ENHANCEMENT OF INTEGRATION OF TECHNOLOGY INTO THE CURRICULUM

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Abstract

This action research study explores how an understanding of the current state of technology use by teachers can contribute to enhancements of integration of technology into the curriculum. Study results indicate that although teachers were able to use technology for basic tasks, they were not able to use technology to develop and implement teaching strategies that impact student learning. Recommendations to improve technology integration by teachers include increasing teacher awareness of the benefits of technology integration, recognizing needs of teachers for technology integration to occur and improving technology-based professional development for teachers.

Introduction

Hoffman (2001) states that the successful use of technology in schools is directly related to the integration of technology into classroom curriculum. Therefore, schools should be working towards achieving greater levels of the integration of technology into the curriculum. Barnett (2001) suggests that technology impacts student learning when there is a connection between the content being studied and the technology being used. Quinn and Valentine (2001) further describe the importance of the integration of technology and curriculum through the following statement: "Technology must be integrated into the curriculum so that it is a seamless component of instruction and evaluation" (p. 2).

Matusevich (1995) states that there is a strong link between the effective use of technology and constructivism. Constructivism is a learning theory centered on the belief that children construct knowledge from their experiences and beliefs. Constructivist theory is focused on providing authentic tasks that are connected to the real world, are challenging, and integrated across curricular areas. Harrington-Leuker (1997) states that constructivism can bring about a pedagogical shift that urges schools to evaluate instruction that centers on the mere transmission of information as opposed to instruction that allows students to construct their own understanding. Byrom (1998) similarly talks of teachers adopting new strategies for instruction when they begin to use technology effectively.

The influx of technology use in schools has also altered the required skills that all learners must have to function in today's classroom. Thornburg (2000) states that students must now be able to sort through vast quantities of data, find specific information, determine if the information is relevant to the reason for investigation, and determine if the information is accurate. Bitner and Bitner (2002) similarly argue that students must utilize technology to help them search and discover knowledge, communicate with others, and solve problems.

However, Bitner and Bitner (2002) and Russell and Bradley (1997) state that some teachers lack confidence to integrate technology into the curriculum and this can be viewed as a form of technology anxiety. It is important to understand and accept that teachers may not accept technology with open arms and may go through a series of stages toward adopting technology. Bitner and Bitner (2002) suggest that "those responsible for asking teachers to use technology in the curriculum should be aware that fears and concerns do exist" (p. 2).

Primary question for this study

The primary question being explored by this study is: how can an understanding of the current state of integration of technology into the curriculum in middle schools contribute to enhancements of the integration of technology into the curriculum?

Research Method and Methodology

The research method for this study encompassed action research, and both qualitative and quantitative methodologies were used to obtain data. Stringer (1999) states that, "Action research is a collaborative approach to inquiry or investigation that provides people with the means to take systematic action to resolve specific problems" (p. 17). Action research takes on a process of observation, reflection, and action (Glesne, 1999). It was the research method of choice for this study as it can be used as a positive means to improve practice. Kurt Lewin, described as the father of action research by Glesne (1999) and Gronhaug and Olson (1999) emphasized the importance of using knowledge acquired through action research for the benefit of society or social improvement.

Action research utilizes qualitative and quantitative methods of obtaining and analyzing data (Glesne, 1999; Palys, 2003). Palys states that a quantitative approach deals with observable causes and effects, is objective through social distance, and results in deductions that begin with theory-based information. An anonymous online survey was used to collect qualitative and quantitative data. It was important to collect objective data, as Palys (2003) notes, in order to create a baseline for evaluating participant demographics and current levels of technology use and integration into the curriculum.

Qualitative approaches, on the other hand, deal with process-based case studies, are human-centered, and require an inductive approach that begins with observation and allows grounded theory, or "theory that emerges from research" (Palys, 2003, p. 74), to surface. The anonymous online survey served as an effective and simple data collection tool for collecting qualitative data. The qualitative data obtained through the use of open-ended questions on the anonymous online survey provided survey participants an opportunity to expand their thoughts about questions related to their current use of technology and to the integration of technology into the curriculum. A focus group interview was also used to collect qualitative data. The focus group interview allowed for participants to participate in the deeper analysis of issues brought forth from the anonymous online survey and to discuss new issues that came to light during the process of the focus group interview.

After completion of the focus group interview, the data was transcribed and then analyzed using content analysis. Major recurring themes were coded using content analysis. Stringer (1999) states that "the task of the research facilitator in this phase of the research process is to interpret and render understandable the problematic experiences being considered" (p. 90). Stemler (2001) notes that content analysis is a powerful data reduction technique that is used to compress large amounts of text into content categories. He goes on to remind readers that content analysis involves more than just a word frequency count; it involves a thorough examination of text for concepts and categories. Palys (2003) states that though the researcher must have a clear idea of what he or she is after when conducting content analysis, they must also attain their focus using personal interests, theory, and exploratory study.

Research Study Results

Demographic profile of respondents

There are 13 middle schools in the School District with 501 teachers. The anonymous online survey garnered 80 results, which works out to a response rate of nearly 16%. Sills and Song (2004) referred to a study's 22% response rate as being modest in nature. Therefore, a 16% response rate might fit into that description of modest also. The modest response rate may reflect sampling error as teachers who were confident technology users and were not threatened by an online survey may have been the main participants in this study. Such results might have impacted the course of the study through representative bias indicating that only a portion of the survey population was surveyed rather than the entire population. Further study would be needed in this area to confirm the presence of sampling error or bias.

37.5% of the respondents to this study were male and 61.3% of the respondents were female as the Figure 4.1 for this study's sex demographics shows. One respondent did not indicate their sex.

