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Computer Integration in Elementary and Secondary Schools: Variables Influencing Educators

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by

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Abstract

Given the prevalence of computers in education today, it is critical to understand teachers' perspectives regarding computer integration in their classrooms. Research identifying stages of implementation, and literature identifying barriers and supports, fall short of explaining what variables impact an educator's ultimate decision to integrate technology in their instruction. The current research surveyed a heterogeneous sample of 185 elementary and 204 secondary teachers in order to provide a comprehensive summary of teacher characteristics and variables that discriminate teachers who integrate technology from those who do not. Discriminant Function Analysis (DFA) identified the following variables as making unique contributions to discriminating high and low integrators: positive experiences with computers; teacher's comfort with computers; specific beliefs about computer technology as an instructional tool; training; challenge; support; and, teaching efficacy.

Qualitative analysis of open-ended survey questions and univariate analysis of differences between "nominated experts" and randomly selected teachers, triangulated the findings to build a model of successful integration that includes integration of content, pedagogical and technological knowledge; personal characteristics of teachers (learning style and willingness to accept challenge); and, support (both technical and human resources). Identification of discriminating individual characteristics has implications for professional development and policies regarding support and integration.

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Table of Contents

Literature Review 1

Barriers to Computer Integration 4

Stages of Integration 6

Pedagogical Beliefs 9

Teacher Efficacy 12

Motivation 13

Identifying the Most Significant Influences 14

Purpose of Current Research 16

General Method 18

Participants 18

Measures and Procedure 22

General Comfort with Computers 23

Home Computer Use 23

Computer Use at School 24

Views on Computers 26

Views on Teaching 27

Views on Work 29

Data Screening and Variable Composition 29

Study One 35

Method 37

Participants 37

Measures 38

Results 42

Univariate Analysis 44

Multivariate Analysis 48

Elementary 48

Secondary 49

Discussion 50

Study Two 59

Method 63

Participants 63

Materials and Procedure 64

Student Use by Location 65

Student Use by Type of Activity 65

Frequency of Planning 65

Level of Integration 65

Use of Computer as a Presentation Tool 65

Ability in Comparison to Peers 66

Results 66

Discussion 69

Study Three 74

Method 76

Participants 76

Measures 77

Procedure 78

Results and Discussion 81

Supports and Barriers 81

Location of Computers 81

"Other" Forms of Professional Development ... 82

School Administration Support 82

Enhances Integration of Computer Technology 87

Inhibits Integration of Computer Technology ... 89

Summary of Barriers and Supports 92

Comparison of High Integrators and Low Integrators 93

Support for Computer Integration 94

Fit with Instructional Style 100

Factors Influencing Planning with Computers 108

Characteristics of Excellent Teachers 112

Characteristics of Excellent Teachers who Integrate Technology 116

Summary of Comparison Between Low and High Integrators 120

How Computers Are Being Used 121

Types of Computer Activities 121

Use Computers to Teach Literacy 122

Summary of How Computers Are Being Used 124

Conclusions 126

General Discussion 132

Implications 143

Limitations and Future Research 147

Closing Comments 149

Appendices 151

References 180

List of Tables

Table 1: Percentage Frequency of School Population of Participating Teachers 21

Table 2: Correlation Matrix for Computer Related and Individual Characteristic Variables 34

Table 3: Means and Standard Deviations for Overall and Specific Integration Measures for Low and High Integration Groups by Teaching Level 38

Table 4: Correlation Matrix for Computer Related and Individual Characteristic Variables 43

Table 5: Univariate and Multivariate Results for Elementary Level 45

Table 6: Univariate and Multivariate Results for Secondary Level ... 47

Table 7: Means and Standard Deviations on the Dependent Variables by Group 66

Table 8: F Statistics and Effect Sizes for Individual ANOVAs on Dependent Variables 68

Table 9: Percent of Participants Responding to Each Qualitative Question 79

Table 10: Coding Themes, Definitions, and Examples for Responses to the Question: “Does your school administration support the concept of integrating computer technology for yourself and students? Explain briefly.” 84

Table 11: Percent Frequency of Respondents, By Division, Indicating

	Themes for the Question: "Does your school administration support the concept of integrating computer technology for yourself and students? Explain."	86
Table 12:	Coding Themes, Definitions, and Examples for Responses to the Question: "What currently enhances your integration of computer technology in the classroom?"	88
Table 13:	Percent Frequency of Respondents, By Division, Indicating Themes for the Question: "What currently enhances your integration of computer technology in the classroom?"	89
Table 14:	Coding Themes, Definitions, and Examples for Responses to the Question: "What currently inhibits your integration of computer technology in the classroom?"	90
Table 15:	Percent Frequency of Respondents, By Division, Indicating Themes for the Question: "What currently inhibits your integration of computer technology in the classroom?"	92
Table 16:	Coding Themes, Definitions, and Examples for Responses to the Question: "Do you support the concept of integrating computer technology for students in your division? Please elaborate."	95
Table 17:	Percent Frequency of Respondents, By Division and Integration Level, Indicating Theme to the Question: "Do you support the concept of integrating computer technology for students in your division? Explain."	97

Table 18:	Coding Themes, Definitions, and Examples for Responses to the Question: "Does the integration of computer technology fit within your personal instructional style? Explain briefly."	102
Table 19:	Percent Frequency of Respondents, By Division and Integration Level, Indicating Theme to the Question: "Does the integration of computer technology fit within your personal instructional style? Explain briefly."	105
Table 20:	Coding Themes, Definitions, and Examples for Responses to the Question: "When you are planning a lesson/unit, what factors make you decide to integrate the computer?" .	109
Table 21:	Percent Frequency of Respondents, By Division and Integration Level, Indicating Theme to the Question: "When you are planning a lesson/unit, what factors make you decide to integrate the computer?"	111
Table 22:	Coding Themes, Definitions, and Examples for Responses to the Question: "If you had to define the personal characteristics of people who are excellent teachers—what would those characteristics be?"	113
Table 23:	Percent Frequency of Respondents, By Division and Integration Level, Indicating Theme to the Question: "If you had to define the personal characteristics of people who are excellent teachers – what would those	

characteristics be?" 114

Table 24: Percent Frequency of Respondents, By Division and Integration Level, Indicating Theme to the Question: "Please identify characteristics that make excellent teachers who happen to integrate technology effectively different from teachers who do not." 118

Table 25: Coding Themes, Definitions, and Examples for Responses to the Question: "How do you use computers to teach literacy?" 123

Table 26: Percent Frequency, By Division and Integration Level, of Highest Level Theme Indicated in Response to the Question: "How do you use computers to teach literacy?" 124

List of Figures

Figure 1: Technological Pedagogical Content Knowledge (TCPK); Mishra & Koehler, 2008 11

Figure 2: Framework for examining the implementation of computer technology 14

Figure 3: Themes for administration support for computer integration 83

Figure 4: Themes for variables that enhance computer integration 87

Figure 5: Themes for variables that inhibit computer integration 90

Figure 6: Themes for support and no support for integration of computers in respective divisions 95

Figure 7: Patterns of themes by division and integration level for the question: *"Do you support the concept of integrating computer technology for students in your division? Explain."* 99

Figure 8: Patterns of themes by division and integration level for the question: *"Do you support the concept of integrating computer technology for students in your division? Explain."* 100

Figure 9: Themes for fit with instructional style 101

Figure 10: Patterns of themes by division and integration level for the question: *"Does the integration of computer technology fit within your personal instructional style? Explain briefly"* for positive responses 106

Figure 11: Patterns of themes by division and integration level for the question: *"Does the integration of computer technology fit*

	within your personal instructional style? Explain briefly", for negative responses	107
Figure 12:	Themes for factors considered when planning to use technology	108
Figure 13:	Patterns of themes by division and integration level for the question: *"When you are planning a lesson/unit, what factors make you decide to integrate the computer?"*	112
Figure 14:	Themes for characteristics of excellent teachers	113
Figure 15:	Patterns of themes by division and integration level for the question: *"If you had to define the personal characteristics of people who are excellent teachers – what would those characteristics be?"*	115
Figure 16:	Themes for characteristics of excellent teachers who use technology	117
Figure 17:	Patterns of themes by division and integration level for the question: *"Please identify characteristics that make excellent teachers who happen to integrate technology effectively different from teachers who do not."*	119
Figure 18:	Themes for use of technology in literacy instruction	122
Figure 19:	Patterns of themes by division and integration level for the question: *"How do you use computers to teach literacy?"* ...	125
Figure 20:	Model for successful integration of computer technology	135

List of Appendices

Appendix A: About This Package 149

Appendix B: Letter to Teachers 150

Appendix C: Second Mailing 152

Appendix D: Second Letter to Teachers 153

Appendix E: Consent to Participate 155

Appendix F: Prize Draw Entry Form 156

Appendix G: Computer Use and Attitudes Survey for Secondary School Teachers 157

Appendix H: Computer Use and Attitudes Survey for Elementary School Teachers 170

Appendix I: Flowchart of Data Samples across Studies 186

Appendix J: Patterns of Themes by Division and Integration Level in Histogram Format 188

Computer Integration in Elementary and Secondary Schools: Variables Influencing Educators

Computer technology continues to advance at an unprecedented rate in all aspects of our society (Watson, 2006). The ever increasing availability of computers and Internet access has made computers a fixture in elementary and secondary schools. National and international statistics show that schools around the world are becoming increasingly well-equipped with computer hardware (Collis, Knezek, Lai, Miyashita, Pelgrum, Plomp, & Sakamoto, 1996; Ertl & Plante, 2004; Pelgrum, 1992) and access to the Internet (Greene, 2000; Riel & Becker, 2000). Statistics Canada reports that over 1 million computers were available to students and teachers in the school year 2003-2004 (Ertl & Plante, 2004). The median ratio of students to computers in Canada was reported, on average, as 5 to 1 with ratios as low as 3 to 1 in smaller schools. Descriptive statistics reporting Internet connections and pupil computer ratios, however, tell us little about the quantity and quality of student and teacher interaction with computers.

