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Experiences and expectations: What prompts an educator to use computers in the classroom?

Craig Ross
Wilfrid Laurier University

EXPERIENCES AND EXPECTATIONS: WHAT PROMPTS AN EDUCATOR TO USE COMPUTERS IN THE CLASSROOM?

By

Craig Ross
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Abstract

Charged with the task of providing today's youth with the education they need, many school boards across North America have invested large sums of money in computer technology. However, although the technology is being installed in the schools, many educators are not using the technology to its full potential as a learning tool.

In the present study, elementary (n=148) and secondary (n=150) educators completed one survey which assessed two domains believed to influence an educator's decision to integrate computer technology into his/her classroom. The first domain was comprised of gender and teaching level (elementary versus secondary), which previous literature has indicated to be significant in influencing computer use. The second domain was composed of individual difference measures such as positive attitudes towards computers, intrinsic motivation, desire for recognition, and desire for monetary reward. Two analyses were conducted to update existing literature on the current use of computers by educators, and to investigate the individual differences which encourage computer use. Analyses of variance were used to examine the impact of gender and teaching level on variance indices of computer use. Overall, although some gender differences were present, they were not always as expected. Three regression analyses explored the individual difference variables. These analyses indicated that the single strongest predictor of classroom computer use was positive attitudes towards computer technology with some more limited impact from intrinsic motivation.

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Throughout the industrialized world, school boards are equipping educators with new technological tools in order to provide students with the skills they need to function in the digital era. In part, the introduction of technology has prompted a pedagogical shift from traditional classroom instructional styles which are teacher-centred to a more student-centred, collaborative model where teachers assume the role of facilitators. However, in many instances, the goal of changing the nature of the teaching environment into a more student-centred and collaborative one is not being met (e.g., Cuban, Kirkpatrick & Peck, 2001; Conlon & Simpson, 2003). Faced with the many demands inherent to teaching, large numbers of educators are not utilizing the technology available to them to its fullest potential as a collaborative learning tool, and instead utilize computers for limited peripheral activities such as word processing (Conlon & Simpson, 2003).

The present study examined the relative impact of individual difference variables on the use of computers by educators. First, gender and teaching level (elementary and secondary) were used to investigate potential differences in reported classroom computer use, including use of computers for instruction and communication functions, as well as integration of computers in the classroom. In addition, potential gender and teaching level differences in perceived ease and enthusiasm, and ability to integrate computers, were examined (see Figure 1).

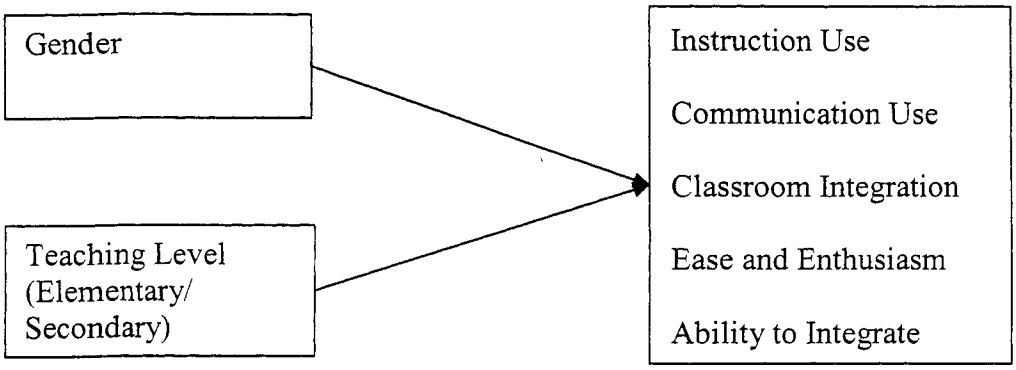

Figure 1: Use of computers and affect as a function of Educators' gender and teaching level.

Second, positive attitudes towards computer technology, intrinsic motivation, and extrinsic motivation (with the extrinsic motivation including both money and recognition) were used to predict classroom computer use for instruction, classroom use for communication and integration of computers into the classroom (see Figure 2).

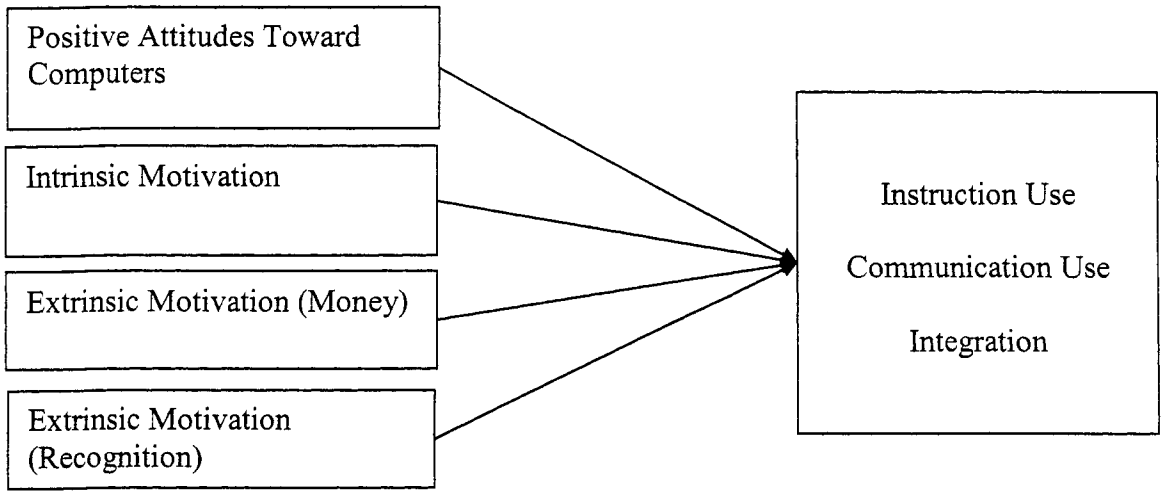

Figure 2: Predictors of use of computers for instruction, communication, and integration of computers.

These analyses provide a means for investigating why the increased presence of computer technology is not necessarily equated with levels of the use of the technology. Current

under-utilization of technology not only indicates an inefficient use of educational dollars, but also a loss of potential learning for students. In the United States of America, the picture across grades 4 to 12 is that the typical educator provides his/her students with fewer than 10 opportunities to use computers during the school year (Becker, Ravitz, & Wong, as cited in Newhouse, 2001). When computers are used at the high school level, computers are more often used in science subjects than in the humanities (Rosen & Weil, 1995; van Braak, 2001), but are utilized less overall than in elementary school (Becker & Ravitz, 1999).

The Importance of Computers

In addition to the standard curriculum, students using computers in the classroom also learn the skills required to effectively use computer technology and develop an appreciation for what the computer is able to accomplish (Escalada & Zollman, 1997). No longer are computers a tool used solely for data processing. Computers are now applied in all areas of life, ranging from communication devices to implements of production processes (Mikkelson, Øgaard, Lindøe & Olsen, 2002).

In addition, when used appropriately, computer-based instructional methods can be used to support a wide range of pedagogical goals. It is widely known that computer software can be used to facilitate drill and practice routines. In addition, more recent software can be used to encourage critical thinking and problem-solving skills (Macmillan, Liu & Timmons, 1997). This development of critical thinking arises through a unique blend of individual learning and group learning that is possible with computer use (Escalada & Zollman, 1997).

Because the use of computers provides both educators and students with a great deal of information, educators have the opportunity to emphasize the process of thought more

than the repetition of facts (Gershner & Snider, 2001). For example, instead of setting out clear projects and worksheets to cover a section of material, curriculum topics may be addressed through a critical question which students are required to explore and answer (Ainley, Banks, & Fleming, 2002). In this way, computers are used as *knowledge construction tools* rather than *knowledge reinforcement tools*, as students must work through material on their own, and devise their own strategies of learning (Ainley et al., 2002). Of course, there are differences in the ways that computers can be integrated into the curriculum for elementary and secondary schools. One of the key ingredients for effective use of computers in the classroom is collaboration: two or more individuals working together for a common goal. As such, there must be interdependence in the collaborative group, and that group must be capable of self-regulation and planning (Gros, 2001). As such, this collaborative learning model is likely to be most effective with secondary and senior elementary students.

Considerations of the Environment

In trying to understand why computers are not commonly used in the classroom, some research focuses on issues related to the "Digital Divide" (Riel, Schwarz & Hitt, 2002). The Digital Divide is traditionally described in terms of three elements which form a chasm that separates technology users from technology non-users. Although any one element can separate technology users from technology non-users, all three elements are necessary for maximum separation. The width of the chasm is represented by issues related to *access* to technology, the slope of the chasm relates to the reasons for use and the ways that educators use computers in their classrooms and is influenced by the interpersonal

dynamic present in each school (the *cultural context*), and the depth is based on a group's *knowledge* about computers.

Separation due to the width of the Divide occurs when computer technology is available to one group of users, but not to another. This may mean that the educators who are not using computers do not have sufficient access to computers in their classroom, or that the computers available to them are not powerful enough to perform the desired activities. When educators do not use technology because they feel that they do not have support, or that their efforts may not be valued, they are experiencing the slope of the Divide. Finally, if educators simply do not know how to effectively use computers in the classroom, they are experiencing the effects of the depth of the Divide. Although the width of the divide has been extensively targeted by school boards with the purchase of new computer equipment, the other two components, namely the *cultural context* of use, and *knowledge* about computers, remain relatively untouched (Riel et al., 2002).

Access and Availability

The approach taken by many school boards is to budget a great deal of money for the initial purchase of technology, but to minimize the amount spent on technical support, instead relying on educators to solve their own problems (Schofield, 1995). Although this approach is very effective at introducing technology into schools and subsequently minimizing the accessibility component of the digital divide, the technique is not effective at actually changing the nature of the classroom (Cuban et al., 2001).

Cuban and his colleagues (2001) in an investigation of educators in Silicon Valley found that mere access to technology did not result in widespread classroom use by either teachers or students. Although school computers were used for administrative purposes and

word processing, very few teachers made any alterations to their teaching style in order to incorporate technology as part of their teaching plans (Cuban et al., 2001). Moreover, these trends of under-use are not specific to the sample studied by Cuban and his colleagues. A research project involving Scottish educators revealed similar patterns of use; although educators may have used available computers for keeping track of grades and report writing, they very rarely integrated them into the curriculum unless a technologically-intensive subject was being taught (Conlon & Simpson, 2003). Thus, although educators were using the computers provided to them, they employed the available technology in a manner which was intended to sustain existing teaching practices rather than devise innovative new techniques (Conlon & Simpson, 2003).

School Environment

The two studies just described (Cuban et al., 2001; Conlon & Simpson, 2003) indicate that although educators may not be using computers to their full potential, educators are not inherently resistant to technology (Guha, 2001). Rather, they are either too busy to consider revising their teaching methods or are lacking examples about alternative means for including computers in order to maximize their effectiveness in the classroom setting (Conlon & Simpson, 2003). The lack of appropriate models of computer use is related to the second component of the Digital Divide–the cultural context of use. Within the school environment, the presence of educators effectively using technology can have an incredibly powerful impact on other educators; whether it be through peer pressure to try out the new media lab, or the provision of lesson plans by technologically-savvy individuals, the atmosphere of a school is an important component in determining the use of technology by educators (Windschitl & Sahl, 2002).

The importance of school culture on a broad level is most readily apparent in the Apple Classrooms of Tomorrow (ACOT) project, sponsored by the Apple Computer Corporation throughout the United States of America. In this program, classrooms were saturated with computers and multimedia technology, with both students and educators being equipped with a computer. ACOT staff also provided educators with training, and provided a service technician for each site. Although the initial introduction of computer technology did little to encourage revolutionary change, educators began to change their teaching practices after becoming comfortable with the idea of the digital classroom, and the changes that the introduction of the computer required (Sandholtz, Ringstaff & Dwyer, 1997). One of the most significant changes necessary to successfully utilize computers in the classrooms affects educators and administrators alike: there must be acceptance of a shift in the conception of the student/teacher relationship. Specifically, and especially at the secondary level, educators need to move from the traditional lecture format to include more chaotic, group-collaboration environments (Sandholtz et al., 1997). This change is a difficult one as it challenges the most familiar model of teaching where the educator plays the role of an expert, lecturing to less knowledgeable or novice students. This shift in instructional format also means that students can become more active in their learning, as they are encouraged to ask questions and seek out information (Collinson, 2001).