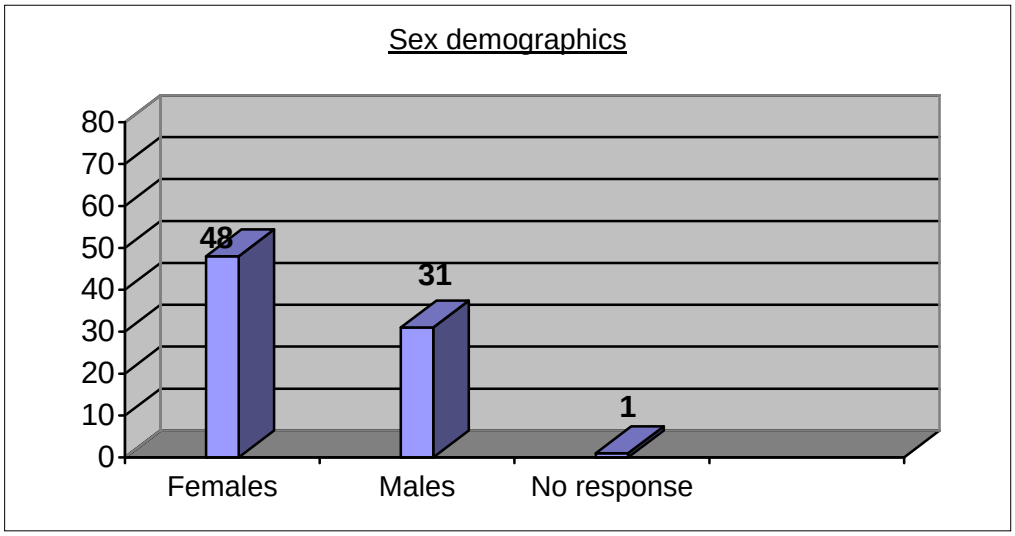

Figure 4.1 Sex Demographics

Kellenberger and Hendricks (2003) and Gressard and Lloyd (as cited in Woodrow, 1992) state that neither teaching experience nor the sex of the teacher have been found to be predictors of teacher computer use for student learning.

Figure 4.2 shows years of teaching experience of study respondents and it identifies that more than 60% of the respondents to the anonymous online survey were teachers with less than 10 years of teaching experience while 16% of the respondents had taught for 20 years or more. It should be noted that there could also be concerns of sampling error due to the fact that there is greater representation from less experienced teachers participating in this study than from more experienced teachers.

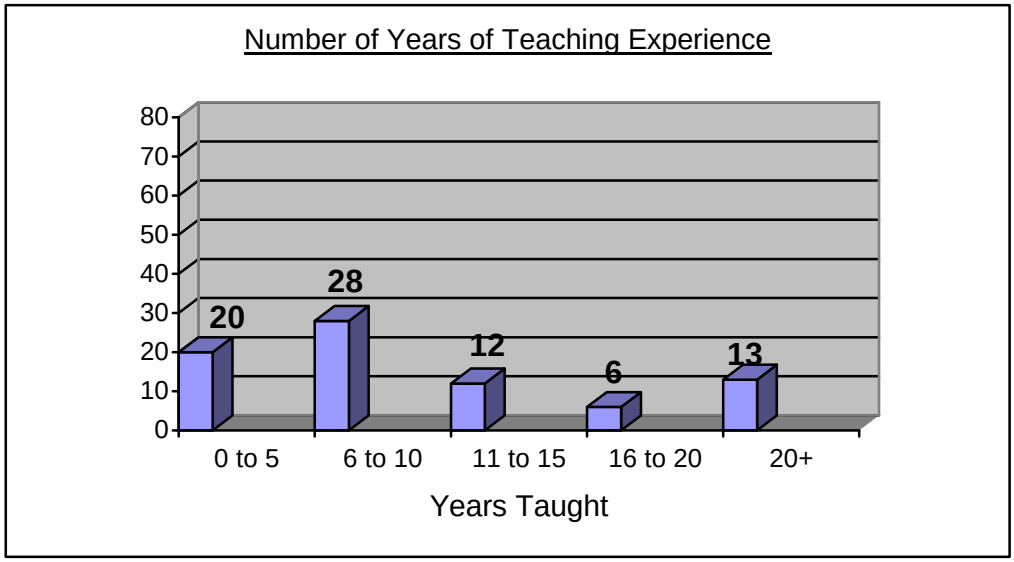

Figure 4.2 Number of Years Teaching Experience

The current state of technology use in middle schools in the school district was examined through the results of the anonymous online survey. Participants responded to questions regarding the regular and confident use of various technology applications such as word processors, email, and Internet browsers. Gressard and Lloyd (as cited in Christenson, 2002) state that teacher experience with computer technology is positively correlated with positive attitudes towards computers. Gressard and Lloyd's findings were confirmed when results from this study showed that more than 85% of the respondents in this study stated that they

"agreed" or "strongly agreed" with the statement that they are regular and confident computer users with respect to the basic uses of word processing (Figure 4.3), Internet browsing (Figure 4.4), and email communication (Figure 4.5). The figures show that middle school teachers participating in this study are confident computer users when using basic computer applications. Brickman, Braun and Stockford (as cited in Langille, 2004) found that word processing, email and Internet web browsing constituted the most frequent use of computers by educators. The work of Galloway, Brickman, Braun and Stockford (as cited in Langille, 2004) and Gressard and Lloyd (as cited in Christenson, 2002) support the findings of this study which show that most teachers have a high level of functional competency with technology.

