Teachers' and students' self-reported attitudes toward technology: A literature review

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Abstract:

Researching teachers' and students' attitudes toward technology in general and in education specifically is an important endeavor, providing insight and direction for all educational stakeholders. This literature review synthesizes trends from research of teachers' and students' attitudes toward technology in general and specifically in the learning process. It also evaluates the trends of the instruments used to measure attitudes. While teachers and students are both positive about technology in general, both express caution with technology in the classroom for various reasons. Teachers perceive a paradigm shift and demand adequate training. Students request guidance and express pedagogical and technical issues.

Keywords: teacher, student, attitudes, technology, literature review

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Developing positive attitudes toward school and learning is an important precursor to academic success (Loyd 1984b). Indeed, research has demonstrated that positive attitudes increase the potential for academic success. Conversely, negative attitudes make academic success less likely (Loyd 1984a). Technology in general has changed the educational landscape, providing some solutions and creating new problems to solve (Zhang 1998). Thus, researching teachers' and students' attitudes toward technology in general and in education specifically is an important endeavor, providing insight and direction for all educational stakeholders.

For teachers, research has shown that positive attitudes toward technology and self-efficacy with computers are important prerequisites to helping others learn about computers (e.g., see Zhang 1998) and to successfully integrating technology into the classroom (Hignite & Echternacht 1992 as cited in Tsitouridou 2004). In fact, Wenzlaff (1998) posits that teachers' attitudes are among a handful of factors that determine the formal and informal curriculum in the classroom. Further, if teachers do not confront these attitudes and beliefs, they remain steadfast even when change abounds. Therefore, this literature review synthesizes findings from studies of teachers' attitudes toward technology in general and in the context of the classroom.

For students, research in traditional curriculum subjects such as mathematics demonstrate a strong link between students' attitudes toward the subject matter and their achievement in that area (Cognition and Technology Group at Vanderbilt 1992). Similarly, students' attitudes toward technology are indicators of their willingness to use the technology as a part of their learning process in school (Sanders & Morrison-Shetlar 2001 as cited in Alghazo 2006) and to adopt technology as part of their lifelong learning strategy (Pelgrum 1996; Fco 2001). This is

particularly important as schools and universities around the world are investing significant time and money in instructional technologies (McDonald 2004). Thus, this literature review also synthesizes findings from studies of students' attitudes toward technology in general and toward using technology in the learning process.

While teachers' and students' attitudes toward technology are crucial, this literature review begins with a discussion of the instruments used to measure attitudes. Clearly, the measurement tool used in a study impacts the findings of the study. Therefore, it is important to understand the historical basis for technology related attitude research as well as the trends in recent research.

Instruments and Measurement

Descriptive researchers, such as those who describe teachers' and students' attitudes toward technology, rely heavily on instruments to measure their phenomenon (Borg & Gall 1989 as cited in Knupfer 1996). Early in technology attitude research, several pioneers created, tested and validated a variety of attitude instruments to measure teachers' and students' general attitudes toward technology (e.g., see Loyd 1984; Loyd 1984; Kay 1989; Pelgrum 1991; Kay 1993; Pelgrum 1996). While each instrument was slightly different, all solicited general attitudes rather than domain specific attitudes.

One of the trends of more recent attitude studies is that researchers have begun to create new instruments to evaluate attitudes within a specific context (Van Braak 2004). Additionally, researchers are using more qualitative methods, such as open ended questions, interviews, focus groups and observations, to obtain a deeper but narrower understanding of attitudes within a particular context. For example, researchers may desire an understanding of attitudes toward working with interactive whiteboards (Hall 2005), multimedia (Fco 2001; Kirkwood 2003),

Internet-based environments (Lee 2005), or even particular environments such as the Jasper series created by the Cognition and Technology Group at Vanderbilt (1992) or three-dimensional environments (Jones 2005).