Advances in multimedia and hypertext capabilities make the computer an attractive cognitive tool for education. Computer assisted instruction can easily be individualized and progress can be recorded (Chambers, Abrami, McWhaw, & Therrien, 2001). Simple visual and audio components can be added to traditional instruction modules (Mayer & Moreno, 2002; Moreno & Mayer, 2002). Text-to-speech and speech-to-text capabilities, video-streaming, networks, and user-friendly simulations provide opportunities in the classroom for cognitive tasks that were not possible only years ago. Indeed, when computers have been introduced, small to medium positive effects of computer instruction have been observed in specific domains such as pre-reading (Blok, Oostdam, Otter, & Overmaat, 2002), spelling (Torgerson & Elbourne, 2002), writing (Christensen, 2004), and science (Mayer, Mautone, & Prothero, 2002); and, for more general measures of learning, such as metacognitive skills (Collis, et al., 1996) and overall student achievement (Niemiec & Walberg, 1985).

Given that the school environment often serves as the one equal playing field in allowing children of diverse backgrounds access to technology, educators can play a critical role in exposing children to computer technology and demonstrating how to use technology effectively for learning. Educators then, have the challenge of acquiring skill with the technology and utilizing it effectively as part of their instruction.

Despite widespread access and possible learning advantages, research suggests that computers are under-utilized in many schools and the potential of computer technology is not being realized (Abrami, 2001; Cuban, 2001; Muir-Herzig, 2004; Sutherland et al., 2004). This problem has been evident for some time and continues to be an issue in both national and international contexts. According to 78% of the principals in a Canada wide study of connectivity and learning, computers were used primarily for word processing with only 34% of teachers using the Internet/intranet to disseminate information (Ertl & Plante, 2004). Rosen and Weil (1995) reported that although computers were available in every school in their study, only half of the teachers used the computers.

Cuban, Kirkpatrick, and Peck (2001) reported that only 4 of the 13 teachers in their case studies had modified their classroom teaching in major ways to accommodate the introduction of technology even among schools designated as having high access to computers. Work conducted in the United Kingdom, Thailand, Greece, and the Netherlands, also suggests that computers are still under-used in terms of quantity and quality of use (Conlon & Simpson, 2003; Demetriadis et al., 2003; Pelgrum, 2001; Wilson, Notar, & Yunker, 2003; Wooley, 1998). The impetus for researchers then is to understand why, when computers are available, they are under-utilized.

The Technology in Schools Taskforce, in Lawless & Pellegrino (2007), defines technology integration as

> "the incorporation of technology resources and technology-based practices into the daily routines, work, and management of schools. Technology resources are computers and specialized software, network-based communication systems, and other equipment and infrastructure. Practices include collaborative work and communication, internet-based research, remote access to instrumentation, network-based transmission and retrieval of data, and other methods. This definition is not in itself sufficient to describe successful integration: it is important that integration be routine, seamless, and both efficient and effective in supporting school goals and purposes (p. 577)"

Integration is also defined in the literature as occurring at two levels: Type I integration, in cases where teachers are automating existing practices and using technology to support current instructional methods; and, Type II integration, which considers technology integration to be a pedagogical endeavor, concerned with how students learn in a digital world, beyond using technology to improve efficiency of current practices (Dutt-Doner, Allen, & Corcoran, 2005). Type II integration questions how technology supports learning and instruction in innovative ways. Regardless of the level of integration, most definitions refer to the use of computer-related technology for instructional purposes (Foon Hew & Brush, 2007).

Although literature provides us with definitions of "successful integration", individual teachers will interpret integration in their own way based on their attitudes, beliefs, and experiences with technology. The definition of technology integration in this research project is an aggregate of variables that includes teacher use, student use in classrooms, teacher planning with technology, and overall integration based on self reports of frequency, quantity, and some measures of quality.

Barriers to Computer Integration

Barriers to the successful integration of computer technology have been identified by researchers through observational work (e.g., Cuban et al., 2001; Sandholtz, Ringstaff, & Dwyer, 1997); case studies (e.g., Hayes, 2007; Windschitl & Sahl, 2002); and, surveys (e.g., Becker & Ravitz, 2001; Rosen & Weil, 1995; Specht, Wood, & Willoughby, 2002). Together with research identifying available supports (Anderson, 1996; Becker, 1994; Hadley & Sheingold, 1993; Rocheleau, 1995; van den Berg, 2002; Wood, Mueller, Willoughby, Specht, & DeYoung, 2005), these studies suggest that both environmental and individual variables impact the effective integration of computer technology. For example, potential barriers include equipment-based issues, such as limited access, technical problems and malfunctions, as well as individual differences in beliefs, attitudes, and skills among teachers.

The rapid advances in computer technology and the changes within schools regarding the presence of technology make it challenging to evaluate the impact of some of the barriers identified in the past, and also make it problematic for identifying potential barriers that may affect educators in the future. Early research in the field of educational technology examined barriers to integration and identified "computer anxiety" as a roadblock to computer use. Following a meta-analysis of studies in this area, Rosen and Macguire (1990) concluded that computer experience was negatively correlated with computer anxiety. That is, fear and apprehension of the computer itself were thought to be responsible for the limited use of computers in the early years of implementation (Anderson, 1996; Lian Chua, Chen, & Wong, 1999; Rosen & Weil, 1995). Recommendations aimed at improving integration included increased exposure and general computer courses with the goal of increasing the computer knowledge and skill of teachers.

As computers became more common place in education, the emphasis on computer anxiety and computer phobia as key barriers was reduced. However, experience with computer technology continues to be a focus in teacher development. Beyond the knowledge and skill required to integrate technology, previous research indicates that teachers also need sufficient resources in terms of computer equipment, curriculum-compatible software, technical support and human resources (Wood, Willoughby, Specht, Stern-Cavalcante, & Child, 2002; Wood et al., 2005).

If familiarity and experience with computers were the sole mitigating factors accounting for the limited use of computers in schools, we should expect to see high levels of use now that computers are no longer "new". This is not the case. The prevalence of technology has not eliminated the underutilization of computers in the classroom (e.g., Wood, et al., 2005) and robust integration of computers in the curriculum has not been achieved. Abrami (2001) suggests that teachers may not be utilizing computers to their potential as a cognitive tool due to lack of experience in the "craft" of computer integration. Hadley and Sheingold (1993) suggest that technology can be successfully integrated when teachers are given support and time to learn and plan for its integration but suggest that it takes 5 or 6 years for a teacher to gain mastery.

Integrating technology appears much more complex than simply providing equipment. For example, given the high prevalence of technology in most Western schools today, access issues that were highlighted in the early 1990s may no longer be relevant. Indeed, short-term longitudinal studies have found significant changes in computer use and technical issues over periods as brief as two years (Conlon & Simpson, 2003).

Stages of Integration

Introducing an innovation or change in practice to experienced teachers is a complex and challenging process (Hargreaves & Fullan, 1992). Several researchers have suggested that integration of any new technology or innovation proceeds in stages or phases (e.g., Hord, Rutherford, Huling-Austin, & Hall, 1987; Sandholtz, et al., 1997; Steinberg, 1991; Valdez et al., 2005). The models outlining stages of computer implementation by teachers depict a similar learning acquisition and adoption trajectory. The evolution starts with mapping computers onto existing repertoires of instruction and ends with changing instruction to map onto the learning opportunities afforded by computer technology.

Sandholtz et al. (1997) identified a five-stage process for technology integration that followed from their intervention study (i.e., The Apple Classroom of Tomorrow), which provided educators in four elementary schools and one secondary school with support and training as well as up-to-date technology in classrooms across the United States. They suggest that educators went through an initial e*ntry* stage. At this stage anxiety was an issue; required time and effort was a barrier; and, computer activities looked similar to traditional tasks. The high demands at this stage are often so great that some educators drop out or stop utilizing the technology. The second stage was a*doption.* Assimilation had begun but there were still few changes in practice. For instance, in writing class, students typed a story from a written draft, or standard worksheets were done using a word processor. The third stage, a*daptation,* occurred when computer technology was thoroughly integrated. Educators saw the benefits of integration and students began to create using the computer. For example, students gathered data in a spreadsheet, created a bar graph, compared charts with other groups and made conclusions. In writing, students used software to plan writing, create an outline and draft a paper on computer. At the next stage, a*ppropriation,* educators integrated computer technology into their own planning and instruction. They used the computer for research in preparation of classes, for e-mail communication, collaboration with other classes, and computerized assessment and evaluation. A laptop or desktop was used by the educator in the classroom as an everyday tool. The final stage was *invention*. Educators who reached this level of integration were leaders in writing curriculum that included technology. They tended to be expert educators within the school, often serving as a catalyst for integration by other educators.