Moreover, because computers can be integrated into traditional teaching methods relatively easily, educators must resist a doubly-tempting situation which encourages a familiar teaching routine (Windschitl & Sahl, 2002). Software packages such as Microsoft's PowerPoint© can easily replace the overhead projector and be integrated into a familiar lecture format while at the same time satisfying a school's request to utilize available

technology. But this use of computers as a lecturing tool does not allow students to engage with material any differently and fails to capitalize on the benefits of computer-enhanced instruction. Likewise, teachers should not become passive observers, surrendering control of their classrooms to computers. Although computers may provide students with information, they do not teach students to question, think about consequences, or be creative–these are skills which still must be encouraged by the educator (Collinson, 2001).

Although the revolutionary classroom changes associated with the ACOT project came from a large, corporately-sponsored venture, the integration of computers into the classroom does not always require such extreme levels of support. With access to the required technology, the presence of a single technology enthusiast can be sufficient to spark a small revolution within a school (Windschitl & Sahl, 2002).

Teaching Development

The final aspect of the Digital Divide which influences classroom computer use is the technological knowledge of the educator. This consideration is especially important in schools where there is not a dedicated technician on site to help with computer problems (Schofield, 1995)–a situation common in schools. Without either the necessary skills or reliable technical support, teachers are unlikely to develop the comfort necessary to integrate technology into the classroom (Macmillan et al., 1997).

For established educators, computer knowledge may be problematic because the computers which existed during their own education were significantly more limited than those computers available today (Cuban, 2001). Thus, although these educators may be able to use functions such as word processing, they may not be familiar with some of the more modern capabilities of the computer, and also may not see the merit in incorporating the

technology (Cuban, 2001). But what about teaching graduates? It would seem that they too are ill-prepared to effectively use computers for educational purposes, with their knowledge geared mostly towards practical tasks such as word processing and spreadsheet management (Sheffield, 1996). While these skills may be useful for an individual from a productivity standpoint, they do not take advantage of the diverse experiences that could be derived from integrating computers. Instead, educators need to become familiar with multimedia packages and research software which allow students to express their knowledge through non-traditional means (Macmillan et al., 1997).

In sum, although educators may be literate in terms of the basic computer functions they are able to utilize, they appear to lack the technological awareness and skill necessary to effectively integrate computers in their teaching routine. As such, even if computers are introduced into the classroom, it is likely that they will be the subject of a lesson rather than an enriching experience (Lowther, Bassoppo-Moyo &Morrison, 1998).

Of course, although educators may presently lack computer skills, this does not mean that they will never be able to successfully integrate technology into their regular teaching plan. As Sandholtz and her colleagues (1997) note, conferences, whether led by technologically-savvy educators or computer experts, can significantly increase the computer knowledge of participant educators. The challenge, therefore, is to make the computer training worthwhile for teachers. The ACOT training described by Ringstaff and colleagues (1997), for example, was an effective program; however the substantial commitment of time makes it unfeasible for most school boards. Alternatives, such as in-service training, which on the surface appear more desirable because they only take one day, are often ineffective at providing educators with the skills they desire (Macmillan et al.,

1997). However, skills-training is not the only way to provide educators with the knowledge they need to utilize computers. The provision of support, either by knowledgeable students or experienced staff, can offer technologically-nervous educators the comfort they require to integrate computers into the classroom and indirectly provide them with the skills they need to solve computer problems (Bradley & Russell, 1997). Whatever the strategy chosen, it is important that educators not only feel that they have the required skills and supports, but that they have an understanding of what it means to effectively utilize a technological classroom. This means an understanding of the different classroom management skills and evaluation methods required to effectively teach in a student-centred classroom (Wang, 2001). The skills needed to conduct a student-centred computer classroom, therefore, are more than just technological in nature.

Individual Differences

Even though they may be significant, the influences of the Digital Divide are not the only ones which impact the decision to use computers in the classroom. In addition to the considerations of classroom style and management that have been discussed, individual differences may also be influential. Specifically, the likelihood of computer technology being used in the classroom can be influenced by a number of individual characteristics, including: the sex and age of an educator; feelings of computer and technology anxiety; internal motivation; or the way that the educator prefers to approach work-related issues– their degree of intrinsic motivation. When considering the way that computers may be used in classrooms, it is therefore important to recognize that educators are individuals that bring their own personal preferences and experiences into the classroom.

Although the number of sex differences in computer behaviour have decreased in recent years (Whitley, 1997), some differences remain. For example, sex differences occur for feelings of computer self-efficacy–a person's belief that s/he can successfully perform a task with a computer (Cassidy & Eachus, 2002). However, although males have indicated greater self-efficacy with regards to computer technology, the actual usage of the Internet has been shown to be similar between males and females (Jackson, Ervin, Gardner & Schmitt, 2001). In addition, males have higher feelings of computer self-efficacy than females, especially when considering complex computing behaviour; however, these types of difference are lessened when females have greater experience with relevant software, or engage in training opportunities (Cassidy & Eachus, 2002). Overall, although some sex differences exist, they seem to be diminishing over time and with increased experience.

Age differences can also be significant, although they may not always be in the expected direction. Looking at computer anxiety, computer liking, and positive attitudes towards computers, it was found that older adults (aged 55 and up) had more positive views about computers than did younger participants aged 30 years or less (Dyck & Smither, 1994). However, these same older adults were less likely to report feelings of computer confidence. Thus, although very positive about the potential applications of computers, the older participants in the study were less likely to feel that they possessed the necessary skills to use computers effectively (Dyck & Smither, 1994).

Style of Technology Use

Computer anxiety is an important consideration in the decision to use computers and can be influenced by a number of factors. In an investigation predicting computer anxiety with personal and job characteristics in the production industry, Mikkelsen and colleagues

(2002) found that age was positively related to computer anxiety, whereas education was negatively related. These researchers also found that the possession of decision making authority and engagement in computer training were associated with lower levels of computer anxiety. This reduction in computer anxiety is significant, as anxiety strongly discourages individuals from using computers (Brosnan, 1999).

It should not be surprising that the way an individual views technology significantly impacts that individual's use of technology. As such, the person who is fearful of the computer is likely to view the computer as difficult to use. This perceived difficulty in use results in a belief that the computer has little value because of the extra effort required (Brosnan, 1999). Accordingly, individuals who are less anxious are likely to perceive computers as more useful. Also of note is that people who are anxious about computers are fearful about using a function, not about performing an activity–the fear is about using a word processor, not writing a report. Therefore, if computer hardware or software can be portrayed as easy to use, it may be possible to encourage its use (Brosnan, 1999).

Intrinsic/Extrinsic Motivation

In addition to anxiety, other individual differences can impact the decision to use a computer. One major determinant of computer use is the likelihood that an individual is likely to engage in new activities and try new things. The intrinsically-motivated individual is one who enjoys intellectual challenge, becoming deeply involved with a project, and gaining experience without concern for the success of a project (Amabile, Hill, Hennessey & Tighe, 1994). In contrast to the extrinsically-motivated individual, someone who is intrinsically-motivated is more likely to take on challenges without thinking about monetary compensation and persevere with a project when things get difficult (Amabile et al., 1994).

It would be expected that educators high in intrinsic motivation would be more likely to undertake the challenge of integrating computers into their classrooms than would their counterparts who are low in intrinsic motivation.

Attitude Towards Technology

Another factor in the decision to use a computer is the perceived applicability of the technology. As Cuban (2001) noted, even engineers who are often on the cutting edge of technology will not use computers when old-fashioned methods work just as well. However, this determination of applicability may also be strongly influenced by personal characteristics. In an investigation of computer use of word processing and programming, it was found that perceptions of computer ability were most strongly influenced by preferred style of working such that those with the highest perceptions of computer ability reported an interest in working with technology and solving complex problems (Colley, Henry, Holmes & James, 1996). And as was noted earlier, beliefs about computer ability facilitate computer use.

Of course, there are also different ways of using the computer; two people using the same word processing software can engage that software in significantly different ways. Where one person may only use the software for report writing, and only use the computer when absolutely necessary, the other might spend time learning about the advanced functions of the package, customizing the user interface, and seek out external information about the software from books and magazines. Where this second type of user would be viewed as a computer enthusiast, the first user would be characterized as using the computer only as a tool (Panero, Lane & Napier, 1997). This difference becomes significant when people have to make a decision about the use of technology. Because the computer

enthusiast is likely to have a higher self-concept of ability, s/he is likely to have higher expectations for the technology and view it as more valuable (Dickhäuser & Stienmeier-Pelster, 2002). Although the importance of the distinction between a computer user and a computer enthusiast can be decreased when the computer is clearly portrayed as a tool, the distinction between the two types of users remains significant in less clearly defined situations, as computer enthusiasts typically have more intrinsic motivation to use a computer (Dickhäuser & Stienmeier-Pelster, 2002).

It is only once these individual differences are combined with the demands of teaching that the full picture of why educators utilize computers in their classrooms can be understood. For example, although subject to the same concerns and discomforts pertaining to the use of computers, educators are in the unique position of having to teach students about the subject of their discomfort (Rosen & Weil, 1995). Furthermore, like the engineers described by Cuban (2001), many educators have demonstrated that they believe computers are difficult to learn and use, and, therefore, have very little benefit for their daily teaching needs (Rosen & Weil, 1995). When faced with the extra time required to plan computer-based lessons which they believe may not help students to learn the material any better, many educators prefer to rely on established teaching strategies (Windschitl & Saul, 2002).

As such, the fears and concerns that lead educators to become anxious about computers appear to be experienced by many to some degree. Through the use of a survey distributed to students passing through a Diploma of Education course, Wilson (1999) investigated the feelings that education students had towards computers. He found that although the majority of these students were comfortable with computer technology, there were some concerns about the technology's use. Moreover, these concerns were found in a

minority of students who were incredibly fearful of computer use. However, the concerns held by highly computer-anxious students were indicated to be the same ones noted by the general sample–the difference was in the magnitude of the fears, such that the highly-anxious students expressed computer concerns with a greater magnitude (Wilson, 1999). Moreover, these anxious education students also indicated that they were less aware of the various uses of modern computers, suggesting that they may not have been motivated to overcome their fear of computers on their own (Wilson, 1999). Without this motivation, anxiety would continue to interfere with the students' approach of computer technology, limiting both exploration and confidence-building (Wilson, 1999).

However, even when educators have an opportunity to engage with computers on a regular basis, anxiety can continue to inhibit computer usage–but the anxiety may take a different form. Specifically, as educators begin to face computer crashes and error messages, they may develop what has been termed "error handling anxiety" which refers to a fear of not knowing how to solve a computer problem (Yaghi & Abu-Saba, 1998). Although increased experience with computers may help to alleviate this type of anxiety, its presence underscores Rosen and Weil's (1995) observation that merely providing educators with computer technology is not sufficient to guarantee its use.

To this point, the majority of the discussion has focussed on the characteristics that inhibit computer use by educators. However, there are a number of traits which can encourage classroom use of computers. As a general tendency, a positive attitude towards technology or a high degree of technological innovativeness has been indicated as a significant predictor of classroom computer use (van Braak, 2001). Also important is a professional attitude towards the practice of education which encourages collaboration with

colleagues and attendance at professional development seminars (Riel & Becker, 2000). Fundamentally, both of these characteristics embody a spirit of change or innovation which is not possessed by the more inwardly-focussed educator, and requires a great deal of out-of-class time to foster (Riel & Becker, 2000). These ideas of devising creative ways to complete routine tasks and engaging in work-related activities outside of work time are components of an intrinsically-motivated work orientation (Amabile et al., 1994).