Additionally, two other research methods have emerged which, while not yet identified as trends in the literature, might be beginning to take root. First, Gagel (2004) evaluates two approaches to assessing technological literacy and attitudes. The most common approach now is the test battery approach which develops instruments to measure certain dimensions of attitudes. Gagel recommends using a typology approach, similar to the Myers-Briggs Type Indicator or the Keirsey Temperament Sorter. He believes this type of instrument could potentially be more meaningful and provide more longevity than those currently in use. Second, Kynigos and Argyris (2004) completed a qualitative study that not only solicited teachers' self-reported attitudes toward technology, but also compared those attitudes to their 'beliefs-in-practice' by observing their classroom behavior. This type of research could be a next step in the evolution of technology-based attitude research.

The lack of a common instrument to measure attitudes makes comparisons of studies more challenging. However, even with different instruments and different contexts, several trends did emerge from the literature. These trends are presented in the next sections.

Teachers' Attitudes toward Technology

Overall, teachers appear to have a positive, but cautious view of technology in general and of technology use in the classroom. Two general trends emerged in the review of literature. Specifically, prior experience with technology is significantly correlated with positive attitudes of teachers and that teachers' specialty or field of study correlates with attitudes toward technology. Two trends were also found when teachers were asked about using technology in the

teaching and learning process. First, teachers sense that technology use brings about a paradigm shift in the classroom which is creating tension for the teacher who views the shift at odds with broader educational paradigms. Second, teachers view training as a critical aspect in the adoption of technology in the classroom.

General Attitudes toward Technology

Early in attitude study, researchers evaluated aspects such as teachers' age, gender and prior experience as indicators of positive attitudes toward technology (e.g., see Loyd 1984; Pelgrum 1991; Kay 1993). Since these early days, teachers' general attitudes toward technology have evolved. Now, two trends remain which appear to have an influence on teachers' attitudes. First, prior experience with technology is still a strong indicator of teachers' positive attitudes toward technology. A new trend has also emerged in which a teachers' field of study is correlated with his/her attitudes toward technology. Both trends are discussed in detail below.

Prior Experience

By far, the most prevalent general finding is that prior experience with technology makes a positive impact on teachers' attitudes. For example, Van Braak, Tondeur and Valcke (2004) noted this specific finding using Loyd and Gressard's (1984) Computer Attitude Scale which was adapted for their survey of over four hundred fifty teachers in Belguim. The authors also used another more specific instrument to measure teachers' attitudes toward using technology in the classroom and then applied path modeling to the results. They found that past experience and favorable attitudes, which were closely correlated, were strong indicators of classroom use of technology. Another significant factor in classroom use was technological innovativeness, which was strongly entangled with experience and attitudes. Technological innovativeness can be

viewed in light of the paradigm shift that teachers perceive when introducing technology into the classroom. This topic is discussed in more detail below.

Additionally, Tsitouridou and Vryzas (2004) studied two hundred seventy-eight early childhood teachers in Greece using an open ended questionnaire. Based on their literature review, the authors noted that teachers' attitudes are far more positive when they have previous experience with technology (Loyd & Gressard 1986 as cited in Tsitouridou 2004) and that the more teachers use technology the more confident they became integrating it into their classrooms (Christensen 1998 as cited in Tsitouridou 2004). Indeed, their study found that teachers who have extensive prior experience are more positive and enthusiastic about technology and more easily recognize the educational benefits. Conversely, they found that teachers without prior technology experience have negative attitudes about the computer in general and about technology's effect on young children's intellectual and emotional development.