Computer technology may present a uniquely challenging medium to integrate because the technology changes at a rapid pace. This requires that educators constantly update their technological knowledge. In addition, these technological advances can affect the potential learning environment, as was seen when the Internet became available within schools. Continual advancement in computer technology may inhibit the smooth acquisition and adoption of the technology. The continual changes may result in teachers being "perpetual novices" in the process of technology integration. Teacher experience may have to be a recursive spiral (Huberman, 1992) rather than a linear development.

More recently, Valdez and colleagues (2005) organized the development of computer-based technology integration into three phases. The phases move through steps of integration similar to the stages described by Sandholtz et al. (1997), but are focused more specifically on the tasks of the students or the relationship of the technology to instructional design. The process is still linear in that instructional design moves from merely automated traditional tasks, through expansion, to data-driven virtual activities but one unique feature is that the rate at which these stages or phases of integration progress could differ across individual educators, schools, and technologies.

These individual differences in the integration process were apparent in a project involving a school-university partnership aimed at the implementation of teaching innovations in elementary schools (Fisler & Firestone, 2006). Despite the same opportunities for professional development, teachers demonstrated variation in learning and were categorized into three groups: *restructurers*, who made extensive changes in their classrooms and were often involved in school leadership and reflective practice; *reviewers,* who made more incremental changes, recognizing the value of the innovation but had a more focused motivation (i.e., making changes to meet a specific need); and, *resisters,* those who actively resisted the changes and stated lack of time and curriculum overload as reasons for not being involved. These individual differences may be responsible for varying rates of computer technology integration by teachers as well. Individual differences in experience, training, beliefs and motivation may all impact a teacher's decision and ability to integrate computer technology.

Pedagogical Beliefs

The impact of the pedagogical beliefs of teachers on classroom practice has been well-documented (Brophy & Good, 1986; Buchmann, 1987; Lumpe, Haney, & Czerniak, 2000; Nespor, 1987; van Driel, Beijaard & Verloop, 2001) but the direct influence on technology integration is not as clear (Wozney, Venkatesh, & Abrami, 2006). In general, teachers are likely to use their past experiences, beliefs, and attitudes about learning and teaching to develop their beliefs about technology as a teaching method or instructional tool, depending on how they classify computers (Ertmer, 2005; McGrail, 2005; Niederhauser & Stoddart, 2001; Windschitl & Sahl, 2002). Their attitudes and beliefs about learning and teaching will influence how they think about technology. To use computers as a cognitive tool in knowledge construction, educators must acknowledge the computer as a learning tool and be able to incorporate it into the classroom. Educators ultimately determine whether and how computers will be used (Mercer & Fischer, 1992; Sanders & Horn, 1994).

The development of computer technology and the identification of new possibilities for learning throughout the integration process, point to differences between traditional instruction and computer-assisted instruction. The potential of computer technology and the vast database of immediately available information via the Internet provide increasing support for use of computers as a cognitive tool. Educational reform has changed the view of the learner from a passive receptor of information in a world where knowledge is considered to exist outside the learner, to a learner who is an active participant in the construction of knowledge (Abrami, 2001; Hokanson & Hooper, 2000; Scott, Cole, & Engel, 1992; Staub & Stern, 2002; Vygotsky, 1978).

Web-based instruction allows learners to construct meaning, engage in social interaction, and problem-solve in a real-world context (Abbey, 2003). Technology can be used to build knowledge through simulations, database searches, manipulation and display of content, analysis, problem-solving, exhibits, collaboration, collection and manipulation of data, design, programming, interactive hypertext, and communication. All of these activities help to support the learner in the active construction of knowledge while collaborating with others and presenting work to an audience (Judson, 2006; Sahin, 2003; Schofield, 1995). It follows that a teacher whose pedagogical beliefs match a constructivist philosophy may be more likely, and able, to integrate computer technology in the classroom. However, teachers generally teach as they were taught (Lortie, 1975) and it is often difficult to change their beliefs (Richardson, 1996). Computer technology has the potential to deliver instruction using a constructivist philosophy but may also lead to changes in the teacher's role that reflect that philosophy (Schofield, 1995).

Pedagogy cannot be considered in isolation, however. Mishra and Koehler (2006) present a model (see Figure 1) that builds on Shulman's (1987) description of teachers' pedagogical content knowledge to include technological knowledge and the interaction of all three areas to create a Technological Pedagogical Content Knowledge (TPCK) that may be necessary for complete integration of computers. Teachers must know "what" they are teaching, "how" to teach it, and how technology supports this.

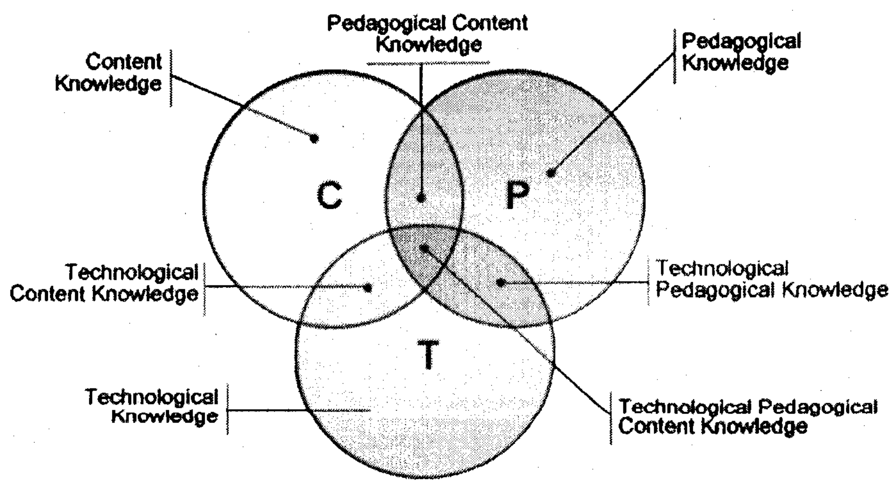

Figure 1. Technological Pedagogical Content Knowledge (TCPK); Mishra & Koehler, 2008

Teacher Efficacy

Even if a teacher's pedagogical beliefs, knowledge, and attitudes toward technology suggest that computer integration would be a meaningful teaching approach, the teacher must believe that he or she is capable of implementing technology successfully in order to act on those beliefs. Bandura (1986) defines self-efficacy as "people's judgements of their capabilities to organize and execute the courses of actions required to attain designated types of performances" (p. 391). A teacher's judgment about his or her ability to perform actions which lead to student learning is based on past experience. It follows that a teacher's positive personal or vicarious experiences with computer technology will lead to greater integration. However, Ross (1994) concluded that teacher self-efficacy is a specific construct that varies within educators across contexts. A teacher with high teaching efficacy may not hold such a positive view of their ability to effect change using computer technology.

Changes in individual practices and the motivation to move through the stages of any innovation are related to the amount of effort a teacher is willing to expend in the face of obstacles (Chester & Beaudin, 1996; Fisler & Firestone, 2006; Hoy & Woolfolk, 1993). The *restructurers,* those who were successful in Fisler and Firestone's (2006) innovation implementation, showed improved positive efficacy and less focus on external conditions. The *resisters* continued to attribute low achievement to external factors, unrelated to their teaching effectiveness.

Motivation

Beyond teaching philosophy and a sense of efficacy, teachers who are willing to make changes and proceed through the stages of adoption, demonstrate an openness to change and a willingness to accept the challenge (Marcinkiewicz,1993; Vanatta & Fordham, 2004). Teachers who are more satisfied with their job of teaching have demonstrated increased instructional support for their students (Opdenakker & Van Damme, 2006). A teacher's motivation to integrate computer technology may be a necessary support in overcoming the existing barriers and obstacles to successful integration.

Type of motivation has been shown to influence learning outcomes and task choice. When individuals are intrinsically motivated, they are more creative (Amabile, 1993) and show better concept attainment (Deci & Ryan, 1987) than when their motivation is more extrinsic. Students who are more highly intrinsically motivated are more curious, more persistent, show preference for novel and difficult tasks, and earn higher grades (Gottfried, 1985). Motivational orientation, degree to which individuals are characteristically intrinsically or extrinsically motivated, is generally established by early adulthood and is relatively stable over time (Ambile, Hill, Hennessey & Tighe, 1994). It follows that a teacher's motivational orientation may affect their willingness to accept the challenge computer integration may present and to be creative in solutions to technical difficulties.

Identifying the most significant influences

Technology integration must be examined in context from the teacher's perspective in order to identify those variables that are currently most influential for teachers in the classroom. A framework of important individual characteristics and environmental influences was established following a brief survey and focus groups with teachers (Wood et al., 2005; See Figure 2).

