

Instructional Implications of Laptop Access: A Case Study Approach

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Abstract: This paper presents the results of a case study conducted to analyze the effects of laptop access via a mobile cart on the instructional activities of two teachers in relation to the National Educational Technology Standards for Teachers (ISTE, 2000). The investigation utilized a modified version of the *Integration of Technology Observation Instrument* (Wetzel, Zambo, Buss, and Padgett, 2002) to note trends in laptop implementation. Analyses revealed teachers' instructional decisions met standards within each of the six categories, however, little evidence of students performing activities beyond the introductory level was observed. Additional examinations utilizing the Apple Classrooms of Tomorrow (Apple Computer Inc., 1995) continuum revealed the teachers' attempts to implement technology to be categorized at the "Adoption" stage. Recommendations for more effective, student-centered technology integration include professional development activities that facilitate additional curricular decisions.

Recent reports have highlighted the increasing numbers of school districts that have created programs aimed at increasing access to technology for teachers and students. Included in these reports are several state initiatives aimed at providing laptops to students, the most notable being Maine, where each 7th and 8th grade student is provided access to their own laptop (Henrico County Public Schools, 2006; Silvernail & Lane, 2004). The goals of the programs include higher student achievement, greater engagement, and improving the accessibility of technology to populations of students who may not otherwise have opportunities to use it (Grant, Ross, Wang, Potter, & Wilson, 2005). With this increased access to technology, however, questions remain regarding the effects of technology integration on teacher behaviors as well as student outcomes and learning (Cuban, 2001; Swan, van 't Hooft, Kratcoski, & Unger, 2005). To

date, no definitive answers have been provided regarding the overall benefit to students and teachers. Therefore, it is important that research is conducted to examine teachers' use of technology, specifically classroom laptop computers, before implementing wholesale change to avoid further taxing many districts that already face budget shortfalls.

Review of Literature

Mark Weiser introduced the term “ubiquitous computing” in 1991 to describe a state in which computers and technology become such a part of the environment that they are no longer noticed. It is this state that many in education seek to create by introducing desktop computers, laptops, and other portable devices into mainstream education. Evidence of the successful effects of these efforts can be noted by the decreasing ratio of children to computers which fell from 9:1 to 4:1 in the period from 1995-2001 (Market Data Retrieval, 2001). In addition, computer use among children under 18 years old has now been noted as being greater than adult use (DeBell & Chapman, 2003). Ninety-one percent of students use a computer and 59 percent access the Internet in some capacity (DeBell & Chapman, 2003).

As important an issue as technology integration has become, much of the research conducted to this point to assess the effects of technology has been application specific studies. Researchers have failed to investigate how technology is changing the fundamental practices of instructional delivery (Russell, Bebell, Cowan, & Corbelli, 2002). This is so prevalent, in fact, that Zhao, Pugh, Sheldon, and Byers (2002) stated “there is a conspicuous lack of attention to the complexities and intricacies of how classroom teachers actually integrate technology in their teaching” (p. 483).

In the landmark study associated with technology use in the classroom, Apple Classrooms of Tomorrow (ACOT) concluded that teachers progress through a continuum of stages in their efforts to integrate technology. These stages included:

1. Entry - teachers gain initial information regarding how to use technology in their classroom;
2. Adoption – teachers implement technology, but use it to support traditional instructional practices;
3. Adaptation – continued use of technology in traditional practices, but increased use of student productivity tools, including word processing software and spreadsheets;
4. Appropriation – technology is utilized as a tool to be used for collaborative projects; and
5. Invention – technology is utilized in novel ways for instructional purposes (Apple Computer, Inc., 1995).

Successful movement within the continuum was dependent upon variables such as collaboration with peers, personal reflection on teaching practices, and training associated with how to integrate technology into every day instruction (Apple Computer Inc., 1995; Vannatta & Fordham, 2004).