Finally, Sharpe (2004b) surveyed over one thousand teachers in Moscow schools finding similar results. Specifically, among teachers who use technology, seventy-seven percent view it positively and claim it can be effectively used in school. Among teachers who do not use technology, only thirty-eight percent find pedagogical value. Interestingly, Sharpe also noted that only a very small percentage of teachers prefer to interact with a computer in their free time. Specifically, less than four percent of surveyed teachers noted the desire to interact with technology, whereas over twenty-five percent of students at the time chose interacting with a computer as their favorite free time activity. Prior experience is also a trend identified for students and discussed below. Of interest here is the apparent generation gap between teachers' and students' time interacting with the computer. In other words, if significantly fewer teachers are obtaining prior experience with computers because they do not prefer to interact with the

computer, as a whole their attitudes toward technology will not be as positive as students' attitudes. This gap could clearly create issues in the classroom if the number of students who desire and even expect to use technology in their learning grows faster than the number of teachers who are willing to use technology in the classroom.

Teachers' Area of Specialty

Teachers of technical topics tend to have more favorable attitudes toward technology in general, and toward integrating technology into learning. Sharpe (2004b) noted that most of the teachers who enjoyed interacting with the computer were information science specialty teachers. Other teachers who enjoyed interacting with the computer taught similar technical topics such as chemistry, math and physics. Additionally, Hirschbuhl and Faseyitan (1994) surveyed over two hundred fifty post-secondary professors and found that the 'technical orientation' of the professor's specialty, along with other factors such as computer self-efficacy and general computer attitudes, predicted technology use.

Further, Aldhafeeri, Almulla and Alraqas (2006) surveyed almost five hundred elementary, intermediate and secondary teachers in Kuwait to solicit their attitudes about the e-learning system in their country. The intermediate and secondary teachers held significantly different attitudes toward the impact of e-learning in Kuwait. While the authors did not specifically note the teachers' area of specialty, clearly elementary teachers must be more generalists and thus few would be considered to affiliate purely with technical topics.

Attitudes toward Teaching with Technology

Two related trends emerged when teachers were asked their attitudes about using technology in the classroom. First, teachers view teaching with technology as a paradigm shift in

the structure and routine of the classroom. Second, teachers see a need for training that includes the technical aspects of technology use, but also moves beyond that to the pedagogical aspects of integrating technology into their teaching.

Paradigm Shift

Teachers appear to be struggling with the best ways to integrate technology into teaching and learning. The literature indicates that teachers sense a paradigm shift in teaching with technology, but reveal some hesitation in embracing the change. Teachers understand that using technology for learning changes their teaching methods (Rice & Miller 2001 as cited in Brown 2004). Additionally, Sharpe (2004b) and Tsitouridou and Vryzas (2004) found that teachers view technology adoption as an important strategy for improving education. However, change is slow and messages are mixed. Zhao, Tan and Mishra (2001) state that educational technology has long focused on assisting teachers, not learners. In fact, they posit that teachers are taught that technology is a tool to help teachers teach, which focuses more on transmitting and communicating messages through presentation software rather than allowing learners to construct knowledge.

In fact, in an early study of teachers' attitudes by one of the pioneers in the field, Kay (1993) surveyed almost six hundred fifty preservice teachers in Canada using his tested and validated Computer Attitude Measure. He found that preservice teachers believed that computers would help them organize their own work. These preservice teachers believed that computers would motivate students, but they did not necessarily view computers as 'natural' or believe computers would help students work in collaborative groups. Further, these preservice teachers believed they would use word processing software with students, but were least likely to use graphics software. These results indicate that preservice teachers at that time were beginning to

see some benefits to technology, but were not ready to change their teaching paradigms significantly.

Later, Wang (2002) sought to examine preservice teachers' attitudes toward the teachers' role in classrooms with technology. Seventy-eight preservice teachers were surveyed at a post-secondary school in Guam. When these teachers were placed in a classroom without technology, they perceived their role as teacher-centered. However, when placed in a classroom with technology, they perceived their role as neither teacher-centered nor student-centered. Therefore, Wang concluded that technology affected preservice teachers' perception of a teachers' role in the classroom. Teachers' views had clearly evolved from Kay's (1993) study.