Computer confidence is another characteristic which encourages classroom computer use. One reason for this is that feelings of computer confidence, and feelings of being in control, are predictive of low levels of computer anxiety (Todman & Drysdale, 2004). However, it is interesting to note that this confidence is not necessarily equated with a high degree of access to computer technology, or high use of that technology; rather, it seems that the most significant experience is that which encourages confidence in basic computer skills (Ross, Hogaboam-Gray & Hannay, 1999). Instead of mere computer experience translating into computer confidence, Ross and his colleagues (1999) note that the way an educator interprets an experience is the most important building block of computer confidence; even with a low frequency of experience, confidence can still be built if experiences with computers are viewed as indicative of high ability. This is important as many educators, whether they are currently high or low users of technology, see merit in including computers in their classroom plans (Guha, 2003). Moreover, educators have also expressed a desire to possess more computer skills in order to incorporate computers into their classroom, with some believing that traditional teaching techniques were less effective than computer-aided techniques (Guha, 2001). As such, many educators wanted to make computers a more

significant part of their teaching strategy, both for administrative and tutorial purposes (Guha, 2001).

Teaching Style

Considering this willingness to utilize computers in the classroom, it is not surprising that educators do engage in computer-assisted teaching. Computers are used by entire classes in order to practice specific skills or to work on group projects (Evans-Andris, 1995) or can be used by individual students as a means of enrichment or skill building (Boyle, 2001). Computers are sometimes used to change the structure of a classroom, allowing students to work in groups in order to explore the curriculum on their own, and at other times simply act as an extension of the blackboard (Goos, Galbraith, Renshaw & Geiger, 2003). The most important determinants in any of these classroom computer uses, however, are the beliefs about the usefulness of computers and the teaching preferences that an educator possesses.

If forced to do so, any educator can incorporate computers into his/her curriculum; however, if an educator uses a computer reluctantly, or chooses to distance him/herself from the technology, the learning experience of the students may be compromised (Evans-Andris, 1995). To effectively incorporate computer technology into the classroom, a teacher must not only be open to the use of a computer, but must also accept some of the student-oriented teaching practices which make up the constructivist teaching orientation (Sandholtz et al., 1997). The constructivist educator plays the role of a facilitator, encouraging his/her students to construct knowledge rather than acting as an expert and transferring ideas to students (Sandholtz et al., 1997). This style of teaching is necessary as students must be free to explore their environment and learn at their own pace before they are able to take

advantage of the experiences and activities available to them on the computer. Without this kind of freedom to explore, students are only able to learn the lesson which has been prepared for them (Sandholtz et al., 1997).

The teaching level of the educator can influence the nature of computer use when it is introduced into the classroom. In early elementary school, skill-based software use predominates. This trend changes after a transition period through the middle grades, when open-ended software is predominately used with senior students (Niederhauser & Stoddart, 2001). Skill-based software is designed to encourage the development of specific skills or abilities, whereas open-ended software encourages students to discover or invent concepts. Whereas skill-based software focuses on right versus wrong answers, open-ended software encourages students to develop a more complex understanding of a topic (Niederhauser & Stoddart, 2001). These trends of use are also consistently related with teaching style, such that open-ended software are most used by educators with a learner-centred teaching orientation (Niederhauser & Stoddart, 2001).

Interestingly, although elementary educators are greater users of computers in the classroom than their secondary counterparts, they have expressed more discomfort in doing so (Rosen & Weil, 1995). This is significant in consideration of data composed of pre-service educators which indicate that even before they begin teaching, there exists a difference in computer experience between educators of different levels. Specifically, secondary trainees indicated more computer experience, and expressed that they were less likely to give up in the face of a difficult computer problem than were their elementary counterparts (Shapka & Ferrari, 2003). Not surprisingly, secondary candidates also experienced less computer anxiety and were more efficient in solving a computer problem

than were the elementary candidates (Shapka & Ferrari, 2003). Thus, although there may be differences in the educational atmospheres between elementary and secondary schools, there appear to be some pre-existing individual differences amongst teacher candidates as well.

The Present Study

The present study investigated the use of computers by educators, as well as the experiences and expectations that educators have with computers. Although the availability of computer technology has increased substantially over the last decade, many of the concerns about computers reported by Dupagne and Krendl (1992) are still relevant. Even with positive attitudes towards computers in the classroom, many educators continue to be anxious about integrating computer technology into their daily lessons. Whether due to time constraints, poor models of integration, or lacking skill sets, educators are not utilizing computer technology to its full potential.

In the present study, through use of a mailed survey, equal numbers of elementary and secondary educators were asked to report on their access to computers, their use of computers at home and at school, and their attitudes towards work and technology. Responses were examined in two sets of analyses to determine the most significant factors which encourage the integration of computer technology in the classroom. The first set of analyses (see Figure 1) investigated the impact of teaching level and gender on classroom computer use, ease and enthusiasm, and perceived ability to integrate computer technology into the classroom. The purpose of this analysis was to update previous literature, as there have been inconsistent findings with regard to gender differences and computer use.

The second set of analyses (see Figure 2) investigated the predictors of classroom computer use through regression analyses. The purpose of this analysis was to determine

the impact of individual differences on computer use, and investigate the role that attitudes toward technology have in making the decision to bring computer technology into the classroom. Although the Internet is a major use of computer technology for some, it is only one possible application, and has many unique considerations and implications for classroom use. In addition, Internet use is often restricted in elementary grades as a result of the high language proficiency and literacy skills required for students to use it effectively and independently. As this study was focussed on exploring the general integration of computer technology in the classroom, questions regarding the use of the Internet were limited.

Method

Participants

Participants were drawn from the Waterloo Region District School Board (WRDSB), a large public school board located in south-western Ontario. Of the 298 educators that participated, 148 were drawn from the elementary and 150 from the secondary level. This represents an overall response rate of 49%, with 45% of the elementary and 53% of the contacted secondary educators responding. The elementary sample was composed of 30 males (M_{age} = 40.3, SD = 7.85), 114 females (M_{age} = 41.02, SD = 9.24), and four individuals who did not identify gender. The secondary sample was composed of 65 males (M_{age} = 42.26, SD = 8.54) and 85 females (M_{age} = 40.64, SD = 8.23). Approximately equal proportions of elementary educators taught at the primary (37.2%) and junior (38.0%) levels, with slightly fewer at the intermediate level (24.3%). A summary of the assignments for elementary educators can be found in Table 1. Educators at the secondary level

represented a wide range of teaching specialities, which can be found in Table 2. Overall, the average number of years teaching was 13.9 years for both elementary and secondary educators (see Table 3 for a summary by division).

The presence of a desktop computer at home was reported by 92.6% of the elementary respondents and 96.7% of the secondary respondents. Of the elementary respondents, 93.3% of males reported having a desktop computer at home, with 46.7% using it every day, while 92.1% of females reported having a desktop computer at home and 43.9% reported using it every day. Of the secondary respondents, 96.9% of males reported having a desktop computer at home, with 76.9% using it every day, while 96.5% of females reported having a desktop computer at home and 70.6% reported using it every day. A summary of the participants' use of technology can be found in Appendix C.

Educators were randomly selected from the school board's most recent employment database. As names were drawn from the employment database of the WRDSB, selection of potential participants was conducted by research collaborators connected with the school board. However, all contact with participants was made by Wilfrid Laurier University (WLU) researchers.

Educators who returned the questionnaire were entered into a draw for one of two paid days of leave or a $75 shopping gift certificate. All participants were treated in accordance with the ethical standards of the APA.

Materials

Each educator initially received one questionnaire package. Each package contained a letter of consent, a questionnaire, a draw form, an opt-out slip and a pre-addressed and

stamped envelope. The letter of consent (which can be found in Appendix A) explained to educators the nature of the study, their rights regarding the study, and the way in which they were selected to participate. The full questionnaire contained 183 forced-choice and nine open-ended responses which investigated educators' attitudes towards computers, their experiences with computers at school and at home, as well as their attitudes towards teaching style and work orientation. The questionnaire used in this research was part of a larger study. Pilot testing indicated that the full questionnaire took approximately 30 to 40 minutes to complete.

This study utilized a subset of the total questions (which can be found in Appendix B). Four main areas were investigated: (i) demographics; (ii) home computer use; (iii) school computer use; and (iv) attitudes towards work and technology. The demographics section considered the age and gender of the participants, as well as the number of years teaching and areas of expertise for teaching. The questions about teaching differed between the elementary and secondary level questionnaire in order to accurately reflect educators' experiences. For example, elementary educators have experiences across different divisions whereas secondary educators typically have experience in a specific discipline.

Home Computer Use

To assess home computer use, educators were asked to identify whether they had access to nine technologies and how frequently they used these technologies. Participants responded to the frequency of their use of specific technology on five-point scales, with 1 representing never and 5 representing every day (see Appendix B, section II). Specifically, the question was: of the following technologies, please indicate whether or not you have them at home and how frequently you use them at home. Assessing this type of availability

is important, as previous experience is often found to predict the comfort an individual has with computers, and one way to experience computer technology is with a system at home (Cassidy & Eachus, 2002).

In addition, participants were asked to report on their ease and enthusiasm regarding computer technology. Specifically, with five point scales anchored with "very at ease" and "very ill at ease", participants were asked; in general, how at ease do you feel about using computers? With a second five point scale anchored with "very enthusiastic" and "very unenthusiastic", participants were asked; in general, how enthusiastic do you feel about using computers? Previous research has indicated that educators with greater comfort with technology are those more likely to be integrating and using technology in the classroom (Mueller, 2003).

School Computer Use

Educators were also asked to report on the frequency with which they used computers in their classrooms, on five point scales ranging from never to every day (i.e., how often do you, as a teacher, use a classroom computer?). Because this study focussed on computer use in the classroom, it was important to determine the amount of computer time students are given, as earlier research has indicated that there can be a discrepancy between the amount of time educators use computers at school and the amount of time educators permit their students to use computers (Windschitl & Sahl, 2002). As such, educators were also asked to report on the frequency with which their students used computers in the classroom (i.e., how often do your students use a classroom computer?).

The next section investigated the nature of participants' use of computers in the classroom. Educators were asked to report on the types of activities for which they use

computers in their lessons by checking off relevant tasks, which ranged from the use of computers for online searches, to having students complete specific assessment tasks. Educators were also asked to rate themselves, on a five point scale anchored with "much more skilled" and "much less skilled," on their ability to integrate computer technology in comparison to the average teacher (see Appendix B, Section III).

Attitudes Towards Work and Technology

In order to better understand why an educator uses computers at home and in class, a series of questions was asked about the way in which participants view computers. Participants were asked to rate, on a five point scale anchored with "a great deal" and "never", the extent to which they integrate computer technology in the classroom (i.e., to what extent do you integrate computer technology in the classroom?), and the frequency with which they intend to integrate the technology (i.e., when you are planning a unit, how often do you assume that computer use by students will be part of your instructional plan?). Educators were also asked whether they view computers as an integrated part of the curriculum (see Appendix B, section III).

In order to understand the attitudes that educators have towards computer technology, participants were asked to indicate one of two statements in a dichotomous pair with which they most agree (see Appendix B, section IV). These questions were drawn from the consumer version of the Survey of Technology Use (SOTU), and probed the more emotional aspects of the computer experience (Scherer, 1998). The SOTU is intended to identify areas of technology comfort, as well as areas which would challenge a person's self esteem (Scherer, 1998). As with previous research (Keefe, Scherer, & McKee, 1996), this instrument was found to have good reliability ($\alpha = 0.84$).

The final area of investigation involved participants' views about work, which tapped the degree to which respondents are driven by intrinsic and extrinsic motivators. This was accomplished with the working-adult version of the Work Preference Inventory (WPI), an instrument designed to be an explicit assessment of individual differences in terms of the way by which they are motivated to engage in work-related tasks (Amabile, Hill, Hennessey & Tighe, 1994). A reliability analysis conducted on the Work Preference Inventory with the data collected in this study indicated acceptable reliability for both the Intrinsic and Extrinsic motivation scales. The reliability for the Intrinsic scale ($\alpha = 0.80$), however, was found to be greater than the reliability for the Extrinsic scale ($\alpha = 0.68$). Two subscales were constructed from the Extrinsic Motivation scale: the Money subscale ($\alpha = 0.58$) and the Recognition subscale ($\alpha = 0.64$). As in previous research (Amabile et al., 1994), the correlation between the Intrinsic and Extrinsic scales of the WPI was not significant ($r = -.1$).