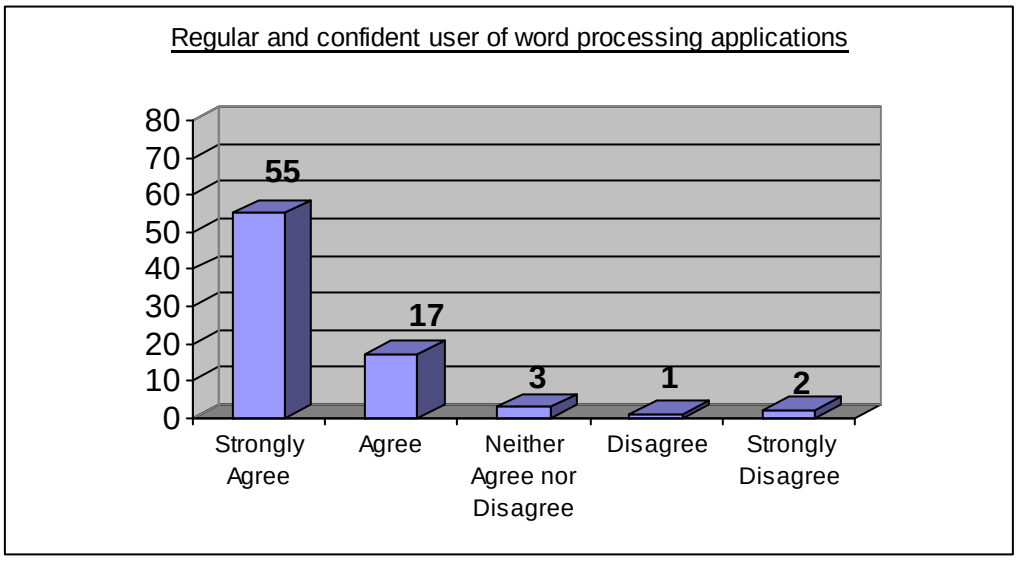

Figure 4.3 Regular and confident user of word processing applications

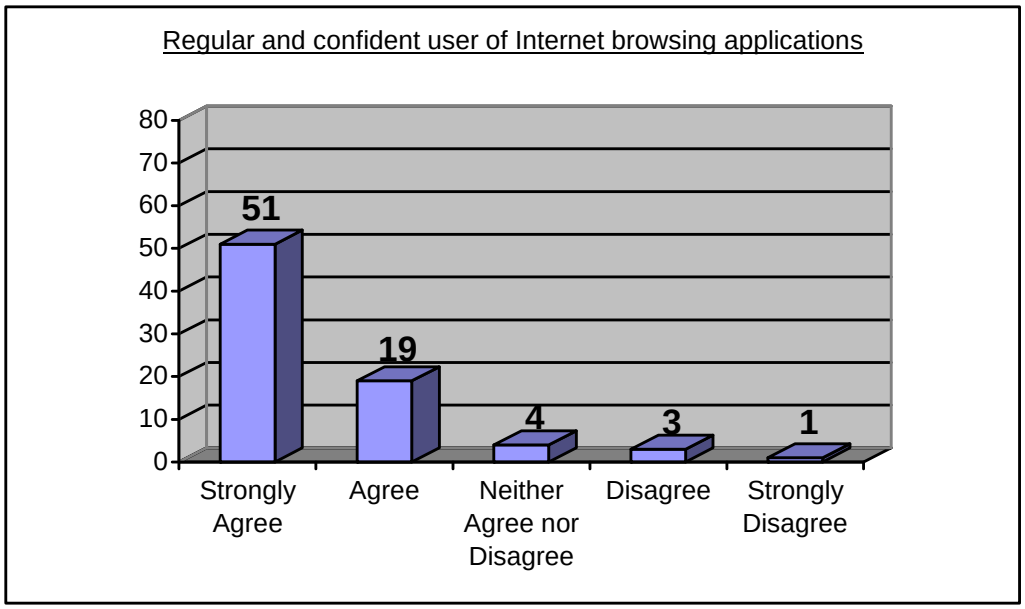

Figure 4.4 Regular and confident user of Internet browsing applications

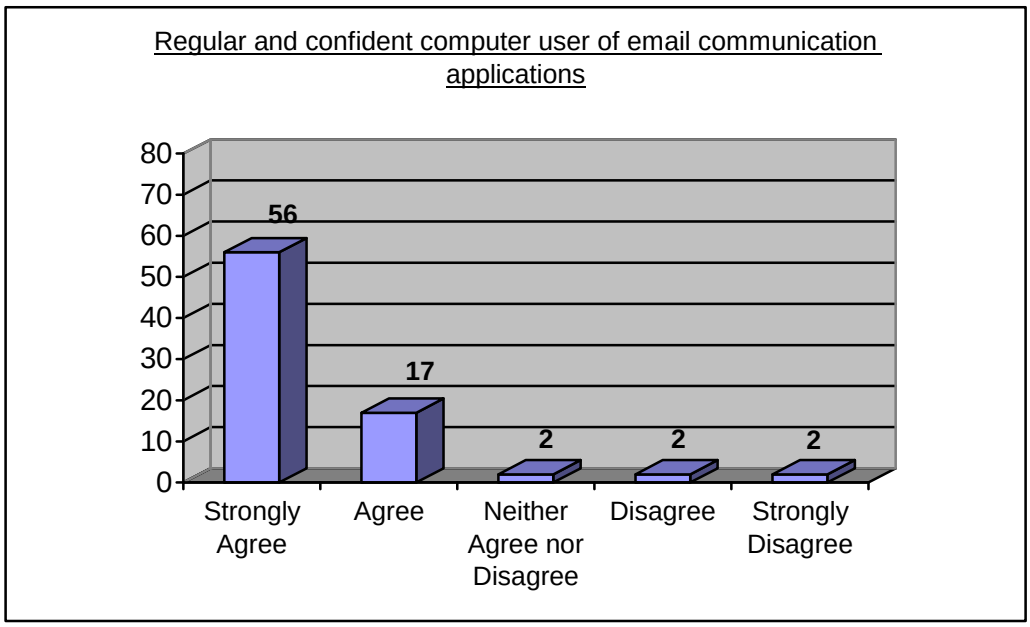

Figure 4.5 Regular and confident computer user of email

Archer (1998), Woodrow (1992) and Yuen and Ma (2002) note that positive teacher attitudes toward computers are necessary for the integration of technology into the classroom to occur and can even improve a school's climate when teachers, who had received technology professional development, used computers to teach higher-order thinking skills. Therefore, results from this study suggest that positive teacher attitudes exist towards technology and that a sufficient climate may exist for the integration of technology into the curriculum across middle schools in the School District.

Functional (administrative) use of computers

Functional competency is described as being able to utilize the computer for administrative functions such as data gathering or communication for the purposes of attendance, marks gathering, reporting, and email communication (School Board, 2001; Voogt et al., 2005). Figures 4.6 and 4.7 show that greater than 90% of respondents state that they "often" or "always" used computers for reporting and email communication, respectively. The results are indicative of an extremely high level of teacher functional competency and are further confirmation of Conlon and Simpson's (2003) findings which show that a high proportion of teachers use computers for report writing, preparing for teaching, and other administrative tasks. It should be noted that the high rate of use of computers for report cards may be due to the fact that the districts report cards are electronic.

