

Leadership, Vision, and Collaborative Technology Integration in the Classroom

Keywords:

computer technology integration, professional development, collaboration, leadership

Abstract: The focus of this paper is successful practices of creating a shared vision to encourage computer technology integration in the classroom resulting in increased student use of these technologies to promote active, directed learning. The role of visionary leadership in technology implementation is necessary to provide a significant purpose and clear values to an innovation such as increased technology integration in the classroom by teachers with their students, and the findings in this study contribute to the knowledge base of effective computer technology integration methods. Teacher volunteers participated in a treatment group that received a professional development intervention that modeled a constructivist hands-on approach to creating technology-rich lessons based on classroom curricula and Internet technologies, and a comparison group that received no professional development. Teacher-created lessons were posted on-line and accessed by students of both groups of teachers, promoting the school-wide use of technology. Results of the study give evidence of the importance of school-based leader support for technology use by teachers in terms of accountability and relevance to encourage computer technology integration in the classroom by teachers with their students.

Delia Raymos Pass, Ed.D.
Rutherford County Schools
354 Chaney Road
Smyrna, TN 37167
USA

drpass@CollaborateandCreate.org

Introduction

Successful practices of creating a shared vision for increased computer technology integration in the elementary classroom begins with leadership and vision. Effective technology integration methods and an increase in student use of computer technology for learning in the classroom is often the result of visionary leadership with clear values and significant purpose. To successfully embrace technology integration in the classroom teachers must be given a clear vision and specific strategies. Facilitation of an integration of technology across campus (or school) can be viewed as a pyramid that includes vision, leadership, and incentives in addition to access and participation (Spodark, 2003; Ehman, Bonk, & Yamagata-Lynch, 2005). In the present study a clear, well-articulated vision created proactive, visible leadership from administrators and teacher-leaders, essential to transforming technology integration and use by teachers and their students school-wide.

The visionary leadership of this technology innovation involved the creation of a shared vision with significant purpose and clear values within one elementary school while examining the realities of our resources and personnel. The overall vision of the technology initiative was to increase technology use by teachers with their students by creating a resource that was easy for teachers to access and use with their students. The implementation of the technology innovation utilized existing resources within the school, with no additional costs or purchases. Supporting structures for the vision included the implementation of a professional development model for staff development by teacher-leaders and the School-base Technology Specialist (STS), and encouragement by the administration for teachers to participate in the intervention. Teacher-leaders within the school created access and assistance during the technology initiative to provide help and timely solutions to technology

issues or questions that may discourage the use and integration of technology in the classroom. The principal and teacher-leaders envisioned a successful outcome creating an environment in which teachers were encouraged, rewarded, and provided with assistance to promote use of computer technology by the teachers with their students.

Review of the Literature

Visionary leadership must encourage teachers to realize the relevance of providing computer technology integration in the classroom and promote their ability to embrace changes brought about by a technology innovation. The importance of exploring change theory in a developmental stage of computer technology integration has been documented in other studies (Toledo, 2005). Leadership skills essential for technology decision-makers to encourage accountability and technology proficiency in teachers requires an in-depth look at what traditionally prevents or restricts teachers from using computer technology effectively with students, and then provide the assistance and encouragement necessary to create a change that includes teacher-leaders and strong school leadership (Hartnell-Young, 2006). It is important to identify strategies to make technology accessible and convenient for teachers to use and to provide hands-on involvement in the creation of lessons and projects based on classroom curricula. The presentation of information that allows teachers to develop technology integrated lessons that are not complicated and time-consuming is realistic and does not take away from additional teaching tasks, and it is more likely that teachers will use this information with their students (Wells, 2007).

Essential leadership factors for a successful school-wide computer technology initiative require vision and leadership at various levels within the local school. Teacher leaders who support technology integration with expertise and knowledge, innovators, or

early users of technology, and teachers who develop technology-rich lessons aligned with content curriculum and use these lessons with students are vital to the buy-in of teachers who remain apprehensive or fearful of using technology (Rogers, 1995). Teacher-leaders, such as technology coaches, mentors, and school leadership cadres, have been found to have a positive impact on others less likely to use technology in their classroom teaching (Ehman, et al., 2005). Administration and faculty must share a vision that supports new modes of teaching which includes collaborative learning strategies. Groups that support this type of learning have been successful in promoting computer technology integration by teachers (Toledo, 2005; Wells, 2007).