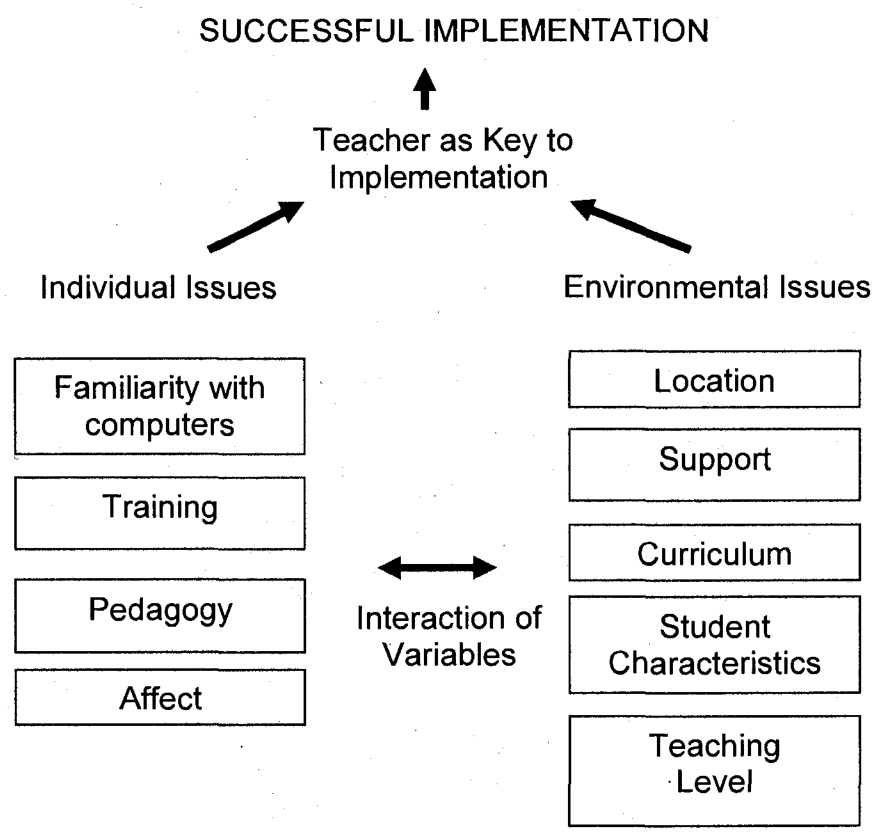

Figure 2. Framework for examining the implementation of computer technology

Thematic coding of teachers' responses to discussion surrounding computer technology provided an overview of variables to consider when examining current, successful computer integration. Wood and colleagues suggest that an individual's response to the rapid changes in computer technology, along with his or her beliefs and attitudes toward computer technology, will impact the decision of whether or not to integrate technology. Indeed, teacher's affect was a prominent component of the focus group discussion and a major theme identified in the coding of the responses.

Earlier research examined environmental variables relevant to technology (e.g., computer use, training, teacher characteristics) that might affect a teacher's decision and ability to integrate computer technology. Following an extensive survey, Becker (1994) identified "exemplary teachers" and the characteristics that made them unique. At that time, demographic variables were identified as significant predictors. Exemplary teachers spent twice as many hours on school computers, had more formal training, more teaching experience, more post-graduate education, and were more likely to have domain specific majors rather than a degree in education. More recently, research has begun to include some measures of teachers' beliefs and attitudes (Judson, 2006; Sahin, 2003; Vannatta & Fordham, 2004; Wozney et al., 2006; Zhao, Pugh, Sheldon, & Byers, 2002), to try to determine how much influence these variables have on integration, and found these variables to be significant predictors of integration.

Specifically, Wozney et al. (2006) attempted to explain the interaction of several variables influencing computer integration using cost-expectancy theory. This theory proposes that teachers consider value (beliefs about the good technology does) and expectancy (efficacy beliefs, access, and support available), and then weigh that against cost (including time, energy, anxiety, teacher numbers) in their decision to implement computer technology in their classrooms. The results of this survey of 764 elementary and secondary teachers in Quebec indicated that the important predictors of implementation are expectancy of success and perceived value—— that is, teachers' attitudes toward technology and the likelihood that they can accomplish their goal. The diminished emphasis on costs lends support for the idea that barriers to computer integration are lessening and that a focus on a teacher's attitudes and perceptions is required.

Vannatta and Fordham (2004) surveyed 177 Kindergarten to Grade 12 teachers to identify factors that influence computer integration. Survey questions examined teaching philosophy, teacher self-efficacy, openness to change, professional development, technology training, use of computers by teachers and students, gender, and teaching experience. The variables that were significant predictors of computer integration included: number of hours teachers put in beyond their contractual work; the number of hours of technology training, and openness to change. However, these variables accounted for only 18% of the variance. Vannatta and Fordham called for additional study of the complexity of the "development of a skilled, reflective technology-using teacher" (p. 262) that includes random sampling of a large, heterogeneous sample and a variety of teacher attributes, both technology and non-technology specific.

Purpose of Current Research

Recent research clearly indicates that it is necessary to investigate the variables that are responsible for successful integration beyond simple experience and training of teachers in order to answer the question: "What is it that makes a teacher successful in the integration of computer technology?" What is needed at this point is an intensive examination of individual characteristics that assess attitudes and beliefs along with the traditional experience and training measures in order to determine the independent contributions these kinds of variables have on the integration of computer technology (Means, Roschelle, Penuel, Sabelli, & Haertel, 2003).

The current research project uses a random sample of both elementary and secondary teachers from a large urban/rural school district to measure the computer use, attitudes and beliefs of teachers who are and are not integrating computer technology in their classrooms. An extensive questionnaire examines teachers' attitudes related to computers, technology, and work in general, in an effort to identify the individual characteristics of teachers who successfully integrate computer technology.

The survey addresses variables expected to impact computer integration, based on the above literature review. Formal measures of computer attitudes, pedagogical beliefs, self-efficacy, and motivation, as well as measures created from responses to the focus groups in an earlier study by Wood et al. (2005), have been combined in a comprehensive written survey. A detailed description of the survey measures and the process of sample procurement are included in a general methods section. Following this general overview of the research project, three studies based on the survey are described in more detail.

The three studies are aimed at identifying expert computer teachers, examining the variables that make them different from teachers who do not integrate technology, and, hearing the voice of the educator in qualitative responses to pertinent questions. The initial study identifies the variables that successfully predict computer integration level using a selected sample of teachers who are integrating technology at a high level and teachers who are using technology in a very limited way. The second study assesses the accuracy of identification of teachers who integrate technology at an "expert" level by school board administration nominations. Nominated experts are compared to a randomly selected portion of the sample to determine the accuracy of those nominations. This study examines whether teachers who appear to be computer "experts" actually differ from their colleagues who may not be identified by administration. The third study reports a content analysis of qualitative responses to open-ended survey questions. This analysis triangulates the findings from the first two studies and expands on the characteristics identified in the quantitative analysis and administrative nominations.

General Method

Participants

Three hundred elementary and 300 secondary teachers were selected at random from the complete list of teachers employed by the Waterloo Region District School Board. An additional 50 teachers at each level were nominated by the school board's computer committee (Computers across the Curriculum, CATC) as "expert" teachers using computer technology. Expert teachers were "over-sampled" (Becker, 1994) to ensure that the sample would include a number of teachers who have successfully integrated computer technology within the classroom. Duplicate names were removed from the random list, resulting in an initial list of 292 random elementary teachers and 50 elementary "experts", and 290 random secondary teachers and 50 secondary "experts". Seventeen of the elementary names were found to be unavailable for participation (1 deceased, 6 on maternity leave, and 10 had changed schools and did not receive the surveys). Fifteen of the secondary names were also unavailable (5 on maternity leave and 10 had changed schools and did not receive the survey). In total then, there were 325 elementary and 325 secondary surveys available for return.

A total of 148 elementary surveys were returned (113 random and 35 expert), representing a return rate of 45.5%. The return rate for the secondary panel was 52.6% (143 random and 28 expert). This made the overall return rate for the mailed survey, 49 percent.

In an effort to provide an appropriate sample size of 200 for each level, another mailing was sent to a second random list of teachers and nominated experts. Once duplicate names from the first mailing were removed from the random list, 139 elementary names (115 random and 24 experts) and 88 secondary (70 random and 17 experts) remained for possible participation. Again, some teachers turned out to be unavailable for participation due to leave or retirement, elementary (1 retired and 2 on maternity leave) and secondary (2 retired and 1 on leave). The return rate of the remaining surveys was 27% for elementary (27 random and 10 expert) and 39% for secondary (23 random and 10 expert). It is suspected that the lower return rate on the second mailing was related to the time of mailing. The initial mailing was done at the beginning of the school year. The second mailing was sent at the end of the school year during an assessment period when teachers' workloads may have been heavier.

The final sample included 185 elementary teachers (140 random and 45 expert) and 204 secondary teachers (166 random and 38 expert). Teachers represented 94 elementary schools and 16 secondary schools from across the school district. The majority of elementary teachers were female (146 female and 39 male) while the secondary teachers were more evenly split (116 female and 88 male).

The mean age of the sample of teachers was 41.8 years (*SD* = 8.43) with average teaching experience of 14.8 years (*SD* = 8.75). The majority of teachers had a university degree (87.2% elementary, 78.3% secondary) and an additional 10% of elementary teachers and 15.3% of secondary teachers held Masters or Ph.D. degrees.

Participants were teaching at schools that ranged from a small population of less than 200 to a large population of over 1 500 (See Table 1 for percentages).

Table 1.

Percentage Frequency of School Population of Participating Teachers.