Currently, technology integration appears to play an expanding role in curricular decisions, however, according to Sandholtz and Reilly (2004) the ability of teachers to utilize technology in their classrooms has not kept up with access to technology in schools. Possible barriers that account for this include teacher knowledge levels, support and training in using technology effectively, and teacher attitudes/beliefs (Bitner &

Bitner, 2002; Ertmer, 2005; Legette & Persichitte, 1999; Rogers, 2000). Ertmer (2005) theorizes that progress is being made in the first two barriers within the above list; however, the impact of teachers' pedagogical beliefs continues to play an important role in technology implementation. Teachers continue to use technology in ways that reflect their personal beliefs regarding curriculum (Cuban, 2001; Fullan, 2001), preferring more traditional, teacher-centered instruction that involves the transmission of information from teacher to student with an emphasis on skill as opposed to problem solving activities (Niederhauser & Stoddart, 2001; Valmont, 2000).

Changing the pedagogical beliefs of teachers is both difficult and paramount. Ertmer (2005) associated the difficulty as being related to "a second order change – change that confronts teachers' fundamental beliefs and, thus, requires new ways of both seeing and doing things" (p. 26). Others describe technology adoption as being lower in the belief-goal hierarchy than pedagogy, thus facilitating technology use within the teacher's current teaching paradigm (Zhao & Cziko, 2001). To encourage a new pedagogical approach where teachers' beliefs are modified to use technology for higher-level, constructivist practices, teachers must begin to examine their own belief systems and be exposed to other teachers using technology in a manner that is consistent with their constructivist beliefs and goals for learning outcomes, which results in improved outcomes (Russell, Bebell, Cowan, & Corbelli, 2002; Zhao, Pugh, Sheldon, & Byers, 2002). Focus should be on students actively involved in the use of technology and applications to develop problem solving abilities, critical thinking skills, and comfort in using technology (Mehlinger & Powers, 2002),

In an effort to increase the likelihood of accomplishing the aforementioned goals, the International Society for Technology (ISTE) developed the National Educational Technology Standards for Students (NETS*S) and the National Educational Technology Standards for Teachers (NETS*T) (ISTE, 1998; 2000). The former set of standards has been adapted or referenced in 39 states' documents related to technology and teaching (ISTE, 2004). NETS*T addresses six broad categories of technology implementation:

1. Technology operations and concepts;
2. Planning and designing learning environments and experiences;
3. Teaching, learning, and the curriculum;
4. Assessment and evaluation;
5. Productivity and professional practice; and
6. Social, ethical, legal, and human issues (ISTE, 1998)

Specific standards are provided within each category to facilitate the assessment of teacher success within the framework, and when utilized to guide instruction, these standards serve as a framework to establish a non-traditional classroom environment (ISTE, 2005). Notable characteristics of changed classrooms include the development of critical thinking skills using technology as opposed to factual recall, multiple opportunities for collaboration, and active exploration of information instead of passive acceptance (ISTE, 2005).

As previously stated, one goal of these standards was to help teachers move from presenters of information to facilitators in the learning process. However, for a “traditional” teacher, this process may prove difficult making implementation of technology less likely to be successful. Numerous studies have shown when teachers

utilize technology in a manner that is consistent with their pedagogical beliefs and goals for learning outcomes, the technology is successfully implemented and results in improved outcomes (Russell, Bebell, Cowan, & Corbelli, 2002; Zhao, Pugh, Sheldon, & Byers, 2002). Examinations of instructional practices specifically in relation to the NETS framework have yielded inconsistent results. Niederhauser and Lindstrom (2006) found practices are becoming less teacher-directed as activities are utilizing a variety of technological tools to engage students in problem solving activities, however, it was noted that teachers' tendencies to take an active role in structuring the activities limited the gains in this area of student development. Others found elementary teachers were more likely to use computers as a communication tool than for problem-solving, productivity, or research (Barron, Kemker, Harmes, & Kalaydjian, 2003).

