners, supported integrators, high school naturals, unsupported achievers and struggling aspires. While enthusiastic beginners are less experienced compared to the others and showed optimistic attitudes by believing that computers are the future for improving the quality of education, unsupported achievers are comfortable with technology and they see computer as a way of expending on what teachers have taught.

## CONCLUSION

Technology should be used as a tool to support instruction. Educational choices have to be made first in terms of objectives, methodologies, and roles of teachers and students before decisions on the appropriate technologies can be made. No technology can fix bad educational philosophy and practice. The challenge is to rethink learning objectives and to align the learning technologies with these objectives.

As Keller (1999) states, technology expands learning environments. Therefore educators should be careful of the attraction of the novelty and potential capability of new technology to provide interesting, efficient, and effective opportunities for learning. Sometimes the attraction of technology leads us to forget the fact that, we, as human beings, still have the same fundamental sets of capabilities and motivational requirements that we had for as long as we have existed and we develop hugely unrealistic expectations regarding opportunities made available by technological advances.

Since technology adoption and utilization are an ongoing issue, there is still need for further investigation. The successful implementation of computers in the classrooms may depend on how well the teachers are prepared to use technologies. There is a need to identify the competencies teachers must posses to use computer technology effectively in classroom. An important question to address is-what teacher competencies are viewed as important for the development and operation of computer technology in K-12 and college school settings.

Research studies should focus on various facets of technology implementation and innovation and their specific effects, as well as how students and teachers use technology, rather than simply comparing different delivery methods. The following questions should be investigated. Do students benefit more from the course before or after participating in lectures

and other educational experiences related to the course when technology is used as part of a course? How is traditional instruction enhanced with technology? What is the appropriate combination of facilitation and technology use?

Whether technology supported courses are applicable to similar courses in other curricula should also be investigated. This is important because technology development often requires considerable time and expense. Thus, applicability across curricula cannot be assumed because educational settings vary in content, language, objectives, and format of instruction (Knebel, 2000). There is a need to research adaptability of technology supported programs to each setting and what are the effective ways in which the technology is being used in classroom instruction.

Studies usually have explored the short-term effectiveness of technology integration in classrooms. Some measures of long-term effectiveness need to be added to the evaluation of technology integration. Looking at the issue from an educational systems change perspective, Branson (1998) assigned an important role to technology to carry out the long-term transition from current teaching-centered educational system, which is considered to reach its final efficiency limits and does not become better, to new learning-centered education system. Another aspect of this challenge is to realize that not all changes, regardless of how technically exciting they may be, are for the good. We need to think about what are some of the processes that are useful in assessing the impact of technological innovations and engaging people in effectively managing change in adopting technology.

## REFERENCES

Albion, P. R. & Ertmer, P. A. (2002). Beyond the foundations: The role of vision and belief in teachers' preparation for integration of technology. *Tech-Trends for Leaders in Education and Training, 46*(5), 34-38.

Andris, M. E. (1996). *An apple for the teacher. Computers and works in elementary schools*. California: Crowin Press.

Branson, R. K. (1998). Teaching-centered schooling has reached its upper limit: It does not get any better than this. *Current Directions in Psychological Science, 7*(4), 126–135.

Cafolla, R. & Knee, R. (1995). *Factors limiting technology integration in education: The leadership gap*. Retrieved November, 10, 2002, from http://www.coe.uh.edu/insite/elec_pub/html1995/152.htm

Chiero, R. T. (1997). Teachers' perspectives on factors that affect computer use. *Journal of Research on Computing in Education, 30* (2), 133-145.

Diem, R. (1996). *Information technology and civic education. Computers in Social Studies Education.* New York: Routladge.

Downes, T. (1993). Student-teachers' experiences in using computers during teaching practice. *Journal of Computer Assisted Learning, 9*(1), 17-33.

Driscoll, M. P. (2000). *Psychology of learning for instruction (2nd ed).* Boston: Allyn Bacon.

Dunn, S. & Ridgway, J. (1991). Computer use during primary school teaching practice. A survey. *Journal of Computer Assisted Learning, 7* (1), 7-17.

Dupagne, M. & Krendl, K. A. (1992). Teachers' attitude toward computers: A review of the literature. *Journal of Research on Computing in Education, 24* (3), 420–429.