Previous studies have outlined the need to adopt performance indicators for administrators and teachers to promote active learning in the classroom (Barron, et al., 2003; Mills & Tincher, 2003). This is an important aspect of evaluating the effectiveness of a technology professional development initiative when the desired result is an increase of curriculum-relevant technology use in the classroom by students. Numerous studies have sought to better understand why some teachers use technology and others do not (Kanaya, Light & McMillan-Culp, 2005; Lumpe & Chambers, 2001; Vannatta & Fordham, 2004), and a large segment of research has examined attitudes and beliefs toward computers, computer self-efficacy, technology proficiency, and specific teacher attributes and the effect of these variables on technology training in an effort to predict classroom technology use (Ropp, 1999; Christenson, 2002; Judson, 2006).

While much has been written about models of effective professional development for technology integration (Hung & Chen, 1999; Christenson, 2002; Mouza, 2002/03; Mills & Tincher, 2003; Prain & Hand, 2003) there is a need for more information on the application

of these models in actual school settings. Relevant studies must be designed to address the division between the interests of researchers and the needs of teachers and schools by establishing a practical and focused research agenda (Bull, Knezek, Roblyer, Schrum & Thompson, 2005), focusing on practices that are consistent with what is known about effective learning (Donovan, Bransford & Pellegrino, 1999). Studies on constructivist learning address the difficulties of putting theories into practice in the classroom and promote the power of technology to transform learning (Bednar, Cunningham, Duffy & Perry, 1992; Nicaise & Barnes, 1996; Jonassen, Howland, Moore & Marra, 2003).

The nation's latest National Education Technology Plan, released in January, 2005, reported that the application of educational technology in schools is still inadequate and the great promise of Internet technology is frequently unrealized (Toward a New Golden Age in American Education, 2004). Although computer technology use in the classroom is increasing, effective use of technology that promotes student achievement is not prevalent (Barron, Kemker, Harmes & Kalaydjian, 2003). Teachers must understand multiple levels of technology use in the classroom to promote the identification of effective computer technology use by students (LaJoie & Derry, 1993; Mills & Tincher, 2003; Dexter, Doering, & Riedel, 2006), and inquiry into the type of professional development that will encourage teachers to use computers for effective learning aligned with the core curriculum is needed to promote technology integration successfully.

Purpose of the Study

The purpose of this study was to investigate the effect of a school-wide technology initiative on teachers' attitudes toward computers, technology proficiency, stages of adoption of technology, and student utilization of a school-wide web-based resource of technology

integrated teacher-created lessons called The Learning Page. Inquiry into successful practices resulting from creating a shared vision to encourage computer technology integration in the classroom with the purpose of increasing student use of these technologies to promote active, directed learning was also part of this study. In addition, the role of visionary leadership in technology implementation to provide significant purpose and clear values to such an innovation was investigated.

The study also investigated factors that contribute to teachers successfully embracing technology integration in the classroom through strong leadership by school-based administrators and teacher-leaders. The school-wide technology initiative involved two groups of teachers to determine the effect of a professional development intervention on computer technology use by teachers with their students, as compared to teachers who only had access to the web-based resource, The Learning Page. Teachers volunteered for one of two groups, a treatment group, the Professional Development Group (PDG), N=29, and a comparison group, the Web Access Group (WAG), N=28. The teachers of the PDG participated in a professional development intervention that involved building the school-wide web-based resource for student use, with access to the researcher/facilitator created website to support the professional development sessions as an on-going resource for teachers, Collaborate and Create.org. Teachers in both groups had various levels of technology proficiency at the start of this study.

Description of Technology Initiative

Professional Development Model

The professional development intervention modeled higher-order thinking and learning by actively engaging teachers in knowledge construction through the use of computer technology (Song & Keller, 2001), with teacher participants developing The

Learning Page, a web-based resource of lessons and Internet links for student use. Empirically tested constructivist technology-rich learning environments that are desirable in the classroom were modeled during the hands-on interactive training (Jonassen, Peck & Wilson, 1999; Becker & Riel, 2000). PDG teachers brought their grade level lessons to the sessions and collaborated with other grade level teachers on the development of technology integrated projects and group activities for students to use across grade levels, creating interactions in which the knowledge in these sessions was socially constructed (Candy, 1991).