These facts are especially troubling when examining the current push to put laptop computers into schools to create a 1:1 ratio of students and computers. Laptop initiatives are now found in more than 1000 schools in states such as Maine, Michigan, and Pennsylvania, to name a few (Windschitl & Sahl, 2002). The programs seek to create conditions in which children become more engaged and motivated to learn, however, consistent with the above research, teachers have struggled integrating student-centered instruction using the laptops (Grant, Ross, Wang, Potter, & Wilson, 2005). Windschitl and Sahl found the ability of the participants in their research to integrate technology was “powerfully mediated by their interrelated belief systems about learners in schools, about what constituted ‘good teaching’ in the context of the institutional culture, and about the role of technology in students’ lives” (p. 165).

Due to the costs associated with 1:1 laptop initiatives, a number of schools and districts have purchased computer carts and created “mobile laboratories” (Grant, Ross, Wang, Potter, & Wilson, 2005, p. 1017) with fewer computers, but increased access to the larger school population. However, according to Grant et al., little research has been completed to examine the effects of these carts. One study comparing the use of 1:1 access to shared computer carts found several advantages of the constant laptop access to the mobile cart including greater use of the computers, integration of technology into more subject areas, more instances of peer conferencing, and a greater degree of individualized instruction (Russell, Bebell, & Higgins, 2004). These results are a promising, but limited step in the evaluation of laptop implementation in the classroom, and further research is needed to justify expenditures associated with laptops.

The current investigation was undertaken to examine the impact of the introduction of laptop access via a mobile computer cart on the instructional practices of two experienced teachers, differentiated by experience and pedagogical beliefs. The following question guided the research conducted in this study:

- Did teachers with different pedagogical philosophies exhibit contrasting uses for laptops provided on a mobile cart?
- Did instruction using laptops facilitate construction of student-centered learning environments consistent with the National Educational Technology Standards for Teachers?

Methodology

Context and Setting

The research activities described in this paper were conducted as a result of the award of a federally-funded grant to provide wireless technology and laptop computers to three schools in north-central Indiana. Provisions within the grant called for the participating schools to receive between 12 and 24 laptops that were then placed on mobile carts to facilitate sharing between cooperating teachers. In addition, field-based support was maintained via a local university to assist installation procedures and maintenance.

Two of the schools involved in the project would be described as suburban while the third school was rural. Each building housed students in grades K-5 with school populations ranging from 236 students to 574 students. The majority of students in each school were white, percentages varied from 75% to 99%. Free and reduced status at two of the schools was similar, 13% and 14%, with the remaining school categorizing 41% of its students as enrolled in this program. Two of the schools had achieved status as a Four Star School, the state's highest performance designation.

Six elementary school teachers from the three schools voluntarily participated in the activities associated with this project. Four of the teachers began in year 1 of the project, with two teachers becoming involved in year 2. However, half-way through year 2, one teacher at the rural location suspended participation for personal reasons. Each participant received the same introduction to the project regarding the resources that were being installed and the instructional requirements, including participation in electronic field trips and video streaming.

Participants

Of the six teachers who participated in the project, two were selected for analyses associated with this research. There were several reasons for this: both participated for two full years, they exhibited dichotomous technology experiences, there was consistent integration of technology into their instruction, and survey data and observation data revealed pedagogical differences in instructional planning and teaching activities. The following are descriptions of the participants who were the focus of this research. Pseudonyms are used here to maintain confidentiality of the participants.

Jane. Jane, a Caucasian female, taught fourth grade in the rural elementary school. Jane has taught for 26 years and holds a master's degree. On an initial survey regarding her stage of technology implementation and computer use, Jane rated herself as in the process of learning to implement technology into her instruction, or at the "entry" stage in the ACOT framework. At the outset of the study, she did not use computer or Internet-based activities in the classroom and described her computer use at home and at school as primarily consisting of using the Internet and email. Jane used these in relation to her teaching activities less than 15 minutes per week. Jane indicated that to effectively integrate technology into her instruction, she needed more time to learn about computers, the Internet, and to change her curriculum; more training regarding how to implement technology into the curriculum; and further opportunities to use technology-enhanced units in conjunction with colleagues.