Further, Kynigos and Argyris (2004) observed and interviewed twelve teachers in a Greek primary school who had been using innovative computer-based mathematics activities for eight years prior to the study. The purpose of the study was to compare these teachers' stated beliefs about innovative computer-based activities with their 'beliefs-in-practice' in those settings. In this school, the school headmaster encouraged innovation and asked teachers to act as a 'catalyst' or 'helper' rather than an instructor. In fact, the researchers found that the teachers in the study most frequently adopted the role of facilitating students' investigations. However, even in this supportive environment, these teachers still reverted to supervisory and directive roles, particularly when coming to the end of a session. One of the main themes of the research was that teachers felt a tension between allowing students to investigate and the need to create a tangible result from their activity within a particular timeframe. Thus, even in schools in which innovative technology-based activities are encouraged and expected, teachers still may have difficulty balancing the students' need for discovery with the broader national curriculum and educational paradigm. In fact, Hall and Higgins (2005) found similar results and recommended a

more flexible curriculum and a re-thinking of teacher and student roles in the classroom to encourage teachers to adopt a more student-centered approach.

Finally, Potgieter (2004) solicited teachers' attitudes on technology use in South Africa's educational system. Questionnaires were given to teachers after they attended a brief introductory educational technology workshop. These teachers also alluded to a tension between the outcomes that are expected of the students and the improvisation that teachers deem appropriate when using technology in the classroom. These studies taken together demonstrate that teachers may show positive attitudes toward technology, but shifting the paradigm of teachers will take a broader effort that includes addressing curriculum issues and product-focused learning outcomes.

Training

Clearly, research has shown that computer training positively impacts teachers' attitudes toward technology (Shashaani 1997 as cited in Van Braak 2004). Lee and Tsai (2005) explored secondary teachers' and students' attitudes toward constructivist Internet-based learning environments. They administered a questionnaire to seventy-eight teachers across Taiwan. Interestingly, the teachers rated ease of use as their most significant factor in integrating the constructivist Internet-based learning environments. This ease of use factor was rated above other factors of the technology-based learning environment such as reflective thinking, critical judgment and epistemological awareness. This study highlights the fact that teachers, while potentially positive about using technology, are still uncomfortable with introducing it into their classrooms.

Tsitouridou and Vryzas (2004) found that the majority of teachers believe that using computers in the classroom improves their status, but fewer wish to make technology training for

teachers compulsory. While the authors saw this as a contradiction and took the view that the teachers were not willing to commit to using technology in the classroom, it is perhaps more of an indictment of the type of training offered to teachers. In another example, Sharpe (2004b) found that teachers are more likely to focus on external obstacles to integration, such as hardware accessibility and inadequate materials rather than focusing on internal obstacles, such as adequate technical knowledge. Again, the researcher is critical of the teacher rather than the type of training that is offered to the teacher.

Brown, Benson and Uhde (2004) studied three post-secondary teachers who used technology in their classroom to differing degrees. This article was designed to illuminate some of the issues teachers face when using technology for learning. On the subject of training, one professor that was profiled held a certificate in instructional technology, but did not view herself as an expert. Additionally, her fellow teachers did not perceive her as an expert either even though they were aware of the certification. This point highlights the trend in the literature that while teachers desire technology training, teachers may perceive the training they receive as insufficient for quality technology integration into the classroom.

Errington (2004) addressed teacher beliefs and technology training, stating that the technical skills approach is inadequate to address teachers' needs. Instead, he advocates anchoring technology training in the context of teachers' beliefs about teaching, learning and the roles of both teachers and learners in that process. In Errington's view, teachers should begin by evaluating their own views of 'worthwhile, possible and relevant' teaching and learning. Further, teachers should detail their notions of adequate technical support for their endeavors. Only after the teacher is well informed on his/her own views of teaching and learning should technical options enter the discussion. In fact, the teacher's individual views on teaching and learning will

likely dictate the type of technical training that is appropriate for his/her own needs and desires, making the training relevant and timely. Interestingly, Errington's view of training would not only address the teachers' perceived frustrations with technology training, it could also allow teachers to work through their paradigm shift issues addressed in the previous section. This dual purpose makes the extra time this approach might take worthwhile and in fact perhaps necessary.