Participants were asked to respond to 30 questions on a four point forced-choice scale about a variety of work-related interests such as curiosity, recognition, and intellectual challenge (see Appendix B, section IV). Although the questions which make up this section of the questionnaire had a work-related theme, they examined traits which are applicable to domains outside of the workplace. Participants were asked to respond to questions about their motivation to solve problems; seek out situations which are enjoyable to them; and have freedom to solve problems in a manner which they believe is best. These questions are important considerations because individual characteristics underlie a number of experiences and preferences which can help to explain an educator's preference to use computers in the classroom. For example, in comparison to those who have low scores for intrinsic

motivation, individuals who score highly on intrinsic motivation factors are more likely to become deeply involved in their chosen activities, demonstrate greater creativity and express greater creativity toward new or unusual things (Amabile et al., 1994). As such, people possessing these traits are expected to be the most likely to undertake the challenge of learning the new skills and technologies which are required to effectively utilize computers in the classroom.

Procedure

Questionnaire packages were sent to potential participants' school mailboxes through the school board's mail system. In an explanatory letter contained in the questionnaire package, educators were told about the scope of the study, informed about matters of consent, and asked to complete the enclosed survey, consent form, and draw ticket and then return all in a pre-addressed and postage-paid envelope to the researchers. In the explanatory letter (found in Appendix A), educators were informed that they were randomly selected to participate, but that they were free to decline participation without penalty. Moreover, educators were made aware that their individual responses would not be made available to the school board.

In order to increase the privacy of the participants' responses, all of the completed questionnaires were returned to Wilfrid Laurier University (WLU) by Canada Post. Thus, although it was possible that members of the Computers Across the Curriculum (CATC) committee may have been aware of the educators who had been invited to participate, the identities of the actual participants were only known to the WLU researchers. To further encourage the privacy of the questionnaires, the only identifying information on the questionnaire was a code number, a fact which was explained to the educators in the

covering letter. These code numbers allowed the researchers to track the identities of the respondents, but only for the purpose of maintaining a participant key. All returned questionnaires were stored in a secured location at Wilfrid Laurier University, and privy only to the researchers involved in this study.

The key itself was necessary as non-responding educators were contacted an additional time to ensure that they had an opportunity to complete the survey. This supplementary contact was utilized to gain proper information about the study response rate. Because educators change schools, it was possible that even the most recent employment database might contain inaccurate entries. This second contact also allowed educators who misplaced their questionnaire packages a second opportunity to complete it. If the researchers did not receive a response after ten weeks, the non-responding educator was sent another questionnaire package to his or her school mailbox. If a survey package was returned unopened, it was assumed that the wrong address was recorded in the employment database. In order to maximize the number of participants, an additional educator was randomly selected from the employment database for each participant who could not be contacted (i.e., due to a move, leave of absence, or death).

At the conclusion of each data acquisition phase of the study, a draw for the participation incentive was made. There were six winners, three each from elementary and secondary schools, drawn from the pool of returned questionnaires. Only educators who completed the questionnaire and returned it to the researchers were to be eligible for this draw–a fact which was known to the participants. The winners were contacted by the researchers, and arrangements to claim the shopping gift certificates were made. The

researchers also contacted the school board to inform them of the draw winners so that the winners were able to easily claim their day of paid leave.

Results

Two sets of analyses were conducted. The first set involved analyses of variance examining the use of computers in the classroom and affective responses to computer use as a function of teaching level and gender. A graphical representation of the analysis and the specific questions which made up the items of analysis can be found in Figure 3.

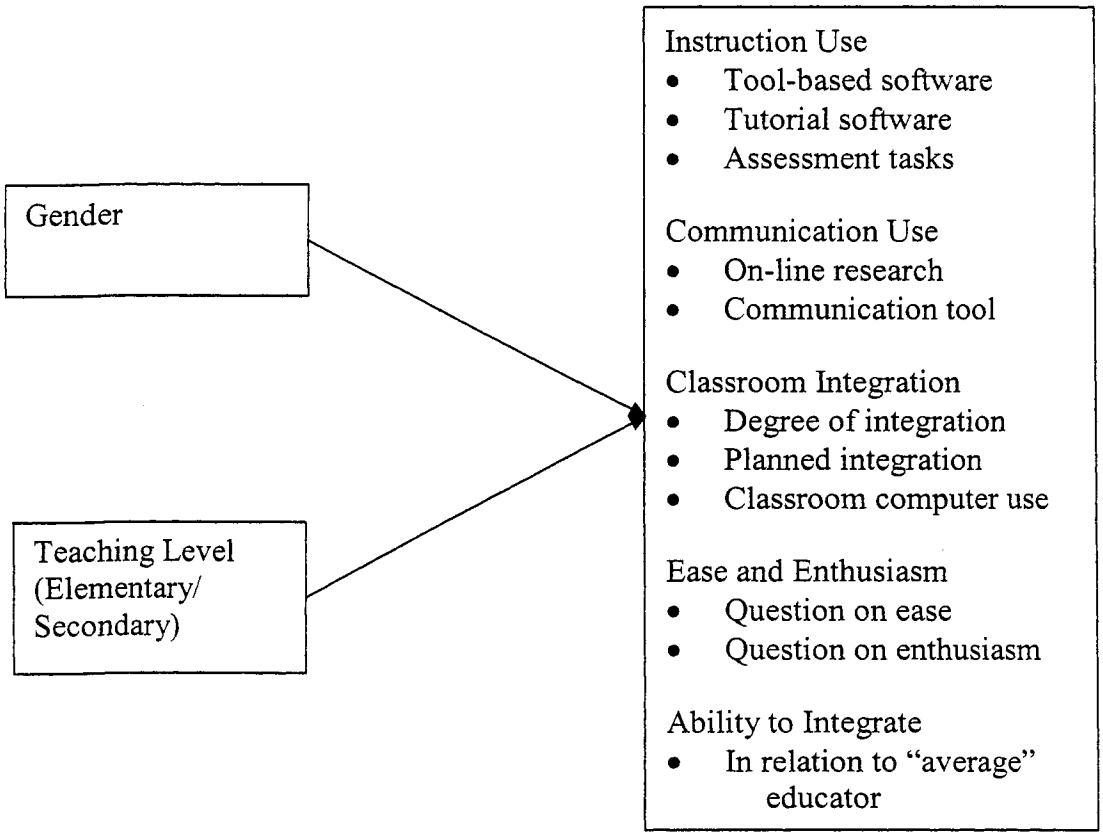

Figure 3: ANOVA analyses for effects of teaching level and gender.

The second set of analyses involved regressions to examine motivational and affective predictors of classroom computer use for communication, instruction, and integration. A graphical representation of this analysis can be found in Figure 4.

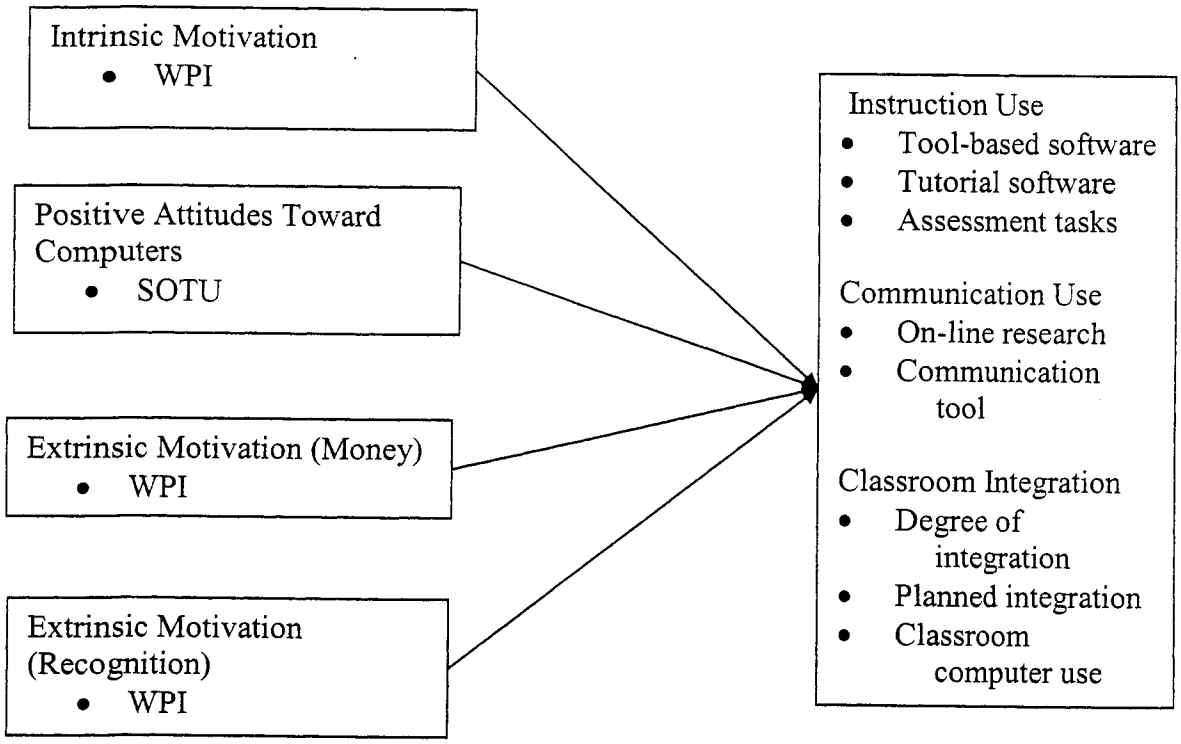

Figure 4: Regression analyses for individual differences predictors of classroom computer use.

Educators Using Computers

Educators' use of computers was assessed through the series of questions for which educators described the computer-based tasks that they had their students complete: i.e., how often do you ask students to do the following activities when you use computers as part of a lesson? Two main categories of computer use were derived; instructional use and communication. The category of instruction use was comprised of a summative aggregate of answers to three questions; use for tool based software (i.e., use tool based software, e.g. databases, spreadsheets, word-processing, multimedia, CAD), subject-specific tutorial software (i.e., use subject-specific tutorial software, e.g., MathTrek, MusicAce), and assessment tasks (i.e., complete specific assessment tasks, e.g., quizzes, tests). The category of communication use involved summing questions related to on-line research (i.e., on-line

research, e.g., Internet Searches, Grollier) and use as a communication tool (i.e., use as a communication tool e.g., e-mail, chat rooms). This analysis can be found in Figure 5.

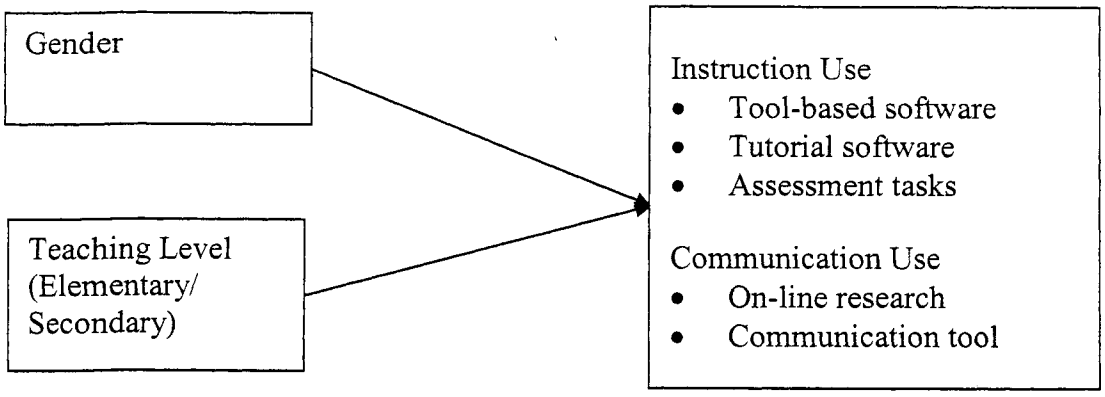

Figure 5: Analysis of teacher-initiated computer-based tasks.