Initial observations and interviews revealed Jane taught in a manner that would be described as constructivist. Her typical role within instruction was that of facilitator – circulating the room, providing feedback and information to help students progress past points of difficulty within content. Students were actively involved in curricular

decisions and evidence of differentiating instruction was present as students were able to select content based on interest during one observation. Jane was also willing to actively participate in professional development activities, both technological and pedagogical (described below), as these would allow her to not only learn to use technology herself, but also how utilize technology within the context instruction to improve student outcomes.

Thomas. Thomas, a male Caucasian teacher, taught fifth grade in the suburban elementary school. Thomas has been teaching for 40 years and holds a master's degree. In response to the question regarding the stage of technology implementation, Thomas indicated "Adaptation" as he successfully adapted technology use to varied contexts. Like Jane, Thomas described himself as needing more time to learn about computers and the Internet and to change his curriculum. Thomas also indicated the necessity of more training in technology and how to integrate technology in the curriculum as being very urgent in the survey. Finally, Thomas responded strongly that he needed time to try out technology-enhanced units and opportunities to collaborate with colleagues during this process. Computer use for Thomas consisted of accessing email, the Internet, and for use in other activities, both school and personal. Overall, Thomas indicated both he and his students (as related to classroom activities) were likely to use the computer for 46-90 minutes per week.

Thomas' style of instructional delivery could be described as traditional. Activities were teacher-directed and students were observed completing traditional pencil and paper activities during independent work times occurring after instruction on several occasions. Notably, Thomas was resistant to pedagogical professional development

related to technology, such as cooperative learning activities. However, he did exhibit a willingness to learn how to use technological applications such as the use of united streaming video.

Procedure

In conjunction with the implementation activities associated with this project, the four original participating teachers were given a survey accessing information including technology use in the classroom, attitudes toward technology use, classroom needs related to technology, and stage of technology adoption. This information was used to establish baseline measures of the teachers that are the focus of this research and are described in the preceding section. During the first year of availability of the new technology networks, teachers were asked to utilize United Streaming video as part of their instruction, to access electronic field trips, and to participate in video conferences associated with the electronic field trips. Professional development activities were conducted weekly with training focused on both technological and pedagogical skills as well as on-demand questions. Topics included, but were not limited to:

- How and when to use technology;
- Using digital media to improve teaching;
- Uses of videoconferencing;
- Differentiated instruction & lesson tiering with technology;
- Cooperative learning activities across schools; and
- Matching instructional methods to student needs using technology.

A second administration of the survey was completed near the end of the first year of implementation to note changes in attitude and computer use of the teachers after one academic year.

Observations of lessons utilizing technology began in year 2 on all six teachers, however, only one observation was conducted in the school added at the outset of year 2 due to the technology related problems experienced by the school. Overall, two to three observations per month were completed on the remaining teachers during year 2.

Scheduling of observations was dependent upon technology use in the classroom, thus the aforementioned network issues and lack of technology-enhanced instruction limited the conclusions that could be drawn from the four participating teachers who are not described in this research.

Observations utilized the Integration of Technology Observation Instrument (Zambo, Wetzel, Buss, & Padgett, 2003). Observations focused on the nine specific areas outlined in the instrument:

1. Class organization;
2. Teacher's role;
3. Teacher's use of technology;
4. Student use of productivity tools;
5. Student use of subject specific learning tools;
6. Student use of interactive communication tools;
7. Student use of research tools;
8. Purpose of research tools; and
9. Students' level of technical skills.

The observations did not use timed intervals as indicated on the instrument, but instead focused on the qualitative aspects of the areas outlined in an attempt to gain more depth of information concerning the actual uses of the technology. Pre- and post-observation interviews accessed further information regarding the rationale for planning technology inclusion in the lesson, the teacher's views concerning the success of lessons using technology, including meeting objectives, and the obstacles that occurred during lesson implementation.