The professional development intervention consisted of three 2-hour hands-on sessions, the resource website Collaborate and Create for access to information on technology integration, and continued follow-up contact with the facilitator/researcher. The Collaborate and Create sessions were posted on the website so the treatment group teachers (PDG) were able to work beyond session times. The Collaborate and Create website included access to multiple web-based resources to assist teachers in developing technology integrated lessons. Teachers in the treatment group (PDG) were encouraged to contribute lessons to the Learning Page throughout the school year, and out of a group of 29, 3 to 5 teachers contributed new lessons on a regular basis.

A third grade social studies lesson example, Chinese New Year, is shown in Table 1. The lesson example shown requires that students work in cooperative groups using teacher-directed Internet websites to search for information on the Chinese New Year. Student products from this lesson can be accessed at www.TheLearningPage/gradelevels/3rd/HinesJ.htm, and The Learning Page can be accessed

at www.TheLearningPage.org. The Collaborate and Create teacher resource page can be accessed at www.CollaborateandCreate.org.



Table 1. Example of teacher-made technology integrated lesson

Web Access Group

Participants in the web access group (WAG) were teachers who did not attend the professional development sessions, but received a one-hour orientation to the instructional resource website for students to use at their discretion with students. The Collaborate and Create website was also made available to WAG teachers, and although many teachers from this non-treatment group reported using the teacher resource, no WAG teachers contributed technology integrated lessons for the student website.

Methodology

This study explored and analyzed the effects of a school-wide web-based technology initiative. The dependent variables of interest were teachers' attitudes toward computers, technology proficiency, stages of adoption of technology, and amount of student utilization of the school-based web resource. This study investigated the effects of both a professional

development intervention and its real-time implementation in an elementary school setting. A true experimental research design was neither possible nor desirable, and given the complexities and on-going processes of an elementary school setting, much of the information that was gathered during the technology initiative was descriptive in nature (Marshall & Rossman, 1999).

Participants/Research Site

The involvement of human subjects began with recruitment from an elementary teacher population through a teacher interest survey. Participants ranged in age from 21 to 54 years with a mean age of 33. Typical to many elementary school settings, 100% of the participants were female, and in this sample 100% white. Sixty-one percent of the participants held a bachelors degree, thirty-five percent a master's degree, and three percent a specialty degree or masters + 45. The number of years teaching experience varied from 1 to 27 years with a mean of 8 years.

The research site was a K-5 public school in a southern school district of the United States with all classrooms containing a minimum of 3 student computers and every teacher having a multimedia cart that included a large screen TV, presentation box, computer, laser disk player, VCR, and printer. The computers linked to a network server and the Internet. There was also a computer lab with 24 student computers and a teacher multimedia cart, two rolling labs with 20 wireless laptop computers on each cart, and two Classroom Performance Systems that engage students for testing/evaluation using wireless remote controls. Internet Explorer was the preferred browser for accessing The Learning Page throughout the research year, and the STS worked diligently with the researcher to ensure all student and teacher computers were in working order and accessible. The professional development model was

based upon the availability of school resources that were adequate but underused (David, 1994; Goddard, 2002).

Research Design

The research design was a non-equivalent group pretest-posttest design. The groups volunteered for the study and were not randomly assigned. The treatment group (PDG), received a constructivist-based professional development intervention on the creation of technology integrated lessons, and the comparison group (WAG), received no professional development, but had access to The Learning Page website of teacher-created lessons. The pre-post program measures were identical for both groups, a combination of reliable and well-validated questionnaires. Data was collected from both groups at the onset and end of the study. (Table 2).

Groups	Pre-test Questionnaire Items	November 2003	December 2003	January 2004	May 2004	Post-test Questionnaire Items
PDG Treatment Group N=29	O1,O2,O3	Professional Development Intervention	Professional Development Intervention	Access to school-wide Website of lessons based on classroom curricula Weekly Logs	Access to school-wide Website of lessons based on classroom curricula Weekly Logs	O1,O2,O3
WAG Comparison Group N=28	O1,O2,O3	No Professional Development Intervention	One hour Orientation to website	Access to school-wide Website of lessons based on classroom curricula Weekly Logs	Access to school-wide Website of lessons based on classroom curricula Weekly Logs	O1,O2,O3

Table 2. Research design for treatment and comparison groups including timeline for questionnaire administration, treatment, and weekly logs

Independent Variables: Group 1 Treatment Group (PDG)-Professional Development Intervention; Group 2 Comparison Group (WAG)-Web Access Group-access to The Learning Page/no professional development
Covariates:Pre Questionnaire Items-O1 Teachers’ Attitudes toward Computers, O2 Technology Proficiency Self-Assessment, O3 Stages of Adoption of Technology
Dependent Variables: Post Questionnaire Items-O1 Technology Proficiency Self-Assessment, O2 Teachers’ Attitudes toward Computers, O3 Stages of Adoption of Technology
Descriptive Data:O4 teacher-reported weekly log of The Learning Page, O5 Computer lab sign-in sheets, O6 Student hits on website (separated by treatment and comparison groups).