Dusick, D. M. (1998). What social cognitive factors influence faculty members' use of computers for teaching? A literature review. *Journal of Research on Computing in Education, 31*(2), 123-137.

Ertmer, P. A., & Hruskocy, C. (1999). Impacts of a university-elementary school partnership designed to support technology integration. *Educational Technology Research and Development, 47*(1), 81-96.

Galowich, P. (1999). *Learning styles, technology attitude and usage: What are the connections for teachers and technology in the classroom?* (ERIC Document Reproduction Service No. ED432312)

George, G. (1996). Managing instructor cyber anxiety: The role of self-efficacy in decreasing resistance to change. *Educational Technology, 36*(4), 49-60.

Hadley, M. & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers.

*American Journal of Education*, *101*(3), 261-315

Hardy, J. V. (1998). Teacher attitudes toward and knowledge of computer technology. *Computers in the Schools, 14*(3/4), 119-136.

Hoffman, B. (1998). Managing the information revolution: Planning the integration of school technology. *NASSP Bulletin, 80*(582), 89-98.

Jordan, W. R. & Follman, J. M. (1993). *Using technology to improve teaching and learning: Hot topics.* (ERIC Document Reproduction Service No. ED355930)

Keller, J.M. (1999). Motivation in cyber learning environments. *International Journal of Educational Technology, 1*(1), 7-30.

Knebel, E. (2000). The *use and effect of computer based training: What do we know?* Operations Research Issues Papers 1(2). Bethesda, Maryland: University Research Co.

Knupfer N. N. (1995). Teachers and educational computing: Changing roles and changing pedagogy. In Robert Muffoletto and Nancy N. Knupfer (ed.) *Computers in Education*. Hampton Press: New Jersey.

Knupfer, N. N. (1989). *The Relationship between elementary teachers' psychological types and their uses of educational computing.* (ERIC Document Reproduction Service No. ED308824)

Loyd, B. H. & Loyd, D. E. (1985). The reliability and validity of an instrument for the assessment of computer attitudes. *Educational and Psychological Measurement, 45*, 903–908.

Mandell, S., Sorge, D.H., & Russell, J.D. (2002). Tips for technology integration. Tech-*Trends for Leaders in Education and Training, 46*(5), 39-43.

Marcinkiewicz, H. R. (1995). Differenced in computer use of practicing versus pre-service teachers. *Journal of Research on Computing in Education, 27*(2), 184–197.

McCormak, V. (1995). *Training pre-service teachers in applying computer technology to lesson planning as a component of the elementary school methods curriculum*. (ERIC Document Reproduction Service No. ED382190)

Moersch, C. (1995). Levels of technology implementation: A framework for measuring classroom technology use. *Learning and Leading with Technology, 23*(3), 40–42.

Onika, R. (1992). *The Factors That Affect Teacher Attitude towards Computer Use*. (ERIC Document Reproduction Service No. ED346039)

Polin, L. (1992). *Making changes in teachers' understanding and use of technology for instruction.* (ERIC Document Reproduction Service No. ED349958)

Ritchie, D. (1996). The administrative role in the integration of technology. *NASSP Bulletin, 80*(582), 42-52.

Scrogan, L. (1989). The OTA report: Teachers, training, and technology. *Classroom Computer Learning 1*, 66-70.

Sheingold, K. & Hadley, M. (1990). *Accomplished teachers: Integrating computers into classroom practice.* Center for Technology in Education: Bank Street College of Education.

Smith, K. (1995). Prediction of teachers' use of technology based on personality. *Journal of Instructional Psychology, 22*(3), 281-290.

Hackbarth, S. (1996). *The Educational technology handbook: A comprehensive guide: Process and products for learning*. Englewood Cliffs, NJ

Stieglitz, E. L. & Costa, C. H. (1988). A statewide teacher training program's impact on computer usage in the schools. *Computers in the Schools, 5*(1/2), 91–97.

Sudzina, M. R. (1993). *Technology, teachers, and educational reform: Implications for teacher preparation.* (ERIC Document Reproduction Service No. ED355207).

Zammit, S. A. (1992). Factors facilitating or hindering the use of computers in schools. *Educational Research, 34*(1), 57-66.