Students' Attitudes toward Technology

Overall, students are quite positive about using technology in general. The literature review found two prevalent trends for students. First, students believe using technology is relevant in their lives. Second, like teachers, students with prior experience using technology tend to have more positive views about the technology. A third general aspect is also included, though without a conclusive trend. Students' gender has been shown in some studies to correlate with positive attitudes and other studies found no gender difference. This is clearly an area for future research.

When students' attitudes are solicited about learning with technology, several trends emerge. Two contexts have specifically been studied in detail. Multimedia and communications technologies are areas of interest to a number of educational researchers and thus a synopsis of those findings is included. Additionally, students offer several areas of concern in using technology in education. Specifically, students are requesting guidance in using technology-based resources for study, students perceive some pedagogical issues with using technology in the learning process, and students express some dissatisfaction with the technical issues that accompany learning with technology.

General Attitudes toward Technology

As with teachers' attitudes, early researchers examined characteristics such as age, gender and prior experience with technology as factors that correlated with positive attitudes toward computers (e.g., see Loyd 1984; Kay 1993; Pelgrum 1996). Gender remains an open question and the current research is summarized below. Also, as with teachers, prior experience continues to offer a strong correlation with positive attitudes toward technology in general. In addition, students perceive technology to be extremely relevant in their lives, which influences their general attitudes toward technology.

Relevance

Overall, students view technology as relevant in their lives. Thus, they are motivated to learn about technology and learn with technology. Specifically, Pelgrum and Plomp (1996) performed a multinational study in 1991 to 1992 which gathered survey data about the nature of computer use in school and students' attitudes toward computers. They found that the majority of students overall found computers relevant, with fifty to seventy-five percent of younger students and fifty-five to eighty-four percent of older students noting relevance. Interestingly, students in the Netherlands showed a slight downward trend in computer relevance for older students. However, young students in the Netherlands viewed the computer as more relevant than in other countries. Thus, older students in the Netherlands, while viewing computers as slightly less relevant than their younger counterparts, held views of relevance consistent with students their own age in other countries (Pelgrum & Plomp 1996).

Additionally, in recent years even more students have come to view technology as relevant in their lives. A study of Russian secondary school children found that in 1992, forty-five percent of students indicated that an information science course would "definitely be of

use." In 2000, sixty-one percent of students found relevance in an information science course (Sharpe 2004b), a significant increase in eight years. Interestingly, the initial figure was gathered in the same year that the Pelgrum and Plomp (1996) study discussed above was completed. It appears that at that time slightly fewer Russian students believed that technology was relevant in their lives than students in other countries. This difference in attitude could be due to differences in computer use among students in different countries. While the precise numbers for computer usage are reported differently in each study, Sharpe (2004a) indicates that fifty-six percent of students regularly used computers whereas Pelgrum and Plomp (1996) noted higher percentage of schools that had computer access for students. In fact, the Pelgrum and Plomp (1996) study found in 1992 many countries with one hundred percent of the surveyed secondary schools equipped with computers for students. Additionally, Sharpe's (2004a; 2004b) data clearly indicate a trend of increasing relevance over the years, which mirrors other country's data (Pelgrum 1996).

More recently, a mixed methods study of secondary students described relevance of computers as one of the main themes of students in their research (Vale 2004). Interestingly, this study noted that boys were much more likely to attribute relevance to computer-based mathematics activities than girls. (See below for a further review of Gender.)

These studies have demonstrated that students have viewed computers as relevant to their lives for many years and that relevance is still an important aspect of learning about and with computers. Further, as students grow older, their perception of the computer's relevance in their lives heightens.