A 2 (gender) by 2 (level) between subjects MANOVA yielded a significant main effect and interaction only for the communication variable. That is, there was a significant main effect for level such that the secondary school educators had their students use the computer for communication more often than their elementary counterparts, $F(1, 268) = 13.6, p < .001$. This main effect, however, was qualified by a significant interaction, $F(1, 268) = 7.06, p = .008$. A simple effects follow up of the interaction revealed that the mean use of communication tasks for female elementary educators ($M = 3.44$, $SD = 1.51$) was significantly lower than that of female secondary educators ($M = 4.69$, $SD = 1.59$), $F(3, 273) = 10.21, p < .001$. A table of means for communication can be found in Table 4. There were no effects for instructional use.

In addition to the use of technology in the classroom, the assessment of classroom integration was calculated by summing the degree of computer technology integration (i.e., to what extent do you integrate computer technology in the classroom?), frequency of planned computer use (i.e., when you are planning a unit, how often do you assume that computer use by students will be part of your instructional plan?) and classroom use by both

educators and students (i.e., how often do you, as a teacher, use a classroom computer?; how often do your students use a classroom computer?). A graphical representation of this analysis can be found in Figure 6.

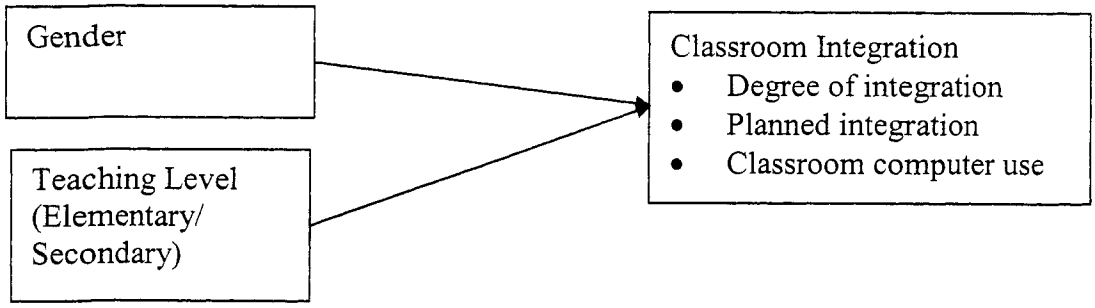

Figure 6: Analysis of Classroom Integration.

The 2 (gender) by 2 (level) between subjects ANOVA revealed no statistically significant interaction or main effects, largest $F(1, 265) = 2.56$, $p = .11$, for the effect of gender.

Educators' Affect Regarding Use of Computers

In order to investigate educators' affect towards computer technology, participants were asked to report on their ability to integrate (i.e., in comparison to the average teacher, how would you rate your ability to integrate computer technology?), and note both their ease (i.e., in general, how at ease do you feel about using computers?) and enthusiasm (i.e., in general, how enthusiastic do you feel about using computers?) with computers. This analysis is represented graphically in Figure 7.

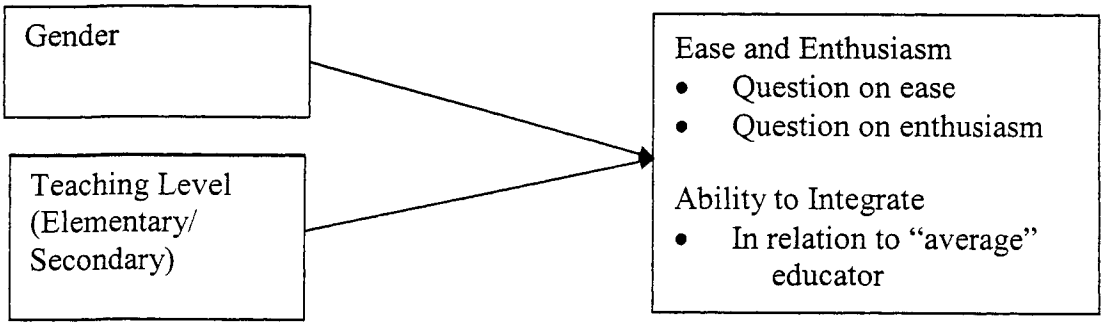

Figure 7: Analysis of educators' affect towards computer technology.

A 2 (gender) by 2 (level) between subjects ANOVA was conducted with educators' self- reported ability to integrate computer technology, and revealed a significant main effect for gender, $F(1, 288) = 4.55, p < .05$. Female educators reported lower ability to integrate computer technology in comparison to the "average teacher" ($M = 2.82$, $SD = 1.08$) than did their male counterparts ($M = 2.46$, $SD = 1.07$). The interaction was not significant, $F(1, 288) = .07, p = .79$.

A 2 (gender) by 2 (level) between subjects MANOVA was used to examine enthusiasm and ease of computer use. There were no significant main effects or interactions for enthusiasm, largest $F(1, 288) = 2.24$, $p = .14$ for the main effect of gender. There was one significant main effect for gender related to ease of computer use, $F(1, 288) = 6.84, p < 0.01$. Female educators ($M = 1.99$, $SD = 1.00$) reported lower ease of use than did their male counterparts ($M = 1.60$, $SD = .87$). A table of means can be found in Table 5.

A correlation between integration of computer technology in the classroom (i.e., to what extent do you integrate computer technology into the classroom?) and educators' self-reported ability to integrate technology (i.e., in comparison to the average teacher, how would you rate your ability to integrate computer technology?) was found to be significant ($r = -.54, p < .01$). Higher feelings of being able to integrate computers were associated with higher reported integration.

Predicting Classroom Computer Use

Three simultaneous-entry regression analyses were conducted to assess the identified forms of classroom computer use—instruction, communication, and integration. Four variables were entered simultaneously into each regression analysis. These variables included SOTU score, Intrinsic Motivation score from the WPI, and the Money and

Recognition subscales of the Extrinsic Motivation scale of the WPI. The correlations between these four predictors and the three dependent variables can be found in Table 6.

A correlation between the intrinsic motivation scale of the WPI and the SOTU was also found to be significant ($r = -.29, p < .01$). More positive feelings towards computer technology were associated with higher levels of intrinsic motivation.

The first regression assessed the use of computers in the classroom for communication tasks (e.g., e-mail), and is depicted graphically in Figure 8.

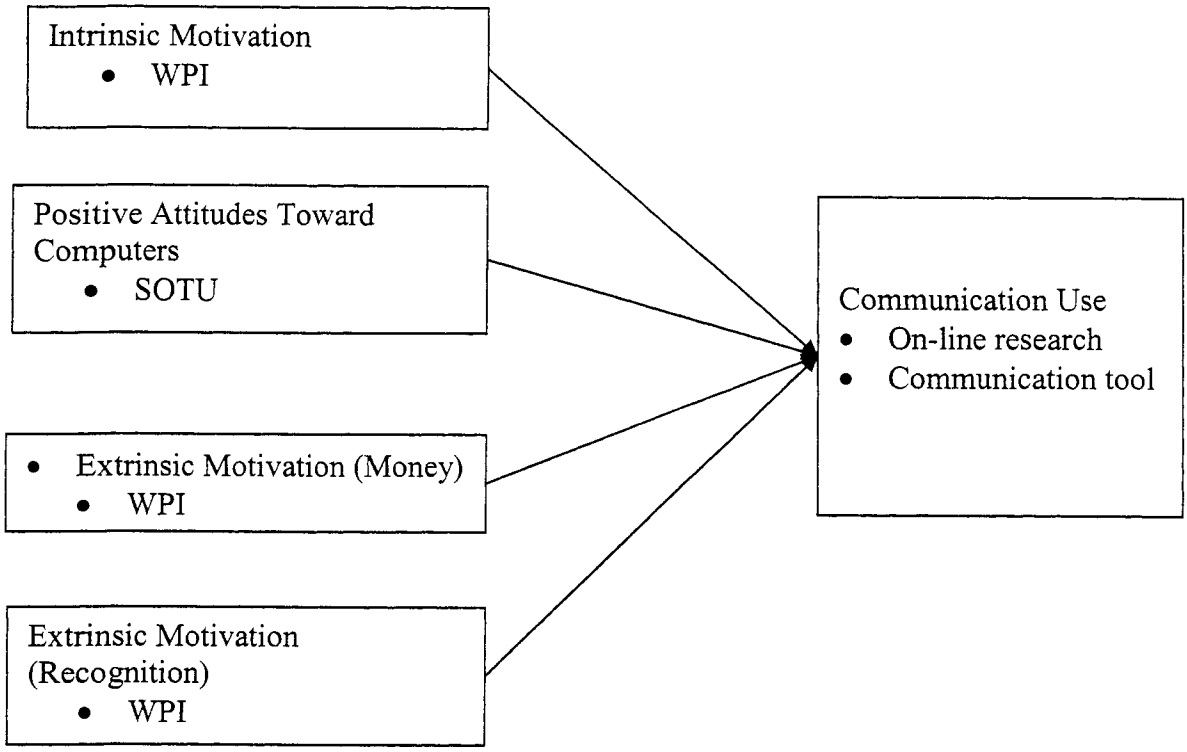

Figure 8, Regression analysis for communication use.

This analysis indicated that the SOTU score, Intrinsic Motivation and the Recognition subscale all accounted for a significant amount of variability of computers used for communication tasks, $R^2 = .13$, $F(4, 244) = 9.13$, $p < .001$ (see table 7 for full regression summary). Higher scores on the Intrinsic Motivation and Recognition scales, and lower scores on the SOTU (more positive feelings towards technology), were associated with greater communication use.

The second regression assessed the use of computers for instructional tasks, and is depicted graphically in Figure 9.

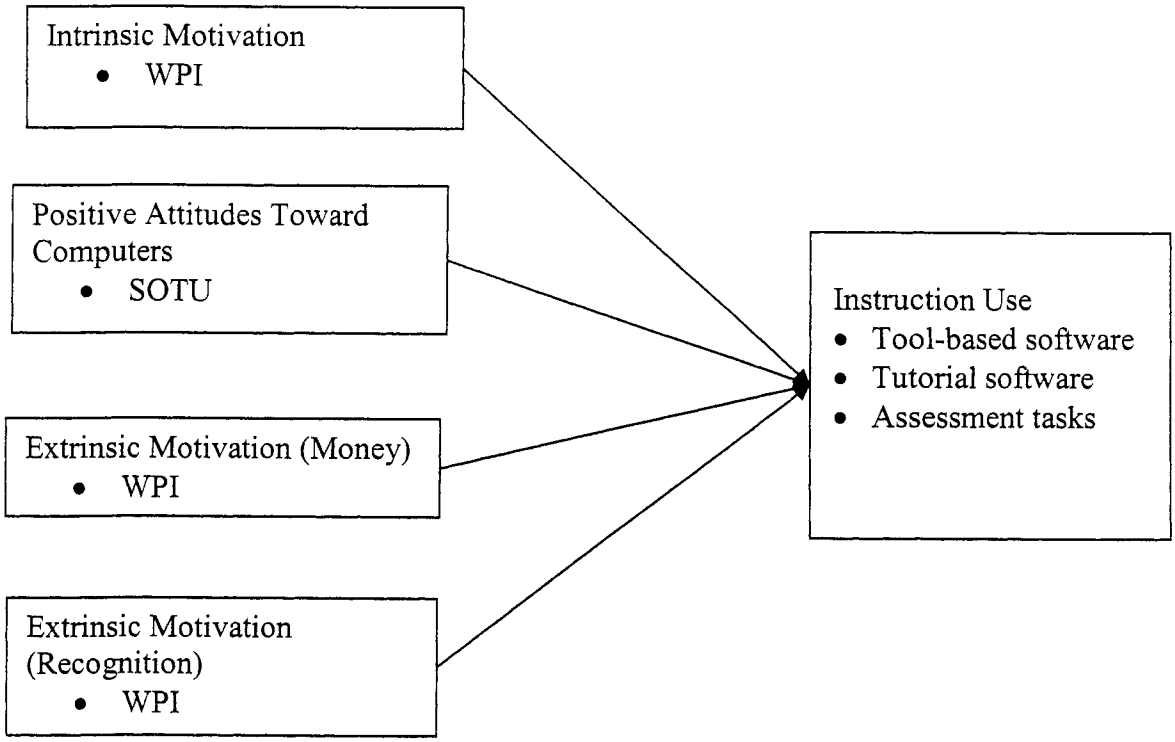

Figure 9: Regression for instructional use.