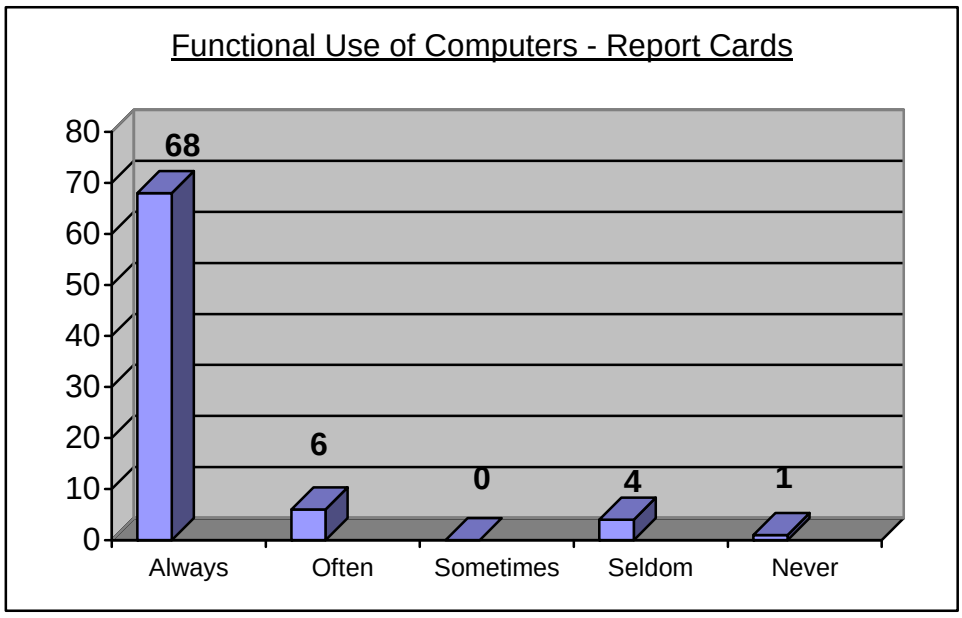

Figure 4.6 Functional use of computers – report cards

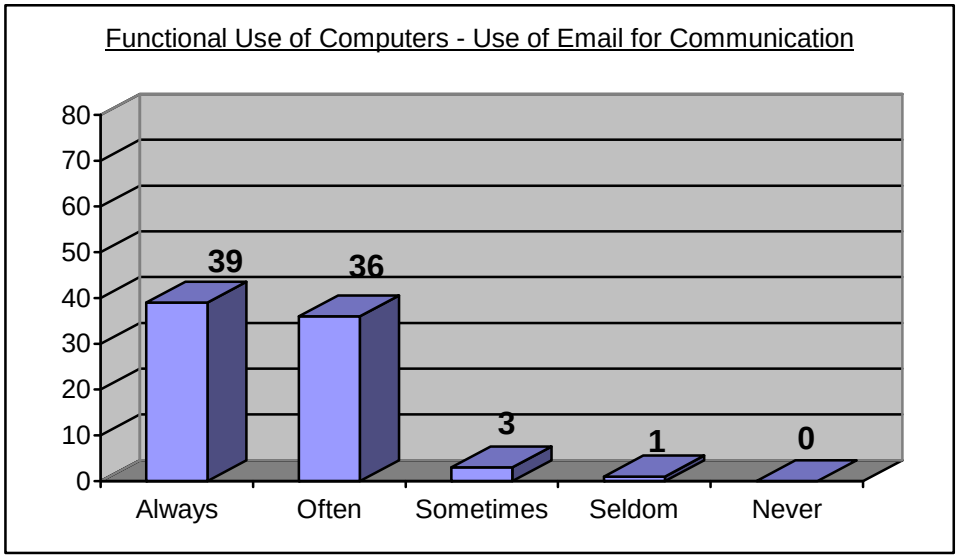

Figure 4.7 Functional use of computers – Email

Pedagogical (instructional) use of technology

Pedagogical competency is described as the ability to utilize the computer for implementing or developing teaching strategies. Pedagogical competency includes the ability to use computers to research teaching methods, to search for and design lessons, and to deliver lessons and support curriculum (School Board, 2001; Voogt et al., 2005).

Figure 4.8 shows that nearly 60% of respondents stated that they “often” or “always” used computers to research teaching methods while Figure 4.9 shows that more than 50% of respondents stated that they “often” or “always” used computers to either search for lessons or to design lessons.