School Population	Elementary (%)	Secondary (%)
200 or less	4.4	1.5
201 to 500	58.5	2.9
501 to 800	32.2	---
801 to 1 000	2.7	5.9
1 001 to 1 500	---	52.9
More than 1 500	---	31.4

Teaching assignments varied across both elementary and secondary levels. In the elementary panel, the majority of participants (63.2%) were regular classroom teachers. A smaller number of the elementary teachers had assignments that included special education (11.4%), core French (4.9%), French immersion (4.3%), and English as a Second Language (ESL) (3.2%). A portion of these teachers (11.4%) had combined assignments. Twenty-one percent of elementary participants were teaching at least some kindergarten, 79 percent were teaching at least some primary (grades 1, 2, and 3), 72 percent were teaching at least some junior (grades 4, 5, and 6), and 57 percent were teaching at least some senior (grades 7 and 8) classes.

The secondary participants taught in a variety of curriculum areas. Teachers taught at least a portion of their time in the following areas: Arts (13.7%), Business Studies (6.9%), Canadian and World Studies (11.3%), Classical and International Languages (2.5%), English (15.7%), English as a Second Language (2%), French as a Second Language (3.4%), Guidance and Career Education (9.8%), Health and Physical Education (7.8%), Interdisciplinary Studies (3.4%), Mathematics, (17.2%), Science, (9.3%), Social Science and Humanities (12.6%), Special Education (9.3%), Technological Education (15.7%), and Teacher-Librarian (3.9%).

Measures and Procedure

Survey packages were mailed to the randomly selected teachers and the nominated experts at their respective schools via the school board's intercampus mail system. The survey package included: a cover page; an information letter (both the cover page and information letter were altered for the second mailing); a consent form with a return envelope; an incentive draw entry form for a teaching release day or a gift certificate at a local shopping mall with a separate return envelope; and, the survey with a third return envelope (See Appendices A through H for examples of each component).

The cover page briefly explained what was in the survey package. The information letter gave the participant more information about the research project and its theoretical basis, as well as contact information for the primary investigators. The consent form included an option to participate or decline participation, as well as a request for permission to use anonymous quotes in presentation of group results. The incentive draw form gave the participant an opportunity to enter his or her name in a draw for a teaching release day or a gift certificate at a local shopping mall. Completion of the survey was not a requirement for draw entry. Both the consent form and the incentive draw form had individual business reply envelopes addressed to the principal investigator.

Two versions of the survey were developed (one elementary and one secondary). The versions were identical in content except for questions relating to current teaching assignments. Each participant was asked to complete one survey. The surveys were comprised of 7 sections: demographic information (age, gender, education, teaching assignment, school population, and teaching experience), followed by sections investigating general comfort with computers, home computer use, computer use at school, views on computers, views on teaching, and views on work.

General Comfort with Computers

This section included two questions assessing comfort level with computers using a 5-point Likert-type scale, where 1 represented "very at ease" and "very enthusiastic" and 5 represented "very ill at ease" and "very unenthusiastic".

Home Computer Use

The home computer use section of the survey consisted of 3 questions. The first question asked participants to indicate, from a list of nine pieces of hardware (e.g., laptop computer), which technologies they had at home and how frequently they used them. Frequency was measured using a 5 point scale indicating: never, a few times a year, a few times a month, a few times a week, or every day.

The second question was an open-ended question that required participants to indicate how many minutes or hours per week he or she spent on a home computer for personal use, school-work related tasks, and any other computer work.

The final question in this section asked participants to indicate, on the same five point scale used in the first question, how frequently they used a home computer for specific tasks in seven different areas: communication, entertainment, office tools, multimedia, personal financing, work related tasks, and study.

Computer Use at School

The Computer Use at School section was composed of 11 major questions. In this section, participants were initially asked to indicate, by circling "yes" or "no", whether or not they had access to computers in five locations within the school: classroom, lab, library or resource centre, pod area (shared work space between classrooms), and "another location". The next two questions asked participants to indicate how often they, as a teacher, used the computers in each location; and, how often students used the computers in each location. Once again answers were given on the five point scale ranging from "never" to "every day." The same scale was used in the following question to measure frequency of computer use as a teacher presentation tool.

A five point scale was used to measure computer use with students in each curriculum area and for specific activities (including on-line research, tool-based software, subject-specific tutorial software, communication tools, specific assessment tasks, and other). The scale ranged from "never" to "a great deal."

Additional questions, in the second half of the Computer Use at School section, asked teachers to estimate the proportion of students who had a computer at home (90% or greater, 75%, 50%, 25% or less than 5%) and to indicate how skilled they thought their students were relative to their own computer skills on a 5 point scale where 1 represented "much more skilled", 3 represented "equal", and 5 represented "much less skilled".

Training was also explored in this section using a yes or no inquiry as to whether or not participants had taken part in professional development workshops in the past 3 years and if so, how many of those were related to computer use. Participants were then asked to indicate from a list, which of the following forms of professional development about computer technology and/or technology curriculum integration, they had engaged in during the past 3 years: conferences, online training, talking with colleagues, videos, journals/books, courses, self-directed/hands-on learning, and other. An open-ended question then asked participants to identify which of these forms of professional development was the most valuable source for them.

The next question was directed at a more specific area of instruction. Participants were asked a direct "yes/no" question regarding their use of computers to teach literacy with an open-ended follow up as to "how" they teach it. The impact that computers have had on literacy instruction and the increasing requirements of language and literacy to function in the information age, were the basis for asking this question.

The final question in the Computer Use at School section was a nine-item experience questionnaire created from responses from focus group discussions in Wood et al. (2005). A five point scale ranging from “never” to “a great deal” was used to measure frequency of experiences with computers, such as, “A student shows you how to use the computer, a software package, or to find an Internet site” or “You develop class assignments or activities that use computers”.

Views on Computers.

This section was a compilation of forced-choice and open-ended questions, formal measures and instruments developed specifically for this study.

A 27 item forced-choice questionnaire asked teachers to indicate their level of agreement with statements surrounding integration of computer technology (e.g., “I see computers as tools that can complement my teaching” and “I find computer equipment unreliable”). A five point scale ranged from “strongly disagree” through “neutral” to “strongly agree”.

The Survey of Technology Use (SOTU) (Scherer, 1998) was used as a measure of attitudes toward computers. Nine items are presented in a three-point semantic differential format (e.g., positive, negative, neutral) to elicit the participant’s “feelings” toward computer technology. For example, participants are asked to indicate their level of agreement with statements such as, “They are satisfying” vs “They are frustrating”.

Four "yes, no, or sometimes" questions were included in this section with space for elaboration. The first three questions concerned support for computer integration: "Do you support the concept of integrating computer technology for students in your division", "Does your school administration support the concept of integrating computer technology for yourself as an educator," and, "Does your school administration support the concept of integrating computer technology for students?" The fourth question asked, "Does the integration of computer technology fit within your personal instructional style?" Two "yes or no" questions that did not include space for elaboration asked "Do you see computers as an integrated part of the curriculum", and "Do you see computers as a stand-alone activity?"

Two questions asked teachers to rate the extent to which they integrate computer technology in the classroom and how often they assume that computer use by students will be part of their instructional plan, on a scale from "a great deal", through "quite a bit", "a moderate amount", "sometimes", to "never".

The final question in this section of the survey asked teachers, "In comparison to the average teacher, how would you rate your ability to integrate computer technology" using a bipolar scale, "much more skilled" to "much less skilled" where 3 represented "equal".

Views on Teaching.

The section on teaching views was made up of 4 separate questions. The first question was open-ended and asked teachers to define the characteristics of excellent teachers. The second question asked for a "yes" or "no" response in reference to the previous question: "Considering your response to the previous question about excellent teachers, are there any features that you would see as different in excellent teachers who happen to integrate technology effectively, from excellent teachers who do not integrate technology?". If teachers answered "yes", they were asked to "please identify those characteristics".

The third question in this section was a shortened version of the Teacher Efficacy Scale (Hoy & Woolfolk, 1993). The purpose of this scale is to measure a teacher's feeling of efficacy, the extent to which he/she believes that his/her behaviour can impact his/her students. Teachers were asked to indicate the degree to which they agree or disagree with 9 statements, on a six-point scale anchored with "strongly disagree" and "strongly agree". Statements referred to teaching specific situations, such as, "When a student is having difficulty with an assignment, I am usually able to adjust it to his/her level."

The final measure in this section was the Teacher Beliefs Survey (Woolley, Benjamin, & Woolley, 2004). Teachers were asked to indicate their level of agreement with 27 statements, using a six-point scale anchored by "disagree strongly" and "agree strongly". Ten of the items measured a traditional, more "behaviourist" approach to teaching and 17 items measured a "constructivist" approach to instruction and interaction with parents. An example of an item from the "behaviourist" scale is "It is important that I establish classroom control before I become too friendly with students." An example of a "constructivist" item is "I guide students in finding their own answers to academic problems." Items from both scales were interspersed in a single list and were not identified as belonging to either factor.

Views on Work.

The final measure included in the survey was the Work Preference Inventory (WPI) (Amabile, Hill, Hennessey, & Tighe, 1994). The WPI has been shown to measure stable motivational orientations in individuals. The primary factors are divided into Intrinsic and Extrinsic Motivation scales. Secondary factors include 4 subscales: two within the Intrinsic factor (Challenge and Enjoyment), and two within the Extrinsic factor (Outward and Compensation).