This research project utilized a case study design to compare the result of access to laptop computers on teaching methodology. Triangulation of the data was the result of using research techniques including observations, interviews, and self-report surveys. Data analysis consisted of the coding of observed behaviors and interview responses to note trends in pedagogy and categorization of activities into applicable NETS*T categories. Differences in coding and categorization between the two observers associated with this research were discussed until a consensus was reached and all applicable instructional events and responses were categorized.

Results and Discussion

Results of the second administration of the self-report survey administered to the teachers revealed several differences in methods of learning about technology, its use in the classroom, and beliefs after the first year of the project. Subsequent observations during the academic year confirmed information obtained in the surveys and allowed the researchers to examine instruction methods associated with laptop.

At the outset of the study, Jane did not actively use technology as part of her instruction and did not actively seek information regarding technology use. In fact, she

liked to joke that she barely knew how to turn a computer on. However, at the end of one academic year, while still using the computer mostly for checking email and for information on the Internet, she was actively seeking information from the local resource person and colleagues. This became evident during the second year observations as at one point Jane was supervising a student teacher and made the point of expressing to the researcher, “It is beneficial to have someone from the university in my classroom because she knows so much more than I do. She is teaching me how to do things I didn’t know.”

While Jane still felt she needed more time to learn to use computers, she indicated that time to change her curriculum did not represent a significant factor. The laptops were viewed as another resource to use within the context of instruction and provided new opportunities for students to investigate and present information. When queried during one lesson why she was using technology, Jane responded, “Because the technology is available and the students enjoy the opportunity to learn this way more than using books.” Jane also noted that she felt it was more interesting to use the laptops for teaching than simply using traditional teaching resources.

A second notable change in Jane was her indication of the increased necessity for more training regarding how to integrate technology into her curriculum and pedagogy. Jane regularly participated in the professional development activities conducted as part of the project. While initially using the laptops only for the required activities, i.e. united streaming video, through knowledge gained from professional development, Jane began to implement activities that matched instructional methods using the laptops to students’ instructional needs. In addition, student presentations using productivity software demonstrated continued differentiation by product. While Jane was described as

constructivist, her initial activities using the laptops would fall into Ertmer's (2005) low level tasks (word processing and internet searches). This is not altogether unexpected as the ACOT framework posits that someone at Jane's level of technology implementation would use the laptops to support traditional instruction. However, continued use and comfort with the laptops produced higher level tasks, which better matched Jane's constructivist philosophy.

Thomas continued to use the computer and Internet for both school and personal reasons. Somewhat surprisingly, while the amount of time Thomas stated that he and his students used the computer remained at 46-90 minutes per week, the stated use of the Internet by both groups decreased from 46-90 minutes per week to 15-45 minutes. The reason for this is not clear. Observations did not reveal any qualitative changes in use – Thomas continued to utilize the laptops to complete the activities associated with the laptop project, using the websites provided to him by the professional development coordinator, i.e. united streaming video and electronic field trips. Very little usage was observed beyond this, but this was consistent throughout the year.

Thomas's responses on the survey indicated a decreased sense urgency concerning time for implementation and training activities associated with technology use. Thomas also felt less need to try out technology enhanced units and discuss them with colleagues before introducing them to students. This is not surprising as observations continued to reveal a traditional orientation in instruction using the laptops, reinforcing the researcher's assessment of his comfort and confidence in this style of style of delivery. In addition, Thomas continued to be unresponsive to pedagogically

oriented professional development, further reinforcing this view. Very little constructivist practice, as advocated by ISTE, was observed.

Thomas indicated he received the largest percentage of information about teaching with technology from the Internet, but also used journals. The former was an interesting response to the researcher as when the researcher presented Thomas with numerous websites related to class content, Thomas replied that he already had too many materials (not technology-based, i.e. manipulatives, etc.) than he could use. In further conversations, Thomas appeared to base his response on simply “teaching with technology” as opposed to “information about” the subject. Observations revealed only the use of websites for participation within the project as described above.