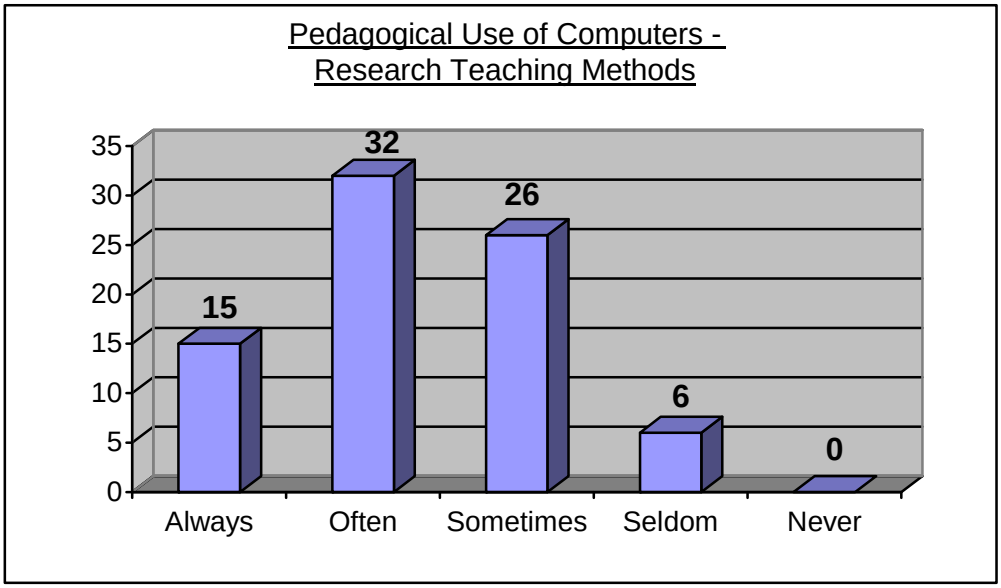

Figure 4.8 Pedagogical use of computers – research teaching methods

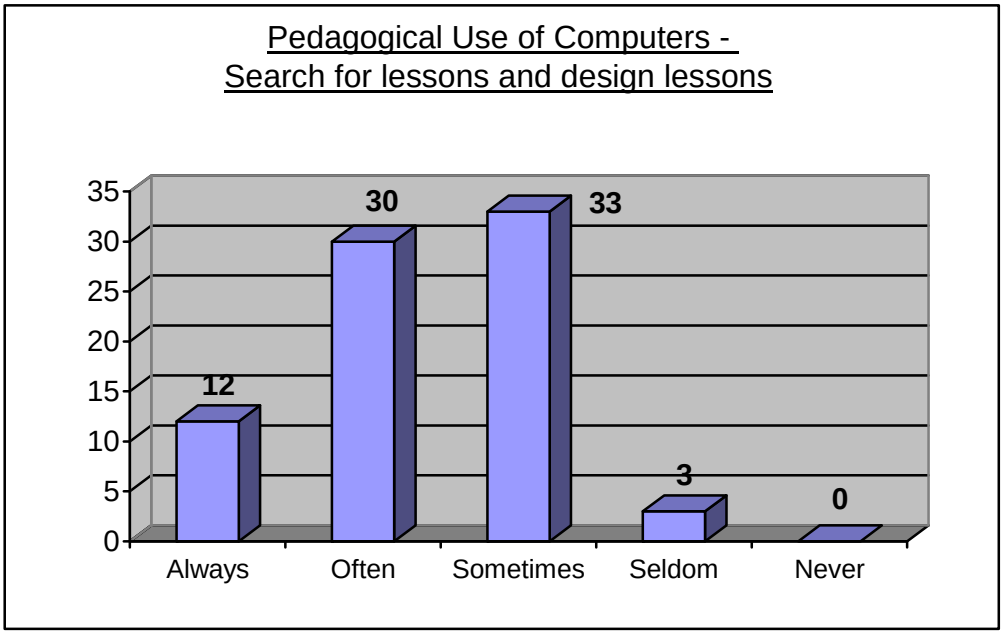

Figure 4.9 Pedagogical use of computers – search and design lessons

However, the results for teacher pedagogical computer use show discord between teachers encouraging students to use technology for the purpose of understanding and completing assignments, yet not actually using technology themselves to develop and deliver lessons and support curricular concepts. Figure 4.10 shows that less than 20% of respondents stated that they "often" or always use computers to deliver lessons or support curricular concepts in the classroom. An explanation might come from Atkins and Vasu (2000) who state that one of the most important reasons that teachers do not use technology with their students is that it is not easy to implement in the regular classroom. Shuldman (2004) also finds that there is a lack of teacher understanding of technology integration in the classroom. The following participant's account confirms Shuldman's statement by revealing an almost blind sense of obligation towards technology integration, "I don't know if I have ever seen any evidence that shows the integration of technology into the curriculum leads to improved student learning.

Whether it does or it does not, it does not mean that it is not worthwhile to pursue because it is so much a part of our culture. It is where we live now."

He suggests technology experiences can be integrated into daily classroom practice only after teachers have sufficient skills and an understanding of how available technologies can be used as cognitive tools. He finishes by suggesting that these skills and understanding only come about with time and practice.

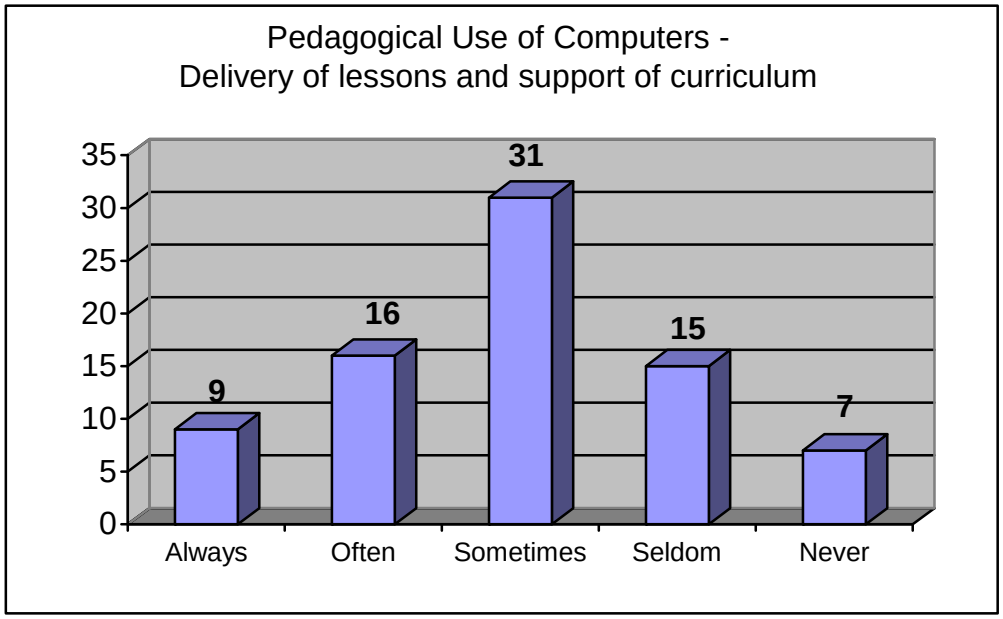

Figure 4.10 Pedagogical use of computers – delivery of lessons

Participants in this study were not convinced of the ability of technology to enhance student learning as only 50% of anonymous online survey participants felt that integration of technology into the curriculum enhanced student learning. Although, Kulik (as cited in Schacter, 1999), Mann, Shakeshaft, Becker, and Kottkamp (1998) and Ross (1999) found that students actually scored higher when technology was integrated into the curriculum.