Participants were asked to rate 30 items in terms of how true it was of them, on a four-point scale, where 1 represented "never or almost never true of me", 2 represented "sometimes true of me", 3 represented "often true of me" and 4 represented "always or almost always true of me." An example from the Challenge subscale is "I enjoy tackling problems that are completely new to me." "What matters most to me is enjoying what I do" is an example from the Enjoyment subscale. "I believe there is no point in doing a good job if nobody else knows about it" is an example from the Outward subscale. The Compensation subscale included items such as, "I am keenly aware of the income goals I have for myself."

Data Screening and Variable Composition

The data was screened initially for missing data. The amount of missing data was very limited and was therefore replaced with the overall mean for each variable with missing values (Meyers, Gamst, & Guarino, 2003).

Secondly, the data was checked for "skewness" and "kurtosis". Values greater than two for skewness and greater than seven for kurtosis were considered a problem. Two variables contained outliers as a result of data entry errors and were corrected. Three variables ("Does your school administration support the concept of integrating computer technology for: yourself?", "Does your school administration support the concept of integrating computer technology for your students?" and "Do you see computers as an integrated part of the curriculum?") that were extremely skewed showed little variability (large majority answered "yes") and were removed from future analysis.

Next, maximum likelihood analysis was used to conduct exploratory factor analysis with Varimax rotation on measures that had been developed from focus groups and the short survey in Wood et al. (2005). These measures included the 27-item Focus Group Theme Questionnaire (FGTQ) from the Views on Computers section and the 9-item Computer Experience Questionnaire (CEQ) from the Computer Use at School section.

The alpha for the Focus Group Theme Questionnaire was .62. Initial factor analysis, using Eigenvalues > 1, resulted in a six factor solution. Items did not load well on specific factors, that is, most items had scores in the Factor Matrix that were equally large on more than one factor. The scree plot indicated a flattening at 4 factors and the first 4 factors had eigenvalues above 1.46. Based on these results, a four factor analysis was conducted. The subsequent four factor solution resulted in more discrete, heavier-loading factors related to the focus group themes (Wood et al., 2005). The four factors were labelled:

instructional tool (items 1, 3, 4, 6, 7, 10, and 23); *positive experiences* (items 22, 24, 25, 26, and 27); *technical issues* (items 13, 14, 15, 16), and *motivational tool* (items 5, 8, and 9).

The alpha for the second measure, the Computer Experience Questionnaire, was .67. Exploratory factor analysis resulted in a three-factor solution. The factors were labeled: *technical problems* (items 2 and 3); *assistance from others* (items 1, 5, and 9); and, *positive outcomes* (items 4, 6, 7, and 8). Factor 1 (*technical problems)* was significantly correlated with factor 2 (*assistance from others)*, $r = .226$, $p < .001$.

Following the factor analyses of the composed measures, composite variables of important latent constructs were created from individual questions included in the survey. Composite variables were constructed for *comfort*, *integration*, and *use*. The comfort construct was an aggregate of the two single-item measures that used a 5 point scale ranging from "very at ease" and "very enthusiastic" to "very ill at ease" and "very unenthusiastic". The two variables were significantly correlated, $r = .73$, $p < .001$.

The *integration* composite variable was composed of eight items with an alpha of .82. It included frequency scores for student use of computers for on-line research, tool-based software, subject-specific tutorial software, and as a communication tool; frequency of computer use as a teacher presentation tool; self-reported extent of computer integration in the classroom; and, frequency of inclusion of computers in the planning process.

The composite variable of *use* had an alpha of .83 for 19 items. It referred to teacher's use of computers at home for a variety of activities and at school in 3 locations (classroom, lab and resource centre).

The 9 individual items of the Teacher Efficacy Scale (Hoy & Woolfolk, 1993) were combined to create a total efficacy score. The alpha for the scale was .77. The Teacher Belief Survey (TBS; Woolley et al., 2004) was split into three subscales: *constructivist teaching* (alpha = .80 for 14 items); *behaviorist teaching* (alpha = .63 for 10 items); and, *constructivist parenting* (alpha = .52 for 3 items). The *constructivist parent* subscale was dropped from future analysis due to its lower reliability and its low relevance to the secondary teachers. The items on that subscale concerned style of communication with parents and were directed more specifically at elementary teachers.

Items on the Work Preference Inventory (WPI; Amabile et al., 1994) were divided into subscales, and three subscales were analyzed: *internal challenge, internal enjoyment, and external outward.* Alphas for each subscale were .80, .63, .66 respectively.

Bivariate correlations were conducted between variables and correlations higher than .6 were considered for redundancy. As a result of high correlations between variables, the following variables were not included in future analysis: age (highly correlated with years of experience), SOTU and the Positive Experiences factor of the FGTQ (highly correlated with each other and the comfort composite—comfort has been used in past research as indicator of comfort with technology; Wood et al., 2005), and the Technical Issues factor of the FGTQ (highly correlated with the Technical Problems factor of the CEQ). See Table 2 for correlations.

The composite variables and remaining constructs are used in the analysis of the following three studies. Relevant measures are described again briefly in each study.

Table 2

Correlation Matrix for Computer Related and Individual Characteristic Variables

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.
1. Level	---																					
2. Age	.05	---																				
3. Gender	-.24*	-.04	---																			
4. Yrs Exp	.02	.79*	-.02	---																		
5. WPI chal	.11	-.07	-.17*	-.07	---																	
6. WPI enjoy	.11	-.06	.05	-.04	.47*	---																
7. WPI outw	.03	-.08	-.10	-.03	-.20*	-.02	---															
8. TBS const	-.26*	-.05	.22*	-.04	.31*	.31*	-.04	---														
9. TBS behav	.14	-.04	-.06	-.04	-.20*	-.12	.20*	-.16*	---													
10. TES	-.17*	.09	.14	.13	.12	.13	.01	.32*	-.04	---												
11. FGTQ inst	.10	.03	-.10	.04	.19*	.14	.00	.24*	-.01	.13	---											
12. FGTQ pos	.04	-.17*	-.21*	-.10	.47*	.27*	-.07	.11	-.11	.09	.41*	---										
13. FGTQ tch	.11	-.04	.04	-.10	-.02	-.00	.07	-.02	.03	-.04	-.13	-.23*	---									
14. FGTQ mv	-.28*	-.03	.20*	-.05	-.07	-.03	.07	.26*	.10	.18*	.39*	.10	-.09	---								
15. CEQ tech	.03	-.11	.06	-.15	.09	.12	-.04	.07	-.10	.01	.00	-.06	.62*	.02	---							
16. CEQ assist	.17*	.10	.13	.09	.02	.11	.02	.21*	-.05	.08	.10	-.14	.19*	.03	.23*	---						
17. CEQ pos	.19*	.00	-.17*	.06	.33*	.15	-.06	.07	-.11	-.01	.51*	.52*	-.10	.08	.10	.09	---					
18. Comfort	.12	-.12	-.18*	-.09	.36*	.20*	-.05	.06	-.07	.02	.42*	.67*	-.17*	.07	.04	-.15*	.60*	---				
19. Present	.08	.01	-.26*	.03	.25*	.04	-.06	.03	-.06	-.05	.41*	.46*	-.15	.01	-.04	-.02	.57*	.47*	---			
20. Self-report	.19*	.02	-.13	.08	.28*	.14	.01	.09	-.12	.03	.53*	.50*	-.11	.10	.04	.10	.68*	.57*	.59*	---		
21. Planning	.18*	-.02	-.14	.06	.30*	.12	-.05	.13	-.11	.02	.53*	.46*	-.17*	.07	-.03	.10	.64*	.51*	.58*	.76*	---	
22. Total Integ	.18*	-.01	-.20*	.05	.33*	.14	-.02	.12	-.10	-.00	.58*	.55*	-.16*	.09	.01	.09	.73*	.61*	.81*	.89*	.89*	---
23. Use	.20*	-.08	-.22*	-.06	.45*	.23*	-.08	.16*	-.08	.01	.37*	.60*	-.05	.03	.07	-.06	.51*	.57*	.48*	.48*	.47*	.56*
24. Training	-.08	.05	-.06	.10	.18*	.13	.03	.09	-.07	-.03	.25*	.22*	-.03	-.01	.01	.05	.33*	.25*	.30*	.33*	.26*	.34*

Note. 1. Level = teaching level, 1 elementary, 2 secondary; 2. Age = age of participant; 3. Gender = gender of participant, male 0, female 1; 4. Yrs Exp = number of years of teaching experience; 5. WPI chal = challenge subscale of WPI; 6. WPI enjoy = enjoyment subscale of WPI; 7. WPI outw = outward subscale of WPI; 8. TBS const = constructivist subscale of TBS; 9. TBS behave = behaviorist subscale of TBS; 10. TES = Teacher Efficacy Scale score; 11. FGTQ inst = instructional tool subscale of Focus Group Theme Questionnaire; 12. FGTQ pos = positive outcomes subscale of FGTQ; 13. FGTQ tch = technical issues subscale of FGTQ; 14. FGTQ mv = motivational tool subscale of FGTQ; 15. CEQ tech = technical issues subscale of Computer Experience Questionnaire; 16. CEQ assist = assistance from others subscale of CEQ; 17. CEQ pos = positive outcomes subscale of CEQ; 18. Comfort = aggregate score of ease and enthusiasm for computers questions; 19. Present = self-report frequency of use of computer as a teacher presentation tool; 20. Self-report = self-report of level of integration of computers in classroom; 21. Planning = self-report degree of inclusion of computers in planning of units and lessons; 22. Total Integ = aggregate integration score of presentation, self-report, planning, and student use scores; 23. Use = aggregate score of teacher use of computers at home and school; 24. Training = number of workshops attended in past 3 years on computer technology.