Thomas rated himself as now being able to creatively apply technology in new contexts, or at the “Invention” stage within ACOT. This was not corroborated by observations. Thomas did not appear to use technology in any new contexts nor did he exhibit any high level, constructivist tasks as described by Ertmer (2005). For example, in Thomas’s class, approximately 43% of the lessons observed using the laptop computers involved the students viewing videos selected by Thomas. The students were then asked to complete worksheets based upon what was viewed. In another activity, the students filled in a crossword via a commercially produced software program and printing the crossword out for assessment purposes. Students were not observed actively producing content. In fact, the students were never observed using even word processing under Thomas’ direction. According the Ertmer (2001), teachers who believed they were implementing constructivist practices, i.e. the top levels of the ACOT framework,

did not always exhibit practices that matched this orientation. This could be said of Thomas for the aforementioned reasons.

Analyses of NETS-T

Technology operations and concepts. Both teachers, at the time the observations began, demonstrated at least introductory knowledge regarding technology implementation. Thomas was the more proficient of the two, as corroborated by the preceding survey data. During the observations, Thomas was able to smoothly plan experiences for the students that utilized the laptop computers, set up the necessary components, and effectively model appropriate use of the applications being used. He also demonstrated the ability to troubleshoot technology related issues, including problems accessing streaming video and printing materials necessary for the lesson. Thomas demonstrated some growth in technology knowledge and skills, as evidenced by the video conference he helped facilitate with the Baseball Hall of Fame. However, observations did not reveal any other emerging technology use nor did interviews reveal any technological innovations that Thomas had read or heard about and wanted to implement in the classroom.

Jane showed an introductory knowledge of technology operations and concepts, but this knowledge was more rudimentary than Thomas and Jane relied on support from a student teacher and the school's technology specialist to effectively understand some technological applications. As the year progressed, Jane was increasingly able to access more application-specific software and successfully help students complete tasks such as reformatting PowerPoint slides or access websites relevant to research being completed for a science experiment. Jane appeared to demonstrate more growth in technology

related areas, however, this could be the result of having more areas to learn. Jane began to implement learning activities that were completely web-based, but did not utilize any new or emerging technologies in her planning or instructional activities.

Planning and designing learning environments and experiences. Thomas and Jane planned and taught lessons that were developmentally appropriate. Attempts were made to meet the needs of diverse learners, however, this often came in the form of mixed ability pairs based on technological proficiency. Teachers implemented this practice to provide opportunities for students who were not as proficient using technology to learn skills related to successful technology applications. During the observations, it appeared the “stronger” student would often take the lead during the lesson and, in some cases, the less proficient peer would not use the laptop during the lesson. Often this student would become a passive observer in the process. No attempts to rectify this were observed.

Both teachers demonstrated the ability to locate appropriate resources for successful technology use. The mobile cart facilitated access to the laptops, thus the task became a question of planning for software or application use. Thomas planned instruction that appeared more traditionally oriented as many activities were teacher directed. Survey data indicated Thomas received his information regarding technology implementation from a variety of sources, including journals, however, as a result of the confidence and comfort associated with his style of instructional delivery, Thomas did not implement current research on teaching and learning with technology. Very little student-centered practice, as suggested by ISTE, was observed. In the case of Thomas, he selected the resources to be used by students – specific videos accessed via the Internet,

relevant websites, etc. Students engaged in watching videos on the laptops and filled out worksheets or in another instance completed an electronic crossword that was printed and turned in.

As Jane gained much of her information on how to integrate technology from peers and the local resource person, it is not clear how much current research impacted her planning as this would be dependent on the knowledge of other individuals. Interview data revealed Jane was often willing to try new methods of instruction using the laptops, but lack of knowledge prevented significant change. Other conversations regarding technology revealed that technology use was planned because it was available as opposed to any research-based foundation. Jane began the observation period planning similar activities, however, on the last observation, Jane allowed the students to select an appropriate search engine and to access what they determined to be appropriate websites for the content that was the focus of their research.