Procedures

Five hypotheses guided the study. Three of the hypotheses examined differences among the two groups of teachers, the Professional Development Group (PDG) and the Web Access Group (WAG), in relation to the dependent variables: attitudes toward computers, technology proficiency, and stages of adoption of technology. The variable “attitudes toward computers” was measured utilizing 5 sub-scales of a standardized instrument: Teacher’s Attitudes Toward Computers, Tac3.2a (Knezek, Christensen, Miyashita & Ropp, 2000). The variable “technology proficiency” was measured utilizing 4 sub-scales of the Technology Proficiency Self-Assessment, Tpsa v1.0 (Knezek, et al., 2000), and Stages of Adoption (Knezek, et al., 2000), was measured utilizing a single score with a minimum of 1 and a maximum of 6 levels related to technology adoption. The three instruments combined made up the pre and post-test sections of the questionnaire and included demographic data. The pretest variables were the covariate in the multivariate analysis of covariance (MANCOVA), and the post program variables the dependent variables.

Hypothesis four examined the relationship between demographic data and the dependent variables attitudes toward computers, technology proficiency, and stages of adoption of technology.

Hypothesis five examined differences between the treatment (PDG) group and the comparison group (WAG) of teachers with respect to amount of student utilization of The Learning Page.

Null hypotheses were tested for each of the five primary hypotheses and related sub-hypotheses. Statistical analyses were performed using SPSS version 12.0 (SPSS Inc., 2003) for hypotheses 1 through 4. The data analysis included Cronbach’s Alpha to assess the

reliability of the research instrument and three tests of assumption to determine the suitability of MANCOVA for analyzing the research data. Separate tests were conducted to assess homogeneity of slopes, equality of error variances, and equality of covariance matrices.

Hypothesis 5 employed multiple data sources to determine student use of The Learning Page by students of teachers in the treatment (PDG) and comparison (WAG) groups. The multiple data sources were used to provide triangulation of collected data sources to verify the amount of use of The Learning Page by students in the PDG and WAG groups, including cumulative hits on The Learning Page collected over an 18-week period from January 2003 through May 2004, weekly teacher-reported forms of website use by students (The Learning Page) and teachers (Collaborate and Create) were also collected over an 18-week period from January 2003 through May 2004. Computer lab logs were collected for the entire 2003-2004 school year to determine patterns of computer lab use for the year. Open-ended administrative surveys collected at the end of the school year for four years (2004 through 2007) provided anecdotal evidence of computer technology use and non-use by teachers. These data sources were analyzed descriptively and included in the Findings. Interviews with administrators and the teacher leaders in the school provided evidence of the success of a shared vision and leadership practices that encouraged increased technology use by teachers with their students and are also discussed in the Findings.

Findings

Analysis provided statistically significant evidence for a greater reported increase in Integrated Applications and Stages of Adoption by teachers who participated in the treatment group (PDG) than by teachers in the comparison group (WAG). The results of the data analysis using multivariate analysis of covariance (MANCOVA) to test hypotheses 1 through

4, including the subscales of the instruments, showed the multivariate interaction between groups, PDG and WAG, and the dependent variables, with the pre-test variables as the covariate, as $\Lambda(10, 36) = .635, p > .05$. A Lambda value of .635 revealed a large effect size of 36% and a small sample size of 57, therefore the univariate tests imbedded in the multivariate analysis were interpreted individually. The results supported the null for every hypothesis except research hypothesis 2, sub-hypothesis (c), there will be a greater reported increase in technology proficiency as it relates to Integrated Applications by teachers who participate in the professional development group than teachers in the comparison group; and research hypothesis 3, there will be a greater reported increase in stages of technology adoption by teachers who participate in the professional development technology intervention than teachers in the comparison group.