Plante (2004) and Voogt et al. (2005) argue that while teachers might have training and confidence with respect to the administrative use of technology, they do not have the same training or confidence with respect to the pedagogical use of technology. They note that without skills in the pedagogical use of technology, connections to curriculum may not be made and student learning may not be enhanced.

Technology-based professional development

In this study, only 30% of respondents had attended district-based technology professional development workshops that they deemed to be useful to their teaching, and fewer than 25% of respondents implemented what they had learned from district-based professional development technology workshops. Barnett (2001) states that the most effective professional development programs are the ones that deliver workshops to teachers, as they need them, at their own school, and using their own equipment. He continues with the argument that spray-and-pray district-based technology workshops, which provide technology information that is general enough in its nature to satisfy all levels of teachers ranging from novice users to expert users, do not lead to any sustained changes in teacher behaviour. The following participant's quote confirms Barnett's statement, "Workshops really only serve a purpose of introducing participants to a technology topic. Most district-led professional development workshops are often based on knowledge that I already have."

Themes

Six themes, related to areas of enhancement of integration of technology in the curriculum, were found through the anonymous online survey and the focus group interview. These themes were: (1) technology accessibility and reliability, (2) time availability for teachers to integrate technology, (3) teacher confidence to integrate technology into the curriculum, (4) professional development (5) impact of technology on student learning (6) Impact of administration's support on integration of technology into the curriculum.

These recurring themes identified in this study are supported by Hoffman (2001), who identified factors for technology integration success such as accessibility to technology, school-based professional development, and administrator support are similar to the themes identified in this study. Bitner and Bitner (2002) also identified areas of consideration to allow for successful integration of technology which include understanding and accepting that teachers may have a fear of change associated with the impact of technology in the classroom, training to provide teachers basics of computer use to instill a level of computer ability and confidence, and the need for a supportive climate to foster experimentation with technology and curriculum without fear of failure.

1. Technology accessibility and reliability

Schuldman (2004) states that "on a most basic level, if districts expect teachers and students to adopt technology as a core instructional tool, then clearly access to instructional technology resources is not a condition, but a precondition" (p. 325). Shuldman's (2004) findings on computer and software accessibility and reliability are validated in this statement from a participant: "Reliability is the biggest thing; it has to work when you turn it on. You have to be able to get where you are going without the computer freezing on you".

Discussions about access to reliable computers and software brought about the following frustrations from a participant: "The hardest part of implementing a program is a lack of access to computers or lack of computer time in the computer labs." Another respondent remarked, "I have not implemented what I've learned because of the limited access to computers and the lack of working computers."

2. Time availability for teachers to integrate technology

Byrom (1998) notes that learning to integrate technology into the curriculum is a slow and time-consuming process that requires time, encouragement and support. The following participant's statement supports Byrom's (1998) findings of the time required to integrate technology into the curriculum. "My issue is dealing with time constraints and trying to keep up with the changing technology." Another spoke about the frustration of not being able to implement what was learned during professional development opportunities. "There just does not seem to be enough time to implement some of what I've learned during district-led technology workshops." The lack of available teacher time to integrate technology was a recurring concern noted by participants during the online survey and focus group interview. Schuldman (2004) elaborates that an impediment to integration has been the lack of available time for teachers to attend professional development opportunities, acquire new technology skills, and plan and reflect on how the integration of technology into the curriculum will occur. Most teachers go through predictable stages in their adoption of technology and this process generally takes from three to five years (Schuldman, 2004).

3. Teacher confidence to integrate technology into the curriculum

Moersch (1995) found that teachers with low levels of computer skills and computer confidence will either ignore technology altogether or will choose the level of technology that they believe they can handle. The skills and confidence necessary to integrate technology are addressed in this quote:

> I get students to access the computer to do assignments, integrate graphs and pictures into their work, access search engines and type their work. But I only do what I know I can do. I am not going to go and try something with my students that is out of my comfort zone.

Another participant stated that, “I am not always confident about the [software] program or able to troubleshoot when students encounter difficulties.” Byrom (1998) reminds us that “no matter how many computers are available or how much training teachers have had, there are still substantial numbers who are ‘talking the talk’ but not ‘walking the walk’” (p. 10). She mentions that though it has been more than 20 years that computers have been in schools, many educators have never used them at all. This finding is well represented in this participant’s powerful statement:

> If I don’t feel that I have the experience, then I am not going to the computer lab and make a fool of myself in front of my students, especially when I know that some of them can do more than I can using the computer.

Atkins and Vasu (2000) concur with Byrom’s (1998) earlier account of the lack of ease of implementation of technology and explain that one of the most important reasons that teachers do not use technology is that it is not easy to integrate into the curriculum of a regular classroom or lab setting.

Conversely, Moersch (1995) found that teachers with high levels of computer skill and computer confidence were more inclined to choose new levels of technology innovation to use within their teaching. Teachers who had low levels of computer skills and confidence seemed resigned to utilizing technology in ways that they were accustomed to and well within their comfort zones. Whereas, those teachers possessing technology skills and confidence seemed to step out of their comfort zones and use technology in innovative ways to support their teaching.

4. Professional development

This section elaborates on professional development, which Barnett (2001) and Dwyer et al. (1995) deem to be necessary to the integration of technology into the curriculum, and divides it into three areas; district-based professional development, school-based development and follow-up of professional development. The benefits and limitations of each of these areas will be discussed.

a. District-based professional development: Hinson et al. (2005) state that most professional district-level development opportunities are often delivered as “one-size-fits-all” (p. 1) workshops. Barnett (2001) similarly describes such workshops as “spray and pray” (p. 2). Both of these terms, “one-size fits all” and “spray and pray”, refer to technology workshops that are designed to appeal to a wide scope of interests and abilities of all teachers as opposed to the unique and specific needs of smaller groups of teachers. Russell and Bradley (1997) argue that one-shot technology workshops often have no consultation with participants and inadequate follow up. The following participant’s account confirms Russell and Bradley’s statement, “I attended one technology professional development workshop. At that time, I had very limited knowledge of computer use and the workshop was above my head.”