Teaching, learning, and the curriculum. Both teachers were able to provide learning experiences that addressed academic content standards, however, neither specifically cited student technology standards as rationales for technology use. Often, the activities utilized for instruction would not be considered student-centered as they were teacher directed. For example, in Thomas's class, the videos viewed by the class were teacher selected and students were asked to complete worksheets based upon what was viewed. In another activity, the students were creating PowerPoint slides based on material researched on the web, however, the websites were preselected and students were given limited choices regarding what famous American to present information on. As part of the instrument used for this research, learning activities are categorized as

promoting either declarative, procedural, or conditional level. Overall, the majority of the lessons viewed in Thomas's classroom contained elements that would be categorized as accessing declarative, or lower level, thought processes. Jane, on the other hand, often demonstrated activities that accessed numerous levels of knowledge within the course of the lesson. For example, [insert information from rat study here]

Assessment and evaluation. Standard IV addresses teachers using technology to assess and evaluate learning and appropriate technology use. While both teachers utilized technology for instruction and asked students to complete technology-enhanced projects, neither Jane nor Thomas specifically used the technology for assessment purposes during the observations. In one lesson, Thomas accessed an online learning activity involving crossword puzzles, however, the students were asked to print out the final results to be turned in. On several occasions, problems developed as students tried to print papers and this created situations where Thomas had to devote significant amounts of time handling these types of issues as opposed to facilitating instruction using the laptops to find answers to fill in the crossword. Similar situations were observed when students created PowerPoints. Rather than using technology as a means to communicate project progress and assessment, both teachers relied on observation and producing hard copies of assignments.

Productivity and professional practice. Thomas and Jane used technology to engage in professional development activities related to teaching. This is revealed through survey data, and as a result of interviews during observations. Thomas described accessing websites associated with topics for instruction. However, it is not clear how often this access was occurring as the researcher offered Thomas several relevant

websites, but Thomas expressed disinterest as he felt he had enough resources from his many years of teaching. This confidence of experience dictating the appropriateness of the activities was revealed on several occasions during interviews. Thomas did not appear to reflect on the use of the technology for teacher-directed activities. His comfort in using technology came as a result of his using it in a manner that reflected his pedagogical philosophy.

Jane, on the other hand, expressed her increasing comfort with integrating technology-enhanced lessons into her curricular decisions. This demonstrated that she was actively comparing prior experiences with current practices. While Jane would not be described as a traditional teacher, observations revealed applications of technology that were teacher-directed. As the year progressed, Jane's increasing comfort allowed her to relinquish some control and to allow students to direct their own internet searches and choose websites they deemed appropriate for an assigned task. However, the students were asked to take notes on paper, as opposed to utilizing the opportunity to familiarize the students with word processing applications, and were able to print one page of information from one website they selected.

Evidence of the teachers using technology to increase their own productivity during the course of the observations was very limited. Both teachers did use an electronic gradebook to maintain and record student assessment data, but this was the only example noted as a result of the research techniques employed. However, both teachers used technology for communication purposes, which could be construed as an efficient means of increasing productivity as emailing can reach a larger audience in a

shorter amount of time than traditional methods. In addition, Thomas used the laptops for a school event that had parents and students collaborating on mathematical concepts.

Social, ethical, legal, and human issues. The two teachers that are the subjects of this research exhibited very limited behaviors related to the performance indicators for Standard VI. As a result of the number of laptop computers provided by the project, the teachers were able to provide all students with opportunities to use the computers during the course of each lesson. Thomas and Jane consistently used pairs and individual grouping arrangements for the instructional activities utilizing the laptops. In addition, as a result of the grouping arrangements, the teachers were able to effectively monitor computer use ensuring that students were accessing material in a “safe” manner. Neither teacher exhibited any behaviors directed towards safe and ethical uses of technology, nor did planning or instructional activities using the technology focus on providing experiences for diverse backgrounds or abilities.