These findings indicate that exposure to the professional development intervention resulted in a greater reported increase in technology proficiency as it relates to Integrated Applications and Stages of Adoption of technology by teachers in the treatment group (PDG) than by teachers in the comparison group (WAG).

The findings for research hypothesis 4 indicated that there was no relationship between demographic data, age, years teaching experience, grade level taught, and educational level and the dependent variables attitudes toward computers, technology proficiency, and stages of adoption of technology.

The findings for research hypothesis 5, there will be an increase in the amount of utilization of The Learning Page by students of teachers in the PDG than students of teachers in the WAG, are reported descriptively. Students of PDG teachers showed evidence of a greater amount of utilization of The Learning Page as evidenced by weekly hits on the

website and weekly teacher-reported forms on website use, yet increased utilization of The Learning Page occurred in both groups, establishing that the school-wide website was being used on a regular basis. Patterns of change in use were identified in both groups, such as increased use by students of teachers in the WAG before state-wide testing as a preparation tactic, and lowered use by students of teachers in the PDG, indicating this group prepared early or used traditional paper and pencil test prep materials with their classes. This finding may also demonstrate that WAG teachers used the website for drill and practice, as opposed to the integrated applications used by teachers in the PDG. Both groups established a substantial increase of the website and there was a documented increase in overall use of the computer lab for the 2003-2004 school year, as evidenced by the computer lab logs.

No differences in attitudes toward computers were found between the treatment group (PDG) and comparison group (WAG), therefore the findings did not support previous research that found more positive attitudes in teachers after receiving technology integrated instruction (Christensen, 2002; Judson, 2006). While this may be attributed to the small sample size, mean scores of the research population increased in both groups, which may be evidence of an improvement in attitudes in both groups due to exposure to the technology innovation.

Administrative support and focus on the goal was vital to the success of the initiative, to increase technology integration in the classroom promoting the school-wide use of technology as a tool for active, directed learning. The Learning Page website was promoted school-wide by the principal, who encouraged teachers to integrate relevant technology lessons into their classroom curriculum. The change in school culture resulted in all teachers in the school developing an interest that eventually led them to experiment using The

Learning Page with their students and increase use of the computer lab. Teacher-leaders and strong administrative support were important factors for successful technology integration in this study and has been shown in similar studies investigating successful professional development models (Ehman, et al., 2005).

The facilitation of technology integration incorporating a vision, with effective leadership as well as access and participation by teacher-leaders, established proactive setting with a clear vision for the initiative in which teachers participated. Support and clearly articulated goals with a vision for success by the principal and availability and access to the teacher-leaders in this study created an atmosphere in the school that promoted the successful use of computer technology by teachers with their students. Teachers were given a specific platform that was easy to use and access, with technology-integrated lessons posted for students to use individually or as a group.

Administrative and teacher-leader interviews verified that it is important to be sure that teachers are accountable for using technology in the classroom. If an evaluation system is in place to observe evidence of technology use by teachers with their students, programs and initiatives promoting technology integration in the classroom would be more successful. Administrative support through announcements and promoting positive technology use by other faculty at meetings and on morning announcements was also found to have a positive effect on technology use by teachers with their students. Incentives, such as announcing the classes who used the technology resources the most through various reporting systems also had a positive effect on teachers using technology with their students. Teacher-leaders observed that once teachers were able to see that the process of adding websites and lessons to The Learning Page was not as difficult as expected, they were more eager to participate in

the initiative. It was also observed that when teachers are not held accountable for the use of technology in their classrooms, many will reject opportunities to learn and accept assistance. In order to move to a higher level of use, teacher-leaders felt that it was the responsibility of the administration to set the standards for the school in order for technology integration programs or initiatives to be successful.

Teacher use and non-use end-of-the-year surveys from 2004 through 2007 revealed that teachers are most often looking at contextual factors and a need for comfort with the available resources. The larger issues surrounding technology integration in the classroom, including local, state, and federal pressure for increased student and teacher technology proficiency and the unrealized potential of technology integration for promoting meaningful learning are all important aspects of teacher use and non-use of existing technology.