* $p < .002$ (corrected for multiple comparisons)

Study One

The rapid advances in computer technology, compounded with institutional changes within schools regarding the presence of technology, make it challenging to evaluate the relative impact of each of these environmental barriers over time. Recent research (Wood et al., 2005) suggests that barriers identified early on may no longer be perceived as the insurmountable barriers they once were. For example, the majority of teachers now have access to and use computers on a regular basis making technical difficulties and lack of access less problematic. Although environmental barriers can present substantial obstacles to the seamless integration of technology within the classroom (Wood et al, 2005), it is the individual differences in beliefs, attitudes, and skills among teachers that is the key area of interest for current research in this field (e.g., van Braak, 2001; Mueller, Wood, & Willoughby, 2007; Paraskeva, Bouta, & Papagianni, 2008; Wozney et al., 2006).

For example, it is educators that have the primary contact with students and it is educators that experience the barriers and supports to integration of technology first-hand. An educator's knowledge, skill and philosophy determine his or her instructional methods (Staub & Stern, 2002) and have significant effects on the students that they teach (Abbott-Shim, Lambert, & McCarty, 2000; Ross, 1994). Teachers account for the greatest amount of variance in student outcomes beyond student ability (Hattie, 2003). Teachers' beliefs about their own computer efficacy, and the values and costs of technology, have been shown to predict computer integration in the classroom (Wozney et al., 2006).

Teacher's perceptions of technology may influence their progress through the stages of implementation of technology. For example, McGrail's (2005) study of middle and high school English teachers' attitudes toward technology, describes the teachers' perceptions of technological change in their instructional practice. Teachers pointed out disadvantages of computer use; pedagogical concerns about students; concerns about instruction and language; administrative challenges; and ethical concerns. It was not obvious to these teachers how computer technology fit into their instructional style or how it could be integrated into current curriculum. A teacher's pedagogical beliefs and how technology fits, or does not fit with those beliefs, may be a determining factor in computer integration. To use computers as a cognitive tool in knowledge construction, educators must acknowledge the computer as a learning tool and be able to incorporate it into the classroom (Hokanson & Hooper, 2000).

The purpose of Study One was to identify the variables that discriminate between teachers who integrate technology and those who do not, at both the elementary and secondary school levels. "High" and "low" integrators were drawn from the combined sample of the expert and randomly selected elementary and secondary teachers, to measure their computer use, attitudes, and beliefs. Teachers completed the extensive questionnaire and were slotted into groups based on an aggregated computer integration score. Study One examined the variables impacting successful integration beyond identification of barriers and reasons for under-use (Conlon & Simpson, 2003), and includes both computer-related and general constructs. These discriminating variables potentially would be useful to administrators and educators in setting priorities, creating policy, and developing professional training programs, as well as providing a scientific basis for classroom practice.

Method

Participants

"Low" and "high" integrator groups were created using the mean overall integration scores. Groups were based on the lowest 25% of scores and the highest 25% of scores within the sample for each teaching level in an effort to capture differences between those who are truly integrating technology and those who are not. Even the "high" integrators had a minimum score of only 1.85 on a scale ranging from 0 to 4. "Low integrators" scored between 0 and .80 on the integration score for elementary teachers (n = 54) and between 0 and .95 for secondary teachers (n = 51). "High integrators" scored between 1.85 and 4.00 for elementary (n = 52) and between 2.15 and 4.00 for secondary teachers (n = 53). Elementary and secondary teachers were treated as unique groups, based on differences in terms of teaching assignment and significant differences in past research (Wood et al., 2005). See Table 3 for means for the groups on each of the integration questions.

Table 3

Means and Standard Deviations for Overall and Specific Integration Measures for Low and High Integration Groups by Teaching Level

		Elementary				Secondary			
		Low Integration		High Integration		Low Integration		High Integration	
Measure	Max.	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Overall Integration	4	.50	.26	2.39	.46	.65	.25	2.89	.50
Self-report	4	.74	.48	2.87	.79	.98	.37	3.59	.57
Planning	4	.52	.50	2.87	.74	.78	.49	3.36	.79
Presentation	4	.19	.40	2.12	.96	.24	.43	2.61	1.15
On-line research	4	.74	.77	2.34	1.14	1.22	.97	2.93	1.05
Tool-based software	4	.85	.92	2.83	.92	.96	1.06	3.47	.82
Subject software	4	.87	.90	2.12	1.08	.47	.76	1.44	1.16
Communication tool	4	.02	.06	.14	.44	.07	.24	.59	1.14
Assessment tasks	4	.21	.62	1.07	1.17	.27	.56	1.70	1.25

The sample of participants included in analysis for Study One included 105 elementary teachers, 54 “low integrators” (6 male, 48 female) and 52 “high integrators” (18 male, 34 female); and 104 secondary teachers, 51 “low integrators” (19 male, 32 female) and 53 “high integrators” (27 male, 36 female). These four groups formed the sub-sample of teachers used in all further analysis in this study.

Measures

The constructs of interest in Study One included both computer-related constructs and general constructs from the survey variables. Computer-related constructs included computer integration, comfort with computers, type of computer use, computer training, attitudes towards computers, and experiences with computer technology. General constructs included demographic variables (gender and years of teaching experience), teacher-efficacy, teaching philosophy, and attitudes toward work. Brief descriptions of questions used to measure each construct and measures of reliability are included below.

Computer integration was a composite of eight items, *alpha* = .82. Three questions asked teachers to rate the extent to which they integrate computer technology in the classroom, how often they assume that computer use by students will be part of their instructional plan, and how often they use a computer as a presentation tool, using a 5-point, Likert-type scale (0-*never,* to 4-*a great deal*). Participants were also asked to report the frequency of student computer use in the classroom for five different activities (on-line research, tool-based software use, subject-specific software use, communication, and assessment purposes),using the same scale. This scale served as the primary mechanism for separating low from high integrating teachers.

Comfort with computers was a composite of two questions using a 5-point Likert-type scale (1-*very ill at ease/unenthusiastic, to 5-very at ease/enthusiastic)* measuring ease and enthusiasm with computers (Mueller & Wood, 2006; Wood et al., 2005). The two variables were significantly correlated, $r = .73$, $p < .001$

Type of computer use was an aggregate of 19 questions measuring teachers' use of computers at home and at school. *alpha*= .83. For example, home computer use was assessed by asking how frequently participants used a home computer for specific tasks in seven different areas: communication, entertainment, office tools, multimedia, personal financing, work-related tasks, and study. Participants reported the frequency of use for each task on a 5-point scale (0-*never*, to 4-*every day*).

Computer training was measured using a single item question that asked participants to report the number of computer-related workshops they had attended in the past three years.

Attitudes toward computers measured whether teachers saw computers as an *instructional tool* (7 items, e.g., "I see computers as tools that can complement my teaching"), *alpha* =.77, and as a *motivational tool* (3 items, e.g., "I use computers to motivate my students"), *alpha* = .66. All items used a 5-point Likert-type scale anchored by "strongly disagree" and "strongly agree".

Reported frequencies of specific experiences with computer technology were gathered using a nine-item Computer Experience Questionnaire (CEQ) that was also developed through statements made by teachers in the Wood and colleagues' (2005) focus group study. Teachers were asked to indicate how frequently they experienced 9 specific events (e.g., "A colleagues comes to you for help in using computers at school"), employing a 5-point Likert-type scale (0-*never*, to 4-*a great deal*). A factor analysis of the 9 items resulted in 3 specific types of experiences: *technical problems* (2 items, e.g., "Equipment failure when using computers in the classroom or lab"), r = .57; *assistance from others* (3 items, e.g., "You ask a colleague for help in using computers at school"), *alpha* = .70; and, *positive outcomes* (4 items, e.g., "Students finish their computer activities during class time"), *alpha* = .75. The three subscales were analyzed separately.

Single-item questions were used to assess demographic variables including participant gender and years of teaching experience.

Teacher efficacy was assessed using a shortened version of the Teacher Efficacy Scale (TES; Hoy & Woolfolk, 1993). Teachers were asked to report the degree to which they agreed or disagreed with nine statements that measured the extent to which they believed that their behaviour could impact their students (e.g., "When a student does better than usual, many times it is because I exerted a little extra effort), using a 6-point scale anchored with "strongly disagree" and "strongly agree". The alpha for the TES was .77.

Teaching philosophy was assessed using the "constructivist teaching" subscale of the Teacher Beliefs Survey (TBS; Woolley et al., 2004). Teachers indicated their level of agreement with 14 statements, *alpha* = .80, using a 6-point scale anchored by "disagree strongly" and "agree strongly" (e.g., "I involve students in evaluating their own work and setting their own goals.").