This analysis indicated that the SOTU score was the only variable accounting for a significant amount of variability in computer use for instructional purposes, $R^2 = .14$, $F(4, 242) = 10.06$, $p < .001$ (see table 8 for full regression summary). Lower scores on the SOTU, indicating more positive feelings towards technology, were predictive of more frequent use of computers for instructional purposes in the classroom.

The third regression assessed the integration of computers in the classroom, and is depicted graphically in Figure 10.

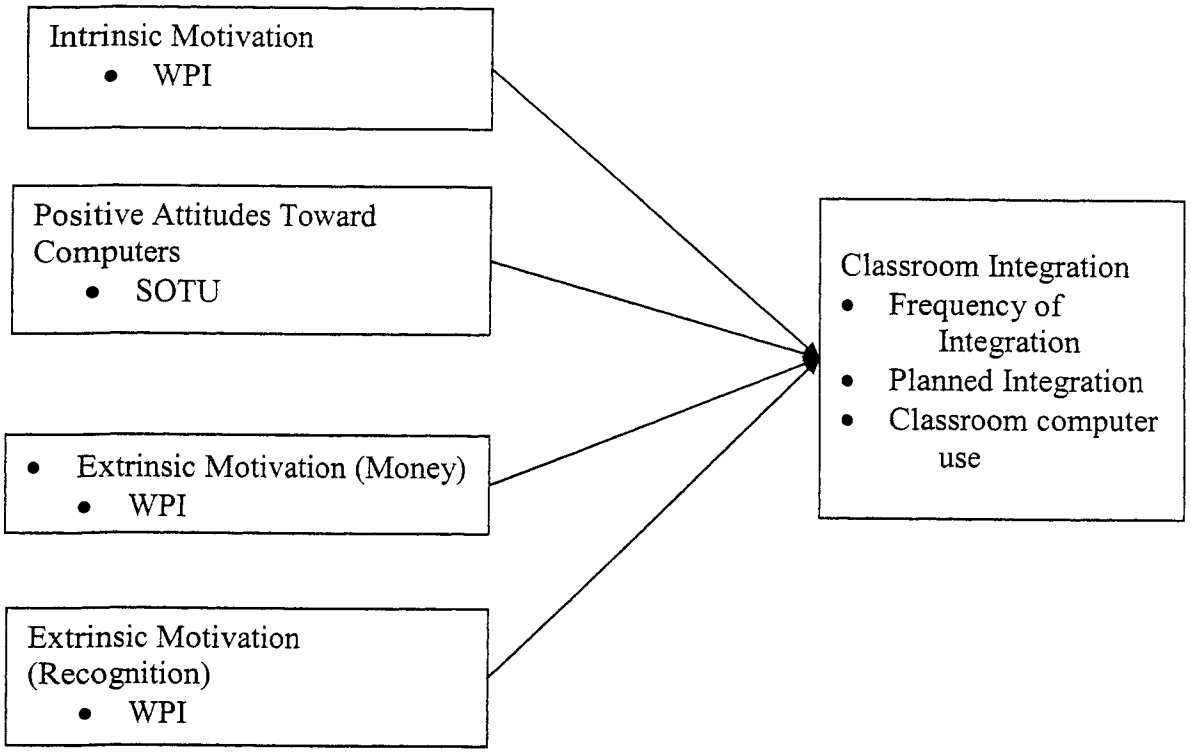

Figure 10: Regression for classroom integration.

This analysis indicated that the SOTU score was the only variable accounting for a significant amount of variability in classroom integration of computers, $R^2 = .24$, $F(4, 237) = 18.95$, $p < .001$ (see Table 9 for full regression summary). As with the previous analysis, lower scores on the SOTU were predictive of greater classroom computer integration.

Discussion

Gender Differences, Affect, and Computer Use

Consistent with previous research (e.g., Whitley, 1997), males rated themselves more favourably against "the average teacher" in ability to integrate computer technology than did female educators. Thus, even though female educators were involved with computer technology, they did not view themselves as favourably as did their male peers. This is

somewhat surprising considering that more than 90% of the female educators in this sample have desktop computers at home, and there was little difference between the percentage of male and female educators that reported using their computers everyday. Differences in the use of computers as a function of gender were also found by Jackson. Jackson et al. (2001) found that although males were found to be more confident with computer technology, females had a greater need to use computers for communication and that this translated into little difference for Internet use between the genders. One possible explanation for the gender differences noted in the present study is that the males and females in this sample use the computer technology in different ways, and that these different styles of use result in higher feelings of computer self-efficacy for the male educators (e.g., Cassidy & Eachus, 2002) For example, male educators, like many men, may be more inclined to perceive computers as interesting in their own right, and as such they may be more likely to "play" with the technology (Singh, 2001). If this is the case, males may be more confident with computer technology because they have experience using computers in a wider array of contexts and functions. This confidence could then lead men to believe that they are more adept at using that technology than their peers.

However, not all gender differences were in traditionally expected directions, which is consistent with research conducted with college students that indicates there are very few gender-based computer differences remaining (Lewis, Coursol, & Khan, 2001). Specifically, when looking at the use of computers for communication, there was an interaction between gender and teaching level, such that female elementary educators used computers far less than their secondary peers for communication, while there was little difference for computer use by males in the two teaching levels.

With a more sophisticated and capable group of students, female secondary educators would be able to introduce communication activities into their lesson plans. Conversely, female elementary educators—especially at the primary levels—would not have students capable of using computers for communication because they do not have the prerequisite literacy skills. Without students possessing basic spelling and writing skills, there would be little benefit in introducing Internet search and communication activities into the elementary classroom. As such, it should not be surprising that it was female elementary educators that reported the lowest levels of communication use.

The language skills of students may also explain why there was little difference in communication use for the male educators, as 77% of the elementary male educators taught grade four or higher. These differences of use between the elementary and secondary educators are also consistent with student reports of computer use, as secondary students have been found to utilize Internet and communication activities more often than elementary students (Colley & Comber, 2003).

The degree of communication use by secondary educators may also reflect a difference in reference between the male and female educators in this sample. Since females are more likely to use computers for communication (Singh, 2001), they may also be more likely to be familiar with the communication-context of use. This is significant as familiarity with a particular technology has been related with greater use (Ross et al., 1999).

But despite the high degree of communication use by female educators in this sample, females still reported lower ease of use than male educators. However, even though females reported less ease, overall ease of use scores for both men and women fell below 2.0, indicating that both males and females expressed a high degree of ease with computer

use. Together, the reported use of computers for communication and the ease of use scale suggest that female educators may be building computer skills, and that the typical differences seen in computer use between the genders may be decreasing (e.g., Whitley, 1997; Cassidy & Eachus, 2002). Thus, for the female elementary educators in this study, it may be that although they find their daily programs easy to use, those programs have little applicability for the classroom. Therefore, female educators may be in the difficult position of being able to use computers, but are unable to transfer their knowledge into a form that is applicable for the classroom environment. However, it appears that the increasing number of women using computer technology may lead to computers to become less associated with "male" activities and therefore more psychologically accessible and acceptable to women of all ages (Lucas & Sherry, 2004). Similar to the finding above, there may also be specific domains—such as communication—that make technology particularly salient to women, and the increased use and familiarity may translate into greater perceived ease of use. Where women traditionally had little connection, interest, or familiarity with technology (Singh, 2001), they are the population most likely to experience significant changes in their perceptions toward technology as technology becomes more acceptable.

Taken together, these findings indicate that classroom computer use is influenced by positive feelings towards computer technology, and that these positive feelings are partially related to feelings of self-efficacy. Supporting this conclusion was the finding that the belief of being able to integrate technology was significantly related to reports of regularly integrating computers in the classroom. Moreover, the establishment of these types of feelings may be particularly salient for female educators who would ordinarily avoid the use of computers in the classroom. As the number of female educators using computers in the

classroom increases, those educators who are more hesitant about the use of the technology may be able to draw comfort and support from their peers, and in doing so, be more likely to attempt to utilize the technology in their own classrooms.

Predicting Classroom Computer Use

In all three regression analyses predicting classroom use, the most consistent predictors of computer use or integration of computers were the positive feelings that an educator has towards computer technology. In these analyses, however, it is important to note that correlational measures are being used. For this reason, it is only possible to make notes of trends and relations as statements of causality can not be made.

The finding of positive attitudes predicting computer use is consistent with previous research which indicates that negative feelings towards computers, whether due to anxiety or the perceived effort required, discourage computer use (e.g., Brosnan, 1999). This also indicates that there must be more than just access to technology for an educator to welcome computer technology into his or her classroom: the educator must believe that computer technology possesses inherent value, and is likely to encourage positive growth. These types of feelings were reflected in the SOTU scores which predicted classroom computer use. For example, higher use was associated with feelings that computers were encouraging and satisfying while also likely to help with creativity, bring people together, and raise self-opinion.

In the case of classroom computer use for communication purposes, Intrinsic Motivation and Recognition also played a role in predicting use. One reason for this may be that communication use is relatively new for the classroom and therefore extra effort is required in order to successfully use the computer in this manner. This would explain why

higher Intrinsic Motivation and Recognition scores predicted higher reports of communication use. Motivation did not play a role, however, in predicting computer use in classroom instruction or integration. This may indicate that instructional use and the ideas of integration are no longer new to the educators in this sample. As such, they may have become relatively standard tools in the teaching arsenal, and consequently are evaluated on their merits similarly to other teaching technology such as VCRs and overheads. Without computers being either new or unknown, educators may no longer need the extra push of recognition or intellectual challenge to integrate or utilize computer technology in their classrooms.

Alternatively, it may be that there are more supports available for this kind of use because it is more common. With support, teachers are more likely to develop the comfort necessary to integrate technology into the classroom (Macmillan et al., 1997). However, those who attempt to use the computer in a novel way are embarking on a journey into the unknown, and are required to solve problems on their own if something should go wrong.

As was noted earlier, more than just positive feelings are influential in making the decision to use computer technology, and one of these extra factors is intrinsic motivation. Noteworthy is that high levels of intrinsic motivation were associated with positive feelings towards computer technology. This relation is likely a result of the fact that intrinsically motivated individuals are more likely to enjoy intellectual challenge, and are often unconcerned with the success of a project (Amabile et al., 1994). This means that an intrinsically motivated individual is more inclined to experiment with computer technology, and in doing so, discover more uses for that technology. Moreover, with greater knowledge

about potential uses and functions, it is more likely that an individual will be positive about a technology.

Another factor which was predictive of computer use in the classroom was a desire for recognition. Interestingly, this factor was only significant in communication use, indicating that communication use may be somewhat different in nature than instructional use and integration. As was suggested earlier, it may be that the use of computers for communication is a relatively new reality for the educators in this sample. If this were the case, the successful introduction of the Internet and communication-based tasks into the classroom would likely bring acclaim of some sort for the educator. As well, there is often status associated with being the individual that is able to understand computers, and capable of solving others' problems. In time, however, this kind of extra recognition is likely to dissipate as communication uses become more commonplace, and therefore there would no longer be this external type of reward for the computer's use.