Prior Experience

Students' prior experience with computers is a significant factor influencing attitudes toward technology, with more experience resulting in more positive attitudes (e.g., see Cole 1994; Vale 2004; Alghazo 2006). In an early study of students' attitudes toward computers, Loyd and Gressard (1984) used the Computer Attitude Scale (CAS) which they created and validated to survey over three hundred fifty students in secondary and post-secondary schools. Their CAS measures three components of students' attitudes: computer anxiety, computer confidence, and computer liking. For all three of these areas, prior experience with computers was a significant influence on students' attitudes. Those students with more experience had more positive attitudes. Specifically, students were asked to indicate their level of experience and those with just six months of experience with computers were significantly less anxious about computers than students with one week or less of experience.

In a more recent study, Jones et al. (2005) completed a comparative study of post secondary students who were preservice teachers taking a Computers in Education overview course. The treatment group used a three-dimensional online learning environment in a blended online and face-to-face course while the control group used a standard face-to-face environment. Because the treatment group had to use technology to fulfill the requirements of the course and were thus immersed in using computers, their fears and anxieties about the dehumanizing effects of computers lowered. In other words, those students who gained more tangible experience with technology lowered their anxiety toward computers, which Loyd and Gressard (1984) noted as a component of attitudes.

This correlation between experience and attitudes has not been refuted, but Sharpe (2004b) noted an additional interesting facet in his study of Russian secondary students. For

seventh grade students, there was no difference in the perceived difficulty of an information science course among regular users and non-users of computers. However, among ninth and eleventh grade students, there were significant differences in the perceived difficulty of the technology based course between regular users and non-users of computers. Thus, the older students become the more their prior experience with technology affects their attitudes.

Gender

No identifiable trends exist in the literature to link gender with attitudes toward technology. Pelgrum and Plomp (1996) found that boys' attitudes toward technology was more positive than girls' attitudes in several countries, including Japan and the Netherlands. However, in other countries, such as the United States there was only a negligible difference between boys' and girls' attitudes. Vale and Leder (2004) linked gender findings not to particular countries, but to differences in age, socio-economic status and the instruments used in the study. In fact, they found that boys had significantly more positive attitudes toward technology than girls in their Australian study. These differences were noted in the areas of computer confidence, pleasure in using computers, and relevance of computers in students' lives. Additionally, Sharpe (2004b) found gender differences in Russian students' attitudes in the areas of perceived difficulty and usefulness, with boys once again demonstrating more positive attitudes.

These studies indicate that if gender differences do occur, boys' attitudes are typically more positive than girls. However, this generalization does not always hold true. In Alghazo's (2006) study of post-secondary students in the United Arab Emirates, girls were found to hold more positive attitudes toward technology than boys. Further, Loyd and Gressard (1984) found no significant difference in boys' and girls' attitudes toward technology in their study of secondary and post-secondary students. Thus, the literature offers mixed results with no

recognizable trend as it relates to gender and attitudes toward technology. This is clearly an area where future research is needed.

Attitudes toward Learning with Technology

Students overall are positive about using technology; however distinctions can be made between computer use at home and computer use at school (Pelgrum 1996; Furlong 2000). Recent literature about attitudes toward technology has become more specific with students, asking them about specific aspects of learning with technology. In particular, several recent studies have evaluated students' attitudes toward learning with multimedia and learning with a variety of communications technologies. Further, a number of studies have established some student concerns that, if not addressed by educators, could lead to negative attitudes toward technology. These areas include students' desire for guidance, pedagogical concerns and technical issues.

Multimedia

Several studies have evaluated students' attitudes toward using multimedia in learning with positive results. Hayes and Robinson (2000) assessed the attitudes of graduate students who used multimedia computer-assisted instruction in a course by employing two different attitude questionnaires. Students indicated a positive attitude toward using multimedia as part of their learning. Interestingly, while students indicated positive attitudes toward multimedia, a slight majority indicated that they favored traditional instruction over the multimedia computer-assisted instruction. This belief could possibly be result of the manner in which the multimedia was used in the course. During the study, teachers exclusively used the multimedia computer as a presentation vehicle for the lesson content. Students did not directly interact with the computer.