The results of this study confirm the earlier statements from Hinson et al (2005) and Russell and Bradley (1997) as only 30% of attendees of technology-based district professional development workshops felt that such workshops were useful to their teaching and only 25% actually implemented into their teaching what they had learned from a district technology-based workshop.

One-size-fits-all workshops designed for a wide scope of teacher abilities and the lack of technology connectivity between workshop schools and teachers’ schools are the issues that district-based technology professional development workshops must address in order to become effective vehicles for teacher training.

b. School-based professional development: The issue of connectivity that negatively impact district-based professional development is the same issue that enhances school-based professional development. Teachers who achieve success with school-based professional development are buoyed by the fact that there is complete connectivity between the workshop and the equipment available. Another comment regarding the benefits of school-based professional development was that “Usually with school based professional development, the information comes from a staff member who you can readily access when problems arise.” It

was mentioned earlier that Russell and Bradley (1997) found a lack of consultation and follow up with one-shot technology workshops. One respondent in this study argued that consultation was actually one of the main benefits of school-based technology workshops, "Workshops have been offered in response to specific requests by staff to satisfy a need identified by teachers." Technology-based professional development programs are often rendered ineffective as a result of lack of access to software and hardware. Barnett (2001) confirms this by noting that staff development programs must deliver workshops to teachers when they need it, at their school, and on their own equipment.

c. Follow up to support professional development opportunities: Inadequate follow up is cited as an issue with one-shot technology workshops (Russell and Bradley, 1997). "The more practice that I have, the better it is. Workshops are on a one session basis and I need more follow up than that." Another participant stated during the focus group interview that, "Whenever I learn something new after a professional development workshop, I always have a bunch of questions that I need to have answered immediately. Face-to-face or email follow up can both work well." Follow up of school-based technology workshops is easier because of logistics as all of the teachers are housed in the same building.

Collaboration is important to the proliferation of technology use as Becker and Ravitz (2001) note that those teachers who collaborate with their peers are much more likely to have their students utilize computer technology than the average teacher. Such a statement supports professional development follow up to encourage collaboration and support from peers when teachers are learning to integrate technology into the curriculum.

5. Impact of technology on student learning

Voogt et al. (2005) state that when pedagogical technology skills are lacking, due to an absence of training or professional development, teachers will not be able make connections with technology and ultimately will not be able to enhance student learning through technology. The lack of pedagogical technology skills may be one of several reasons that middle school teachers feel student learning is not enhanced by using technology. Though there was a lack of agreement between this study's results and the literature on the impact of technology and student achievement, there was agreement that student attitudes towards learning were improved when technology was used. Kulik (as cited in Schacter, 1999) concluded that students liked their classes more, developed more positive attitudes about instruction, and learned more in less time when they received computer-based instruction. Cradler and Bridgforth (1994) and Archer (1998) also found that technology integration led to improved student attitude and confidence. Archer even spoke of the improvements made to school climate when teachers utilized computers to teach higher-order thinking skills once they had received adequate professional development training.

6. Impact of administration's support on integration of technology into the curriculum

There was overwhelming praise of those administrators who supported teacher technology integration by using modeling, encouragement, expectations, and money for technology or training. Schiller (2003) and Brockmeier at al. (2005) state that the principal has a critical role in facilitating the integration of computer technology into the teaching and learning process. Results from this study confirm Schiller (2003) and Brockmeier at al.'s (2005) findings of the importance of the principal to technology integration. More than 80% of teachers agreed that their administrators supported the use of functional (administrative) technology. A participant stated that, "Report cards, daily attendance, emails, and even electronic newsletters to parents are expectations at our school." Hope and Stakenas (as cited in Brockmeier et al., 2005) mentioned that there are three primary roles that principals have; role model, instructional leader and visionary. The positive impact of supportive administration on technology use by teachers cannot be overstated. Teachers look to administration to provide technology direction. Carr (1999) speaks of a traditional top down model of teacher technology adoption that requires administration to mandate the use of technology. This model can only be successful if there is a high degree of administration support, facilitation, and sponsorship.

Study Conclusions and Recommendations

The primary question for this study asks how an understanding of the current state of integration of technology into the curriculum in middle schools can contribute to enhancements of the integration of technology into the curriculum? This action research study of the current state of integration of technology into the curriculum allows for the conclusion that many middle school teachers do not show high levels of pedagogical competency and therefore lack the confidence and ability to integrate technology into the curriculum. There are several possible reasons for this perceived inability of educators to integrate technology into the curriculum. The lack of adequate technology-based professional development opportunities for educators may be one factor and lack of time to learn practice and implement new technology opportunities in classroom settings. This study also finds that educators are not necessarily convinced that the integration of technology into the curriculum positively impacts student learning These conclusions, based on an understanding of the current state of technology integration into the curriculum, can be used for the identification of specific recommendations that need to be addressed in order to facilitate the progression of integration of technology into the curriculum. The recommendations are addressed in the following order; (1) increase the awareness of integration of technology and curriculum and its impact on student learning, (2) increase recognition of the needs of teachers to integrate technology into the curriculum and (3) increase the effectiveness of professional development opportunities.

Recommendation 1 – Increase awareness of the benefits of the integration of technology

There seems to be a need to increase the awareness of integration of technology into the curriculum in the school district. This need for awareness of the benefits of integration of technology comes as a result of participant responses from the anonymous online survey and focus group interview. These responses suggest that many teachers feel that the integration of technology into the curriculum does not necessarily enhance student learning. The following response from a focus group participant seems to reflect this confusion, “I don’t know if I have ever seen any evidence that shows the integration of technology into the curriculum leads to improved student learning. Whether it does or it does not, it does not mean that it is not worthwhile to pursue because it is so much a part of our culture. It is where we live now.”