Support for the idea of computer technology becoming more accepted in teaching can be found in the rates of reported computer integration. Independently of the gender and teaching level differences explored above, most educators are integrating computer technology to some degree, as only 4.8% of educators reported never integrating computers into their classrooms. However, this integration is not complete—although a maximum score for integration was 20, the average reported integration score was 12. This means that while educators do integrate computers into their lesson plans, this integration does not occur every day, or with every unit.

But regardless of the reported rate of integration, it is significant to note that approximately 86% of both elementary and secondary educators noted that they viewed

computer technology as an integrated part of the curriculum. This is important, as computers have a much more positive influence on student learning when used in conjunction with a curriculum, rather than as a stand alone piece of technology (Goos et al., 2003). These reported views on integration are encouraging considering that elementary educators have previously been found to be more likely to use computer technology in the classroom than their secondary peers, but also express more discomfort in doing so (Rosen & Weil, 1995). Taken together, these results of integration suggest that educators are better understanding the ways in which computers can be used in the classroom, and that this understanding is helping to overcome the differences that used to be inherent to teaching level.

Although some gender and teaching level differences remain, it appears that part of of the decision to use computers in the classroom is based upon the positive feelings that an educator has towards the technology. In this way, computers may no longer be the affect and anxiety-laden entities that have been previously found in the literature (e.g., Dupagne & Krendl, 1992). Rather, computer technology may finally be reaching the status of an educational tool, in much the same way as a VCR or overhead projector. If this is the case, the decision to integrate a computer into a lesson plan is likely based more on the computer's ability to add value to the lesson than to avoid an anxiety-invoking technology, seek out intellectual challenge, or attain acclaim for being on the forefront of technology.

What is less clear, however, is why communication use of computers in the classroom is predicted by more than just positive attitudes. One very real possibility is that the use of computers for communication necessitates use of the Internet, which is an entity independent of the computer itself. Because more effort is often required of the educator to

use the Internet—due to the need to pre-screen websites, and ensure backup plans if the connection is lost—it may be that the majority of educators do not yet see the value in regularly using Internet-based activities (e.g., Brosnan, 1999). As such, it may be that only those who are intrinsically motivated to solve problems, or who desire to be recognized for their efforts, are willing to invest the extra effort required.

Another possibility for the difference in predictors for communication use is that there are not many pre-existent supports or lesson plans that can be followed. As educators begin to experiment with a new technology, and determine what works, a base of knowledge can be established within a school that makes it easier for less-savvy educators to use the technology themselves (Windschitl & Sahl, 2002). Moreover, this base of knowledge can make the technology appear less intimidating, and therefore more accessible for everyday use (Schnedel, 1994).

It is possible that this kind of support system is responsible for the increased intention and practice of integrating computers into the classroom. As the ACOT program demonstrated, it was only once educators became comfortable with the idea of computers being integrated into the classroom that they began to make full use of the available technology (Sandholtz et al., 1997). This also suggests that as communication uses of the computer become more commonplace, the roles of intrinsic and extrinsic motivation may begin to decrease, as educators become more able to view the Internet as another classroom tool.

The Digital Divide

As the participants were recruited through a random sampling of educators in the school board, it reasonable to believe that their results are applicable to the school board as a

whole. However, as only half of the contacted educators completed and returned the survey, the results should be interpreted with some caution. But for the present sample at least, the implication is that the Digital Divide (Riel et al., 2002) is becoming less of an issue when describing computer use by educators. Although the *Divide* is traditionally used in an attempt to describe the factors which separate computer users from non-users, it may no longer be the appropriate approach, considering the high degree of computer use reported by the educators in this sample. Considering that many educators reported using computers in their classrooms, and that greater than 90% reported having computers at home, it is unlikely that the width (access to technology) or the depth (knowledge about computers) of the Digital Divide are as influential as they might have once been.

The best way to discuss the differences between computer users and non-users may now be in terms of the slope of the Digital Divide (the cultural context of use within the school) and the degree to which individuals feel positive about the technology. If a school is receptive to the innovative ideas of an educator, and willing to provide support to those who use computer technology in a new way, it is much more likely that a spirit of technology enthusiasm will spread throughout the institution than if the school is indifferent or even hostile to new ideas (e.g., Windschitl & Sahl, 2002). On a more individual level, positive attitudes towards computer technology may now be the best way to explore differences, as each of the regression analyses conducted in this study indicated positive attitudes as a significant predictor of three different classroom computer uses. For these two reasons, the conception of the Digital Divide as a "chasm" may no longer be the most accurate. Instead, the *Divide* may now be more of a bump in the road, such that one needs only to gather

enough momentum in terms of positive attitudes and institutional support in order to become a technology user.

Future Directions

Although these results suggest that computers are being integrated into the classroom, they do not the address the nature of that integration. One of the most significant uses of classroom computer technology is in establishing a learner-centred classroom. This means that students become more active in their learning, and more responsible for gathering their own information and drawing conclusions (Collinson, 2001). While this style of use is very beneficial to students, it is not the only way that a computer can be introduced into the classroom. If desired, an educator can simply substitute PowerPoint© for the classroom overhead projector, and rightly claim that the computer is being used in his/her classroom (Windschitl & Sahl, 2002). However, this style of use does little to change the traditional learning environment of the classroom.

By looking at the percentage of educators who believed that computers were an integrated part of the curriculum, it appears that a more learner-centred approach is being utilized, as "integration" is often associated with more than just using the computer as a presentation tool. However, future research should verify this assumption to ensure that computers are being used in the most beneficial way, and that educators utilize the same definition and meaning for integration as is intended by researchers.

Another future area of investigation should be the ways in which educators come to feel positive toward computer technology. Since the single most important predictor of computer use was positive attitudes, the mechanisms behind the development of those positive attitudes need to be understood. One possibility is that through workshops and

other forms of training, educators are able to experience new uses for the computer, and in doing so view it as a more valuable piece of equipment (e.g., Wood, Willoughby, Specht, Stern-Cavalcante, & Child, 2002). It may also be that personal experience is paramount, and that it is only through successful classroom experiences that educators come to believe that computers can positively impact a lesson plan. As the key predictor of computer use is positive attitudes, it is imperative that all educators have the opportunity to view computer technology in a beneficial capacity, and that they be provided with sufficient support to assist during times of difficulty.

Extra research is also required to determine the other predictors of classroom computer use. While positive attitudes towards computers had a significant role in predicting use, they by no means accounted for all of the available variance. Although not explored in this study, it is likely that the area in which an educator teaches impacts the use of computer technology. For example, it is much easier to integrate computers into a digital science lab than it would be to find effective software for a foreign languages class. Also, as was mentioned previously, the availability of support, either within a department or a school, is crucial for those computer users who are not confident with the technology. Therefore, it is likely that the availability of support, especially during the early stages of technology introduction, would significantly impact the decision to use computers in the classroom.

Even though the computer may be a more complicated piece of equipment than a VCR, it also has the potential to be a far more influential learning tool. The key, therefore, is to ensure that educators are not intimidated by the technology, but also have resources available to them which ensure that the computer is used effectively. With sufficient

experience and positive feelings, educators may eventually use computers as freely as any other teaching tool—something which will fundamentally change the face of education.

Table 1

Breakdown of Elementary Educators by Teaching Division

Division	Percentage of Educators
Primary	37.2%
Junior	38.0%
Intermediate	24.3%

Table 2

Breakdown of Secondary Educators with a 50% or Greater Subject Load in a Specific Discipline

Subject Area	Percentage of Educators
The Arts	5.0%
Business Studies	1.6%
Canadian and World Studies	3.6%
Classical and International Languages	0.9%
English	1.6%
English as a Second Language	0.9%
French as a Second Language	0.9%
Guidance and Career Education	3.7%
Health and Physical Education Science	1.0%
Interdisciplinary Studies	0.3%
Mathematics	4.0%
Science	4.6%
Social Science and Humanities	5.6%
Special Education	3.2%
Teacher-Librarian	1.3%
Technological Education	7.0%

Table 3

Average Number of Years of Teaching Discipline by Teaching Level

Level	Primary (JK-3)	Junior (4-6)	Intermediate (7-8)	Senior (9-13)	Overall
Elementary	5.8	4.6	3.2	0.8	13.9
Secondary	0.1	0.3	6.1	12.2	13.9

Table 4

Reported use of Computers for Classroom Communication, by Teaching Level and Gender

Elementary Female	3.44, SD=1.51[a]
Elementary Male	3.97, SD=1.27[ab]
Secondary Male	4.17, SD=1.26[bc]
Secondary Female	4.69, SD=1.59[c]

Note: Different subscripts indicate significant differences

Table 5
Mean Scores for use of Computers as a Function of Gender and Level

Measure	Male Elementary	Female Elementary	Male Secondary	Female Secondary
Tool-Based Software	2.90	2.88	3.18	3.21
Tutorial Software	2.70	2.59	2.11	1.72
Assessment Tasks	1.73	1.39	2.05	1.82
On-line Research	2.83	2.41	2.95	3.39
Communication Tool	1.13	1.03	1.23	1.28
Classroom Use (teacher)	3.33	2.87	3.32	2.99
Classroom Use (student)	2.50	2.75	2.79	2.53
Degree of Integration	3.00	2.78	3.26	3.08
Planned Integration	2.83	2.44	2.92	2.88

Table 6

Intercorrelations Between Predictors and Dependent Variables for Computer Use Regressions

Predictor	1	2	3	4	5	6	7
1. SOTU	___	-.29**	-.17**	.03	-.37**	-.27**	-.48**
2. Intrinsic Motivation		___	-.001	-.15*	.16*	.23**	.24**
3. Money Subscale			___	.32**	.13**	.15**	.11
4. Recognition Subscale				___	.05	.01	.002
5. Instructional Use					___	.50**	.92**
6. Communication Use						___	.53**
7. Integration							___

* $p < .05$
** $p < .01$

Table 7

Summary of Regression Analysis for Variables Predicting Communication Use

Variable	*B*	*SE B*	ß
SOTU Score	-.09	.03	-.20*
Intrinsic Motivation	.05	.02	.18*
Recognition	.07	.03	.14*
Money	.05	.03	.10

*$p < .05$

Table 8

Summary of Regression Analysis for Variables Predicting Instructional Use

Variable	*B*	*SE B*	ß
SOTU Score	-.26	.05	-.34**
Intrinsic Motivation	.02	.03	.05
Recognition	.04	.05	.05
Money	.05	.05	.06

** $p < .001$

Table 9

Summary of Regression Analysis for Variables Predicting Integration

Variable	*B*	*SE B*	ß
SOTU Score	-.52	.07	-0.45**
Intrinsic Motivation	.06	.04	.10
Recognition	.03	.08	.02
Money	.03	.08	.02

** $p < .001$

Appendix A
Letter of Consent

On Letterhead

January 2004
Dear Teacher,

We are writing to you today to ask for your participation in a research project that examines computer technology in the classroom. This research project represents a collaborative venture for the Waterloo Region District School Board (CA TC group) and researchers at Wilfrid Laurier University (Eileen Wood), Brock University (Teena Willoughby) and The University of Western Ontario (Jacqueline Specht). Together, we are investigating perceptions about computer technology in the classroom and feelings, experiences, and beliefs that might have an impact on perceptions about computer technology in the classroom environment. We are hoping that you will be willing to fill-in the enclosed survey.

Our rationale for this project stems from responses that we received in an earlier study conducted with educators at the Waterloo District Region School Board. In that study, educators at both the elementary and secondary levels participated in focus groups. The results of the focus groups yielded an understanding of both barriers and supports educators face with respect to integrating technology. These results are currently being disseminated within and beyond the school board and are serving as a basis for modifying computer support. We would like to extend this work by studying when, where, and why computers "fit" or do not "fit" for elementary and secondary educators. In total we will be asking for about 30 to 40 minutes of your time. You will be asked questions about your experiences with computers, with work and your views about teaching and technology. Some of the questions are multiple choice and some are open-ended allowing you to express your personal thoughts. Both the quantitative data and qualitative data (your comments) serve special functions in identifying important issues. Your input is critical to our understanding and for directing subsequent interventions and decisions regarding computer technology in the classroom. The results of this research may also be presented at academic conferences and in academic journals. We also hope you will find the survey interesting.