In another study of adult learners, Kirkwood (2003) used a survey and focus group interviews to solicit students' attitudes toward multimedia technology at the Open University in the United Kingdom. Students were strongly positive about the use of multimedia technologies in learning. The overwhelming majority of students appreciated using a range of multimedia in their courses, believing that the media contributed significantly to their learning. Further, students believed that the multimedia technologies brought the subjects "to life" for them. Interestingly, Kirkwood found that these adult learners, most busy with full time jobs and families, remained positive about multimedia, but became more selective about the media they used over time as they attempted to balance their studies with the other demands in their lives.

Finally, Hall and Higgins (2005), in a study of younger students, found that year six students appreciated the multimedia aspects of interactive whiteboards used in the classroom. They believed the multimedia aspects of the interactive whiteboard offered versatility to their lessons and they also appreciated the multi-sensory aspects of the whiteboards. Thus overall, students are very positive about using multimedia and believe it is helpful to them in their learning. They tend to appreciate the diverse ways in which multimedia can stimulate their learning.

Communications Technology

Many educators are interested in students' attitudes toward using technology to enhance communications, such as an online class discussion board or e-mail. Kirkwood (2003) found that adult learners at the Open University appreciated online communication only insofar as it contributed directly to their learning experience. However, other studies showed no differentiation for online communications activities, with students indicating overall positive attitudes toward using technology to communicate. For example, Jones et al. (2005) noted that

students viewed communications technologies positively and used them to enhance their learning experience. Additionally, Alghazo (2006) found that students specifically identified the enhanced communications in Web-based instruction as an advantage for their learning. In particular, the students held positive attitudes toward using technology for online discussions of course content and communications with the course instructor and classmates.

Further, Shang (2005) conducted a study of Taiwanese university students' attitudes toward using e-mail journaling as a means to learn a second language. An open-ended survey was used to solicit feedback and attitudes. Students viewed learning with e-mail positively and the study's self-efficacy measures indicated that these positive attitudes contributed to the effectiveness of e-mail for improving second language reading performance.

Some educators are concerned that students will feel isolated using exclusively online communications tools and these feelings will negate any positive attitudes and benefits of the technology. Mahoney (2006) studied graduate nursing students in online and face-to-face courses to examine their perceived sense of belonging. Using a tested and validated survey instrument designed to solicit students' sense of belonging, no difference was noted in attitudes between online and face-to-face students. Importantly, Mahoney found that the main factor in students' perceived sense of belonging was not the technology used, but it was the timely feedback from the course instructor.

Unfortunately, no studies were found documenting younger students' attitudes toward communications technologies. While special care must be exercised when young children are communicating with others via technology, this would likely be an area for future research. Clearly, adult learners have a positive attitude toward using communications technology in their learning process.

Desire for Guidance

An emerging trend appears to be that post-secondary students desire guidance from instructors when selecting technology-based course materials. Kirkwood (2003) noted that Open University students rated instructor selected course technology higher than technology they could find and access on their own. In another study, Murray, Hourigan, Jeanneau and Chappell (2005) surveyed over twelve hundred post-secondary students soliciting their attitudes toward using the World Wide Web (WWW) to support learning. Students expressed concerns about their ability to discriminate quality information online. Additionally, they lacked confidence in their effective use of Internet search engines. Interestingly, a little over half of the students had not used the WWW for study prior to entering the University of Limerick. Because of their lack of experience and expertise in using the WWW for study, many students expressed their desire for training in finding and using WWW materials for their courses. Moreover, students also attributed effective use of the WWW with detailed subject matter knowledge. Therefore, they expected their instructors to provide links and WWW resources that supplemented their course materials in much the same way instructors provide reading lists for courses.