Implications

As the majority of the research regarding technology and education has focused on application-specific studies related to technology use, the current research can be cited as an impetus for the necessity of further examination into technology use and pedagogy. Calls for this type of research have already been made (see Russell, Bebell, Cowan, & Corbelli, 2002; Zhao, Pugh, Sheldon, and Byers, 2002) and this constitutes a necessary step in the assessment of progress. Currently, the pervasive view that access to technology equates to adequate implementation predominates. Somewhat reminiscent of the idea that “if you build it, they will come” from the movie *Field of Dreams*, computers

and laptops are being purchased and put into classrooms without regard to adequate training in how to properly use this technology as part of instruction, not peripherally.

This research provides an additional example of the barrier of pedagogical beliefs and teaching practices using computers. Without the proper attention directed towards teacher reflection and development of attitudes regarding what constitutes effective use of computers (see Albion & Ertmer, 2002), instructional patterns appear that are consistent with that teacher's chosen pedagogy. Accordingly, Bitner and Bitner (2002) reinforce the importance of teachers allowing their style of instructional delivery to be modified by technology. While the current research provided professional development specifically focused towards integrating technology in an appropriate manner, only Jane took advantage of this, and evidence of a progression towards more student-centered uses of technology was observed. In the case of Thomas, acknowledging teachers cannot be told they have to change their instructional patterns, it would have been helpful for more specific information on the technology standards to help increase the possibility of reflective practice and eventual change. In addition, as recommended by Albion and Ertmer, it would have been helpful to provide Thomas with opportunities to both see and discuss technology use with teachers considered exceptional in this area.

Garthwait and Weller (2005) recommend teachers setting goals for technology use and state that without goals, technology use in the classroom will not progress or change as teachers will question the use of technology as necessary to the attainment of the curricular goals. With increasing access to technology, it is important that teachers, and institutions examine the application of technology in the classroom and set specific goals with regards to use. The two teachers associated with the current research were not

asked to set goals for use, however, Jane expressed an interest to one researcher that she was trying to learn and use technology, thus more change was observed in overall use within instruction. Thomas did not set goals beyond using the laptops in the ways described as part of the project, thus had no impetus to challenge himself. Further professional development aimed at developing collaborative efforts between the teachers, as outlined in the ACOT research (see Apple Computer Inc., 1995; Vannatta & Fordham, 2004) could have been used to create attainable goals for both teachers.

One essential question posed by Garthwait and Weller (2005) is: are laptop activities viewed as an add-on to the curriculum or are they seen as something that can be fully integrated? In general, teachers need to be made aware of the most productive forms of instruction using technology and the role they should take on as a result of the implementation. This awareness, in conjunction with information given to administrators, will help schools reevaluate what is currently taking place in classrooms and lead to change towards more productive technology usage and better learning outcomes for students. Institutes dedicated to training future teachers can begin to examine how future teachers are being educated in the implementation of technology into their classrooms. In preparing teachers to enter the classroom, it is important to not only educate students about what technology is available and how to use the technology themselves, but to also teach these education students how utilize this technology during instruction. As these institutions seek to create this climate using the NETS*T, it is important that they also focus on their students develop lessons integrating content area standards, but also applicable NETS*S too.

Summary

Perhaps Sutherland-Smith (2002) accurately portrayed the present educational climate with the statement that “technology is being used simply because it is technology” (p. 665). Without specific examinations of how technology is being implemented and professional development activities aimed at changing instruction, increasing access will not produce the desired results of a more constructivist approach to technology enhanced instruction. For this to occur, it will be necessary to educate teachers on not only what technology is available to them, but how to fully integrate this technology into their instruction. Laptops have the potential to make a tremendous impact on individualized learning, however, if used only as a tool to reinforce traditional practices, there will be little to no impact on student outcomes or achievement.

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