There are some frequently asked questions that we would like to answer at the outset. You might be wondering why you received a copy of this survey and whether anyone will be able to trace your responses back to you. First, your name was selected randomly from a recent list of educators at the school board. Your participation is completely confidential. You will note that all the return materials are directed through regular post to Dr. Eileen Wood at Wilfrid Laurier University. All the data we collect will be received, stored, coded and analyzed by the university researchers and their research assistants. The data we collect will be stored in a locked research room at Wilfrid Laurier University and will be destroyed seven years after our research is published. Only group data (collapsed across participants) will be reported. We are taking these measures to ensure the confidentiality of all completed surveys. You will also note that you have been asked to make sure that your name does not appear on any part of the survey. This, too, will ensure that, at a later time, no one can match the responses on the survey with anyone individual. Although participants are asked to make sure that their name does not appear on the survey, there is a code on each survey. We are using that code to track the surveys at the mailing stage only. This is to help us understand the response rate to the survey so that we don't accidentally attribute a failed mailing or erroneous mailing (wrong address) as a decision to decline participation. When no response is received from the first mailing, we will use the survey code to mail a second copy of the survey only to those participants for whom no response (either consent to participate or decision to decline participation) was received. As soon as a response is received from any participant, their name will be deleted from our survey-name code, meaning that from that point forward no information could be traced to the original participant. Three months after the second mailing occurs, all names remaining on this original participant list will be deleted from our

records. In the end, no names will be retained. Again, this will ensure your confidential participation.

Please note that your participation is completely voluntary and that you are free to withdraw your participation, or omit questions at any time in this investigation without penalty. The Research Ethics Board at Wilfrid Laurier University reviewed and approved this project and you are welcome to discuss the ethics approval with Bill Marl' at the Research Office (884-1970 ext. 2468). In addition, the Research Committee of the Waterloo Region District School Board approved this study.

For your reference, the title of this research project is "Computer Technology in the Classroom".

You will also note that there is a separate response card to acknowledge whether you would like to participate or not, and a card allowing your name to be entered in a draw. Both of these cards can be sent separately in the stamped envelopes provided. There are three draw prizes for each education level (elementary and secondary). The draw prizes are two one day releases and one gift certificate for $75.00. The release days can be taken at the discretion of the winner. The gift certificate can be used for any of the malls in Waterloo and Kitchener. The chances of winning a prize will be contingent on the total number of draw entries received but the maximum possible odds would be 1 in 300. These prizes are a small acknowledgment of the time and effort we are asking of you.

We hope that you will be willing to participate in our research project and we look forward to sharing our findings with you at the end of this research. At this time we would like to thank you for taking the time to consider our request for participation. If you have any questions regarding this research please feel free to contact us (Eileen Wood 519-884-1970 ext. 3738, or Teena Willoughby 905-688-5550, ext. 4067). Please leave a message if no one is in the office. Thank you again for taking the time to consider this request.

Sincerely,

Eileen Wood, Ph.D.

Appendix B
Questions Used in Analysis

I. Demographic information (Elementary and Secondary):

Age:		**Gender:**	Male Female

Elementary Questions

Current teaching assignment: In which grade(s) do most of your current teaching responsibilities fall (circle all that apply):	K 1 2 3 4 5 6 7 8
Past teaching experience: Total number of years teaching:	
Total number of years throughout teaching in each division:	Primary Junior Intermediate Senior Other (_____)

Secondary Questions

Current Teaching Assignment: Indicate the proportion of your current teaching assignment for each curriculum area: 1. The Arts: Music, Visual Arts, Drama, Dance 2. Business Studies 3. Canadian & World Studies 4. Classical & International Languages 5. English 6. English as a 2nd language 7. French as a 2nd language 8. Guidance & Career Education 9. Health and Phys. Ed Science 10. Interdisciplinary Studies 11. Mathematics 12. Science 13. Social Science & Humanities 14. Special Education 15. Teacher-Librarian 16. Technological Education	**Proportion of teaching assignment** _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

Past teaching experience:

Total number of years teaching:

Total number of years throughout teaching in each division:	Primary Junior Intermediate Senior Other (_____)

II. HOME COMPUTER USE

Of the following technologies, please indicate whether or not you have them at home and how frequently you use them at home:	**Have at home?**	**How Frequently Do You Use Them?**				
		Never	**A few times a year**	**A few times a month**	**A few times a week**	**Every day**
1. desktop computer	1. ____	____	____	____	____	____
2. laptop computer	2. ____	____	____	____	____	____
3. printer	3. ____	____	____	____	____	____
4. Internet access	4. ____	____	____	____	____	____
5. CD burner	5. ____	____	____	____	____	____
6. scanner	6. ____	____	____	____	____	____
7. digital videocamera	7. ____	____	____	____	____	____
8. digital camera	8. ____	____	____	____	____	____
9. PDA (e.g., Palm pilot)	9. ____	____	____	____	____	____

In general, how at ease do you feel about using computers?	Very ill at Ease		Neutral		Very at Ease
	1	2	3	4	5

In **general**, how enthusiastic do you **feel** about using computers?	Very enthusiastic		Neutral		Very unenthusiastic
	1	2	3	4	5

III. School Computer Use:

How often do **you, as a teacher**, use a:

	Never	A Few Times a Year	A Few Times a Month	A Few Times a Week	Every Day
1. Classroom computer.....	1. ...□...	...□...	...□...	...□...	...□...

How often do **your students** use a:

	Never	A Few Times a Year	A Few Times a Month	A Few Times a Week	Every Day
1. Classroom computer.....	1. ...□...	...□...	...□...	...□...	...□...

How frequently do you ask students to do the following activities when you use **computers as part of a lesson?**

	Never	Sometimes	A Moderate Amount	Quite a Bit	A Great Deal
1. On-line research (e.g, Internet searches, Grollier)	1. ...□...	...□...	...□...	...□...	...□...
2. Use tool-based software (e.g., databases, spreadsheets, word-processing, multimedia, CAD)	2. ...□...	...□...	...□...	...□...	...□...
3. Use subject-specific tutorial software (e.g., MathTrek, Music Ace)	3. ...□...	...□...	...□...	...□...	...□...
4. Use as a communication tool (e.g., e-mail, chat rooms)	4. ...□...	...□...	...□...	...□...	...□...
5. Complete specific assessment tasks (e.g., quizzes, tests)	5. ...□...	...□...	...□...	...□...	...□...
6. Other (Please specify: _____)	6. ...□...	...□...	...□...	...□...	...□...

To what extent do **you integrate computer technology** in the classroom?

A Great Deal	Quite a Bit	A Moderate Amount	Sometimes	Never
5	4	3	2	1

Do you see **computers** as: An integrated part of the curriculum? Yes No

When you are **planning** a unit, how often do you assume that computer use by students will be part of your instructional plan?

A Great Deal	Quite a Bit	A Moderate Amount	Sometimes	Never
5	4	3	2	1

In **comparison to the average teacher**, how would you rate **your ability to integrate** technology?

Much more	More skilled	Equal	Less skilled	Much less skilled
1	2	3	4	5

IV. Attitudes Toward Work and Technology

Indicate with an "X" your level of agreement with the following statements **about computers**:

	Generally Feel	Neutral	Generally Feel	
1. They are satisfying	____	____	____	They are frustrating
2 They help my creativity	____	____	____	They interfere with my creativity
3. They are encouraging	____	____	____	They are discouraging
4. They bring me together with people	____	____	____	They separate me from people
5. They raise my opinion of myself	____	____	____	They lower my opinion of myself
6. I am comfortable with computers	____	____	____	I am intimidated by computers
7. I approach computer technology in a THINKING way	____	____	____	I approach computer technology in a FEELING way
8. I feel good around computers	____	____	____	I feel anxious around computers
9. People encourage my computer use	____	____	____	People discourage my computer use

Please rate each item below in terms of how true it is of you.

	Never or almost never true of me	Sometimes true of me	Often true of me	Always or almost always true of me
Intrinsic Motivation Questions:				
13. I enjoy tackling problems that are completely new to me	13. ...□...	...□...	...□...	...□...
26. I enjoy trying to solve complex problems	26. ...□...	...□...	...□...	...□...
3. The more difficult the problem, the more I enjoy trying to solve it.....	3. ...□...	...□...	...□...	...□...
5. I want my work to provide me with opportunities for increasing my knowledge and skills	5. ...□...	...□...	...□...	...□...
11. Curiosity is the driving force behind much of what I do	11. ...□...	...□...	...□...	...□...
28. I want to find out how good I really can be at my work	28. ...□...	...□...	...□...	...□...
7. I prefer to figure things out for myself	7. ...□...	...□...	...□...	...□...

30. What matters most to me is enjoying what I do .....
27. It is important for me to have an outlet for self-expression .....
14. I prefer work I know I can do well over work that stretches my abilities
8. No matter what the outcome of a project, I am satisfied if I feel I gained a new experience .....
17. I'm more comfortable when I can set my own goals .....
23. I enjoy doing work that is so absorbing that I forget about everything else .....
20. It is important for me to be able to do what I most enjoy.....
9. I enjoy relatively simple, straightforward tasks .....

Extrinsic Motivation (Recognition):

24. I am strongly motivated by the recognition I can earn from other people
29. I want other people to find out how good I really can be at my work ....
6. To me, success means doing better than other people .....
18. I believe that there is no point in doing a good job if nobody else knows about it .....
15. I'm concerned about how other people are going to react to my ideas...
21. I prefer working on projects with clearly specified procedures.....
1. I am not that concerned about what other people think of my work.....
2. I prefer having someone set clear goals for me in my work.....

Extrinsic Motivation (Money):

19. I am strongly motivated by the money I can earn.....
10. I am keenly aware of the promotion goals I have for myself .....
16. I seldom think about salary and promotions .....
4. I am keenly aware of the income goals I have for myself.....
25. I have to feel that I'm earning something for what I do .....
22. As long as I can do what I enjoy, I'm not that concerned about

exactly what I'm paid
.....

12. I'm less concerned with what work I do than what I get for it 12. ...□... ...□... ...□... ...□...
.....

Appendix C
Reports of Technology Use and Availability at Home

Technology	Do Not Have	Never	Few Times a Year	Few Times a Month	Few Times a Week	Every day
Desktop Computer						
Elementary	7.4%	0.0%	4.7%	8.8%	33.8%	45.3%
Secondary	3.3%	0.0%	0.0%	4.0%	19.3%	73.3%
Laptop Computer						
Elementary	56.8%	4.1%	8.1%	3.4%	12.2%	15.5%
Secondary	61.3%	4.0%	6.0%	6.0%	12.7%	10.0%
Printer						
Elementary	4.7%	0.0%	4.1%	23.0%	53.4%	14.9%
Secondary	2.0%	0.0%	2.0%	18.0%	44.7%	33.3%
Internet Access						
Elementary	6.1%	1.4%	2.0%	8.8%	31.1%	50.7%
Secondary	2.7%	0.7%	0.7%	4.7%	26.7%	64.7%
CD Burner						
Elementary	34.5%	21.6%	20.9%	21.6%	0.7%	0.7%
Secondary	30.7%	10.7%	17.3%	33.3%	6.0%	2.0%
Scanner						
Elementary	56.8%	9.5%	18.2%	13.5%	2.0%	0.0%
Secondary	47.3%	7.3%	16.0%	22.7%	5.3%	1.3%
Digital Video						
Elementary	81.1%	3.4%	6.1%	7.4%	2.0%	0.0%
Secondary	80.0%	2.0%	8.7%	7.3%	1.3%	0.7%
Digital Camera						
Elementary	60.1%	4.1%	7.4%	19.6%	8.8%	0.0%
Secondary	49.3%	5.3%	6.7%	24.0%	12.7%	2.0%
PDA						
Elementary	82.4%	8.1%	0.7%	3.4%	1.4%	4.1%
Secondary	80.0%	4.7%	1.3%	0.7%	4.0%	9.3%

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