While these two studies do not provide a conclusive trend, certainly they offer evidence that students' attitudes toward using WWW technology in learning could be evolving into a desire for guidance and assistance. Unfortunately, no studies were found exploring younger students' attitudes toward the guidance and training on WWW learning materials they receive from teachers. Therefore, this area offers a rich research opportunity for students of all ages.

General Pedagogical Issues

Students using technology in the learning process have developed a critical attitude toward the way in which computers are used in schools. Pelgrum and Plomp (1996) noted that as students aged, their enjoyment in using computers declined. However, students who only used computers at home actually increased their enjoyment as they aged. These trends occurred in each country reported and led the authors to conclude that the manner in which computers were used in school was directly related to this downward trend.

More recently, Furlong et al. (2000) used a mixed methods design to study over eight hundred elementary and secondary students' computer use and attitudes in the United Kingdom. They found that while students were very positive about using computers at home, they were quite negative about using computers at school. The students attributed this negative attitude to several factors. Specifically, the students viewed school lessons as too prescriptive, which left little to no time for playfulness and discovery.

In another United Kingdom study, Hall and Higgins (2005) used focus groups to solicit students' attitudes about using interactive whiteboards in a year six classroom. One-third of the focus groups commented on issues with their teachers' skills using the interactive whiteboard. Further, additional groups of students noted that the lessons teachers planned did not give every student the opportunity to interact with the whiteboard, which students viewed as a significant negative aspect.

Finally, Vale and Leder (2004) found that boys in particular expressed discontent with the way in which the teacher organized their learning when using technology. Thus, students' attitudes toward technology are affected by the amount of technical and pedagogical training a

teacher has received. Teacher training was also addressed in the Teachers' Attitudes section above.

Technical Issues

Students in a variety of studies expressed frustration with technical issues related to learning with technology. Furlong et al. (2000) found that students became frustrated with the hardware and software at school because it was significantly slower than that which they accessed at home. Additionally, students in Alghazo's (2006) study acknowledged several technical issues which caused frustration, including slow Internet speed and difficulties accessing their web-based course from home. Finally, Hall and Higgins (2005) also documented students' frustrations with technical problems when using interactive whiteboards because it caused delays and disruptions. Technical issues may be hard to avoid with technology lessons. However, students' attitudes again point to the need for educators to be trained thoroughly in using technology or to have a fully trained resource at hand.

Conclusions

Teachers and students both are positive about technology in general. With both groups, prior experience is a strong correlating factor with positive attitudes. For teachers, their field of study also has been found to correlate with positive attitudes. For students, a perception of relevance clearly dominates the literature. Further, students' gender continues to be an area which requires more research. The studies of gender have conflicting results over the years and thus no conclusion can be drawn in that area.

When discussing technology use specifically in the teaching and learning process, both teachers and students develop more cautious attitudes. Teachers sense a paradigm shift that

accompanies technology, but which is not evident in the broader educational context. Thus, a tension has developed for teachers which must be resolved. Further, teachers desire training, but it is not clear that they view the current array of training options sufficient for their purposes. Clearly, this is an area that requires more research.

Students view multimedia and communications technologies positively overall. There are no studies that document attitudes toward communications technologies for students younger than post-secondary, which is an area that needs research. Students hold some concerns for using technology in the learning process. Specifically, they seek more guidance in using technology-based resources, they express general pedagogical issues and become frustrated with technical issues. Again, younger students were not included in the studies that documented students' desire for guidance with technology-based resources. This is certainly an area where research would be welcome.

Research methods into technology-based attitudes have evolved over time. One promising research design which proved quite fruitful was the comparison of teacher beliefs and teacher 'beliefs-in-practice.' This research design is encouraged in the future to determine whether teachers self-reported attitudes are translating into the educational environment.

Finally, the attitudes of other educational stakeholders could be important in the overall evaluation of technology in education. Specifically, no research was found documenting parental or community based attitudes toward technology use in schools. This is an area that could bring further insight to the rich discussion of attitudes toward technology.

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