Teacher responses from users of the Learning Page for Students felt that the teacher-created lessons helped them to successfully integrate technology into their classroom curriculum, including problem-solving skills and collaboration among students. A number of teachers from grades 3 through 5 used the online resource for whole group lessons and as a supplement to teaching themes from the classroom for guided, directed learning. Teachers stated that since the lessons provided specific Internet resources for students to study topics and themes related to the classroom curriculum, that they were able to use the site to reinforce concepts taught in the classroom. Fourth and fifth grade teachers used the online resource most frequently for state testing review and mathematics review according to surveys, while the lower grade levels used the themes on The Learning Page as a general online activity lesson rather than as a supplement to a specific classroom curriculum.

Non-user teacher responses listed the following factors most frequently as reasons for not using technology with their students; lack of time, the need to prepare for state testing with non-computer related methods, creating technology-rich lessons based on the classroom curriculum is time-consuming, not sure that Internet resources are appropriate for younger students, and the computer lab was not available or not set up with working computers, which was stressful when working with students. In addition, teachers felt that they needed more computer technology training and professional development, yet overall, the majority of teachers in both groups responded positively to using The Learning Page as a resource with their students as a positive experience.

The particular setting for this research served to illuminate the larger issues surrounding technology integration in the classroom, including local, state, and federal pressure for increased student and teacher technology proficiency. The professional development intervention provided hands-on involvement of lessons and projects for students based on the classroom curricula that were not complicated and time-consuming. In addition teacher leaders, or innovators, provided the expertise and knowledge to teachers who were apprehensive or fearful of using technology (Rogers, 1995). The professional development model in this initiative was applied in an actual school setting and directly addressed the need of the teachers and this school by establishing a focused research agenda based upon the needs of the faculty by looking at their specific abilities, and adjusting to the available technology at this particular school. This study contributes to the knowledge base of effective computer technology integration methods and may have a positive impact on related future research.

Recommendations for Further Research

Further examination of the technology initiative and professional development model investigated in this research is needed to address limitations of the present design. Additional recommendations for replication of this study include increased accountability of teachers by the principal through bi-monthly interviews and meetings with the project facilitator and classroom observations. Further research is needed to determine the effects of the technology initiative with a larger sample size and a control school not exposed to the professional development intervention.

Future research may include implementation of The Learning Page across a school district or districts to investigate the effect on schools that are only given access to the website in comparison to schools with a professional development intervention and on-going support in the development of technology integrated lessons. A district level study would provide a larger sample size and would facilitate use of a control site to give stronger credibility and broader generalizability to the findings and conclusions.

Other related studies may include a longitudinal study investigating the relationship of integrated learning on student achievement and the impact of a web-based curriculum on student learning. Further examination of the effect of leadership on successful technology integration and of specific leadership qualities found to encourage a school-wide increase of technology integration in the classroom by teachers may be a future topic to be addressed.

References

- Barron, A. E., Kemker, K., Harmes, C., & Kalaydjian, K. (2003). Large-scale research study on technology in K-12 schools: technology integration as it relates to the national technology standards. *Journal of Research on Technology in Education*, 35 (4), 489-507.
- Becker, H. J., & Riel, M. M. (2000). Teacher professional engagement and constructivist-compatible computer use. Retrieved June 20, 2003, from <http://www.crito.uci.edu/TLC/FINDINGS/REPORT4/>.
- Bednar, A., K., Cunningham, D., Duffy, T. M., & Perry, D. J. (1992). Theory into Practice: How Do We Link? In T. M. Duffy & D. H. Jonassen (Eds.), *Constructivism and the Technology of Instruction: A Conversation* (pp. 17-34). Hillsdale, New Jersey: Lawrence Erlbaum Associates.
- Bull, G., Knezek, G., Roblyer, M. D., Schrum, L., & Thompson, A. (2005). A proactive approach to a research agenda for educational technology. *Journal of Research on Technology in Education*, 37 (3), 217-220.
- Candy, P. C. (1991). *Self-direction for Lifelong Learning*. San Francisco, California: Jossey-Bass Publishers.
- Christensen, R. (2002). Effect of technology integration education on the attitudes of teachers and students. *Journal of Research on Technology in Education*, 34 (4), 411-433.
- David, J. L. (1994). Realizing the promise of technology: the need for systemic education reform. Retrieved on August 24, 2003 from <http://www.ed.gov/pubs/EdReformStudies/SysReforms/david1.html>
- Dexter, S., Doering, A. H., & Riedel, E. S. (2006). Content area specific technology integration: a model for educating teachers. *Journal of Technology and Teacher Education*, 14 (2), 325-345.
- Donovan, M. S., Bransford, J. D., & Pellegrino, J. W. (Eds.). (1999). *How People Learn: Bridging Research and Practice*. Washington, D. C.: National Academy Press.
- Ehman, L., Bonk, C., & Yamagata-Lynch, L. (2005). A model of teacher professional development to support technology integration. *Association for the Advancement of Computing in Education Journal*, 13 (3), 251-270.
- Goddard, M. (2002). What do we do with these computers? Reflections on technology in the classroom. *Journal of Research on Technology in Education*, 35 (1), 19-63.