Only half of the respondents to the anonymous online survey felt that lessons that integrate technology into the curriculum, contributed to enhanced student learning. The literature, however, suggests that technology not only enhances student learning (Kulik as cited in Schacter, 1999), it also develops positive attitudes and improves student attitude and confidence (Archer, 1998; Cradler & Bridgforth, 1994). The lack of teacher pedagogical competency may be a factor that contributes to the perceived inability of technology to enhance student learning. Voogt et al. (2005) found that though teachers might have high levels of functional competency in basic areas of technology use, they do not have similar levels of pedagogical competency. This suggests that teachers are very capable of utilizing technology but need to be trained to use it effectively in the area of integration of technology into the curriculum. This disparity needs to be addressed at all levels of the school district; school district management, administrators, and teachers. Some suggested recommendations to increase the awareness of integration of technology and curriculum and its impact on student learning are:

> **1.1.** Improve the visibility of technology integration in curriculum through the use of specialists, such as keynote speakers or experts in a particular technology-based field, who can show cutting-edge examples of enhanced student learning through the use of technology.
>
> **1.2.** Place importance on the issue of integration of technology into the curriculum by making it a school district goal or school-wide goal.
>
> **1.3.** Provide opportunities for teachers to observe or cooperatively teach with teachers who are integrating technology into the curriculum

Recommendation 2 – Increase recognition of the needs of teachers to integrate technology and curriculum

There needs to be an increased recognition by the school district of the needs of teachers to integrate technology into the curriculum. This recognition must include awareness of emotional factors such as teacher anxiety towards technology and also the accessibility needs of technology software and hardware. Some teachers have a level of anxiety towards technology and its integration into the curriculum. Brosnan (1998) and Harris (1985) coined the phrases technophobia and cyberphobia respectively, to relate to the excessive fear of new technology. With this awareness of anxiety towards technology in some teachers, it is easier to understand that teachers go through a series of 5 stages in their adoption of technology (Dwyer, Rigstaff, and Sandholtz, 1991). Barnett (2001) states that only 50% of teachers ever reach the third stage of Dwyer et al.'s model, adaptation, even with a strong program of professional development. Such a staggering statement shows how challenging the adoption of technology really can be for teachers. The recommendations that follow reflect the challenges that teachers face when learning to integrate technology into the curriculum:

2.1. Design professional development opportunities with the knowledge that many teachers have anxiety towards using technology and account for varied confidence and ability levels by promoting integration workshops that are for users at specific stages of technology adoption.

2.2. Provide time during the school year without students present for professional
development based on integration of technology into the curriculum.

2.3. Provide teachers with time to practice new technology skills, time to plan, and time to reflect on how technology can be integrated into their classroom curriculum

2.4. Provide each teacher with a reliable computer on their classroom desk.

2.5. Provide access computer labs that are consistently reliable and have a common platform [Apple or Windows], and consistent software programs

Recommendation 3 – Improve the effectiveness of professional development opportunities

Improvements in the area of professional development are necessary to provide teachers an opportunity to learn how to integrate technology into the curriculum. There must be a clear understanding of teacher issues that hinder the integration of technology into the curriculum. These teacher issues such as anxiety towards the integration of technology into the curriculum, lack of confidence in their technology skills, and lack of available time must all be taken into account when designing professional development opportunities. Suggestions by study participants include clearly identifying the level of the workshop: "Professional development opportunity write-ups should have good descriptions with the level of the content of each workshop also clearly identified." Another participant suggested, "Don't combine teachers who have had a lot of experience with those who have had very little." A further suggestion was to improve district-based technology professional development by utilizing district or technology grants to access money for continuous professional development. The following list includes suggested recommendations to improve professional development opportunities:

3.1. Increase the availability of district-based technology integration workshops that are specific to teacher ability and skill levels.

3.2. Clearly identify the content level of workshops when advertising technology based professional development opportunities. This will allow novice technology users to attend basic level workshops and advanced technology users to attend higher level workshops.

3.4. Increase the availability of school-based technology integration workshops that are district-funded, administrator supported and teacher-directed. A focus group participant clearly explained the need for more school in-service opportunities as they allow for teachers to learn, practice, and implement an integration of technology into the curriculum skill or lesson immediately because it is available to them at their school.

3.5. Provide timely follow-up opportunities after professional development workshops for teachers to share what they learned and ask questions that may have come up following the workshop. Participant responses stated that follow-up after professional development workshops can occur face-to-face or online via email or discussion groups.

3.6. Continue the funding of district-sponsored, technology-focused school-based teams to encourage specific integration of technology into the curriculum learning at the school level.

3.7. Have a knowledgeable technology mentor in each school to immediately deal with specific school-based technology issues.

3.8. Spread the culture of technology across a school by having technology-using teachers become mini-experts about a piece of technology that they are familiar with.

3.9. Increase awareness and promotion of technology integration-based graduate programs that encourage teachers to improve their technology skills through professional development programs and courses.

Future Research

The strength of an action research study can often be found in the questions that arise through the course of the investigation. Several questions deserving of further research came to light in this study.

Though many researchers such as Bain and Ross (1999), Kulik (as cited in Schacter, 1999) and Mann, Shakeshaft, Becker, and Kottkamp (1998) found that students scored higher when technology was integrated with curriculum, teachers in this study were not entirely convinced of the ability of technology to enhance student learning. Therefore, further research needs to be conducted to explain why only half of respondents to this study felt that lessons or activities that integrate technology and curriculum “often” or “always” enhance student learning. In this present age of educational accountability (Hinson, Laprairie & Cundiff, 2005), measuring, impacting, influencing, and enhancing student learning are of the utmost importance. In fact, the issue of enhanced student performance through technology use may well be the most important theme related to this study based on the increased requirement of teachers, schools, and school districts to show educational accountability.

Finally, results from this study showed that teachers have high levels of functional competency and are confident technology users with respect to email, Internet browsing, and word processing. However, teachers have low levels of pedagogical competency and are not confident technology users with respect to integrating technology into the curriculum. Barnett’s (2001) statement that only half of teachers ever reach the third stage, adaptation, of Dwyer et al.’s technology adoption model confirms this lack of progression. Further study must be undertaken to ascertain the reasons for the slow or halted progression of teacher confidence and ability to integrate technology into the curriculum.

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