- Hartnell-Young, E. (2006). Teachers' Roles and Professional Learning in Communities of Practice Supported by Technology in Schools. *Journal of Technology and Teacher Education*, 14 (3), 461-480.
- Hung, D. W. L., & Chen, D. (1999). Technologies for implementing social constructive approaches in instructional settings. *The Journal of Technology and Teacher Education*, 7 (3), 235-56.
- Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning With Technology: A Constructivist Perspective*. Upper Saddle River, New Jersey: Prentice-Hall, Inc.
- Jonassen, D., Howland, J., Moore, J., & Marra, R. M. (2003). *Learning to Solve Problems with Technology: A Constructivist Perspective* (2nd ed.). Upper Saddle River: New Jersey: Prentice-Hall, Inc.
- Judson, E. (2006). How teachers integrate technology and their beliefs about learning: is there a connection? *Journal of Technology and Teacher Education*, 14 (3), 581-597.
- Kanaya, T., Light, D., & McMillan-Culp, K. (2005). Factors influencing outcomes from a technology-focused professional development program. *Journal of Research on Technology in Education*, 37 (3), 313-329.
- Knezek, G., Christensen, R., Miyashita, K., & Ropp, M. (2000). Instruments for assessing educator progress in technology integration. Denton, TX: University of North Texas.
- LaJoie, S. P., & Derry, S. J. (Eds.). (1993). *Computers as cognitive tools*. Hillsdale, N.J.: Lawrence Erlbaum Associates.
- Lumpe, A. T. & Chambers, E. (2001). Assessing teachers' context beliefs about technology use. *Journal of Research on Technology in Education*, 34 (1), 93-107.
- Marshall, C. & Rossman, G. B. (1999). *Designing Qualitative Research*. Thousand Oaks, Ca.: Sage Publications.
- Mills, S. C., & Tincher, R. C. (2003). Be the technology: a developmental model for evaluating technology integration. *Journal of Research on Technology in Education*, 35 (3), 382-410.
- Mouza, C. (2002-2003). Learning to teach with new technology: implications for professional development. *Journal of Research on Technology in Education*, 35 (2), 272-289.
- Nicaise, M., & Barnes, D. (1996). The union of technology, constructivism, & teacher education. *Journal of Teacher Education*, 47 (3), 203-210.

- Prain, V., & Hand, B. (2003). Using new technologies for learning: a case study of a whole-school approach. *Journal of Research on Technology in Education*, 35 (1), 441-458.
- Rogers, E. M. (1995). *Diffusion of Innovation* (4th ed.). New York: Free Press.
- Ropp, M. M. (1999). Exploring individual characteristics associated with learning to use computers in preservice teacher preparation. *Journal of Research on Computing in Education*, 31 (4), 402-416.
- Song, S. H. & Keller, J. M. (2001). Effectiveness of motivationally adaptive computer-assisted instruction on the dynamic aspects of motivation. *Educational Technology, Research and Development*, 49 (2), 5-19.
- Spodark, E. (2003). Five obstacles to technology integration at a small liberal arts university. *T.H.E. Journal*, 30 (8), 14-24.
- SPSS, Inc. (2003). *SPSS 12.0 for Windows*, Chicago, Illinois: SPSS, Inc.
- Toledo, C. (2005). A five-stage model of computer technology integration into teacher education curriculum. *Contemporary Issues in Technology and Teacher Education*, 5 (2), 177-191.
- Toward a new golden age in American education: how the internet, the law and today's students are revolutionizing expectations.* (2004). National Educational Technology Plan, U. S. Department of Education.
- Vannatta, R. A. & Fordham, N. (2004). Teacher dispositions as predictors of technology use. *Journal of Research on Technology in Education*, 36 (3), 253-271.
- Wells, J. G. (2007). Key Design Factors in Durable Instructional Technology Professional Development. *Journal of Technology and Teacher Education*, 15 (1), 101-122.