Attitudes toward work were assessed using three subscales of the Work Preference Inventory (WPI; Amabile et al., 1994). Two subscales assessed intrinsic orientation, *challenge* (5 items, e.g., "I enjoy tackling problems that are completely new to me") and *enjoyment* (10 items, e.g., I enjoy work that is so absorbing that I forget about everything else"); and one assessed extrinsic orientation, *outward* (10 items, e.g., "I am strongly motivated by the recognition I can earn from other people"). Participants rated the items on a 4-item scale ranging from 1 (*never or almost never true of me*) to 4 (*always or almost always true of me*). Alphas for the 3 subscales were .78, .70, and .66, respectively.

Results

Analyses focused on examining the differences between teachers who do and do not integrate technology. First, differences on the survey measures between the groups were examined using univariate analyses. Second, to assess which measures best discriminate between the two groups a multivariate discriminant function analysis was conducted. Separate analyses were conducted for the elementary and secondary samples for each of the above. Correlations among study measures are listed in Table 4.

Table 4

Correlation Matrix for Computer Related and Individual Characteristic Variables

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. Years of Teaching	---														
2. Integration	.05	---													
3. Comfort with computers	-.09	.61*	---												
4. Computer use	-.06	.57*	.57*	---											
5. Training	.10	.25*	.25*	.23*	---										
6. FGTQ Instructional Tool	.04	.58*	.42*	.37*	.25*	---									
7. FGTQ Motivational Tool	-.05	.09	.07	.03	-.01	.39*	---								
8. CEQ Tech. problems	-.15	.04	.04	.07	.01	.00	.02	---							
9. CEQ Assistance from others	.09	.09	-.15*	-.06	.05	.10	.03	.23*	---						
10. CEQ Positive outcomes	.06	.73*	.60*	.51*	.33*	.51*	.08	.10	.09	---					
11. Teacher Efficacy Scale	.13	-.01	.02	.01	-.03	.13	.18*	.01	.08	-.01	---				
12. TBS Constructivist	-.04	.12	.06	.16*	.09	.24*	.26*	.07	.21*	.07	.33*	---			
13. WPI Challenge	-.07	.33*	.36*	.45*	.18*	.19*	-.07	.09	.02	.33*	.12	.31*	---		
14. WPI Enjoyment	-.04	.14	.20*	.23*	.13	.14	-.03	.12	.11	.15	.13	.31*	.47*	---	
15. WPI Outward	-.03	-.02	-.05	-.08	.03	.00	.07	-.04	.02	-.06	.01	-.04	-.20*	-.02	---

Note: * $p < .002$ (corrected for multiple comparisons)

Univariate Analysis

Univariate group comparisons were conducted using one-way Analysis of Variance (ANOVA) on each construct of interest for both elementary and secondary samples. A significance level of $p < .004$ was used to correct for multiple comparisons. ANOVAs were conducted on 15 variables: gender, teaching experience, comfort, use, training, attitudes towards computer technology as an instructional tool, attitudes towards computer technology as a motivational tool, CEQ technical problems, CEQ assistance from others, CEQ positive outcomes, teacher efficacy, constructivist teaching, and work beliefs including challenge, enjoyment, and outward subscales. Means and standard deviations for the low and high integration groups at each level (elementary and secondary) are displayed in Tables 5 and 6.

Group differences in the elementary panel were significant for the computer related measures of comfort, use, training, attitudes towards computer technology as an instructional tool, and positive outcomes, smallest $F(1, 104) = 35.754$, $p < .001$ for the measure of training. Individual characteristic variables that showed significance differences included the work beliefs challenge subscale, $F(1, 104) = 37.303$, $p < .001$, and the teacher belief constructivist subscale, $F(1, 104) = 10.872$, $p = .001$. The partial eta squared results indicated that the magnitude of the significant group differences were all large (smallest partial eta squared of .10 for TBS Constructivist to largest of .62 for CEQ Positive Outcomes; See Table 5).

Table 5

Univariate and Multivariate Results for Elementary Level

	ANOVA					DFA	
	Low Integrators		High Integrators				
Variables	*M*	*SD*	*M*	*SD*	Partial η^2	*SC*	*SCDFC*
Gender	$.89_a$	.32	$.65_a$	.48	.08	.17	.06
Years teaching exp.	12.35_a	8.46	15.99_a	7.80	.05	.13	.06
Comfort	3.27_a	.86	4.68_b	.55	.49	.59	.39
Use	17.65_a	7.89	31.12_b	10.52	.35	.44	.06
Training	1.11_a	1.14	5.00_b	4.64	.26	.35	.26
Attitudes							
Instructional tool	3.51_a	.50	4.31_b	.43	.42	.51	.30
Motivational tool	3.48_a	.70	3.63_a	.73	.01	.06	.01
Experiences							
Technical problems	2.75_a	1.34	2.63_a	.82	.01	.04	.09
Assist. from others	1.93_a	.54	2.02_a	.87	.01	.04	.11
Positive outcomes	1.83_a	.54	3.51_b	.80	.62	.75	.53
Teaching beliefs							
TES Teacher efficacy	4.64_a	.63	4.70_a	.71	.01	.03	.10
TBS Constructivist	4.11_a	.60	4.49_b	.59	.10	.19	.10
Work Beliefs							
WPI Challenge	2.56_a	.54	3.13_b	.43	.26	.36	.21
WPI Enjoyment	2.92_a	.42	3.12_a	.39	.06	.14	.09
WPI Outward	1.95_a	.33	1.88_a	.36	.01	.06	.09

Notes. Means in the same row with different subscripts are significantly different at $p <$ .004 SC=structure coefficients. SCDFC=standardized canonical discriminant function coefficients.

For the ANOVA results, standardized results are shown.

The secondary results reported a similar list of significant variables with the exception of the training measure and the teacher belief constructivist subscale. The computer related measures of comfort, use, positive outcomes, and attitudes towards computer technology as an instructional tool, showed significant differences between low integrators and high integrators. The smallest F was for computer use, $F(1, 102) = 60.025$, $p < .001$. The only individual characteristic to demonstrate a significant difference between groups was the work belief challenge subscale, $F(1, 102) = 8.983$, $p = .003$. Parallel to the elementary groups, the magnitude of the differences for the secondary groups were large (smallest partial eta squared of .08 for WPI: Challenge Subscale to largest of .56 for CEQ Positive Outcomes; See Table 6).

Table 6

Univariate and Multivariate Results for Secondary Level

	ANOVA					DFA	
	Low Integrators		High Integrators				
Variables	*M*	*SD*	*M*	*SD*	Partial η^2	*SC*	*SCDFC*
Gender	$.63_a$	.49	$.49_a$	.51	.02	.10	.04
Years teaching exp.	15.53_a	7.49	14.09_a	8.13	.01	.06	.09
Comfort	3.38_a	.88	4.77_b	.42	.51	.70	.37
Use	21.58_a	10.11	36.49_b	9.51	.37	.53	.30
Training	1.45_a	1.79	2.79_a	3.43	.06	.17	.09
Attitudes							
Instructional tool	3.58_a	.55	4.33_b	.40	.39	.54	.30
Motivational tool	2.85_a	.88	3.27_a	.85	.06	.17	.03
Experiences							
Technical problems	2.66_a	1.21	2.91_a	1.07	.01	.08	.20
Assist. from others	2.20_a	.82	2.23_a	.80	.00	.02	.06
Positive outcomes	2.14_a	.64	3.73_b	.77	.56	.78	.54
Teaching beliefs							
TES Teacher efficacy	4.44_a	.63	4.53_a	.53	.01	.05	.03
TBS Constructivist	3.90_a	.63	4.14_a	.70	.03	.12	.04
Work Beliefs							
WPI Challenge	2.82_a	.59	3.12_b	.44	.08	.20	.07
WPI Enjoyment	3.05_a	.39	3.15_a	.41	.02	.09	.00
WPI Outward	1.93_a	.36	1.95_a	.48	.00	.02	.15

Notes. Means in the same row with different subscripts are significantly different at $p < .004$. SC=structure coefficients. SCDFC=standardized canonical discriminant function coefficients.

For the ANOVA results, standardized results are shown.

Mulitivariate Analysis

To examine which individual characteristics best discriminate between teachers who integrate computer technology and those who do not, at both the elementary and secondary school levels, all study variables were simultaneously entered into a discriminant function analysis (DFA). DFA can be thought of as a reverse MANOVA (Sprinthall, 2000). Rather than comparing scores on dependent variables for significant differences, scores on study variables are used to predict group membership. Unlike the univariate analysis, DFA provides an estimate of the relative importance of each of the study measures to the separation between the two teacher groups when examined simultaneously. Again, separate analyses were conducted for the elementary and the secondary groups.

Elementary. The overall Wilks' Lambda for the discriminant function analysis conducted for the elementary panel was significant, Λ = .260, $X^2(15)$ = 129.86 , p < .001, indicating that overall, the variables in the study differentiated between the low integrators and high integrators. The discriminant function explained 74% of the separation between groups and 95.3% of the 106 teachers in the sub-sample were correctly classified by the resulting function.

As shown in Table 5, the measures having the strongest correlations with the discriminant function (i.e., structure coefficients of .30 or greater) for the elementary groups included, in descending order of importance: positive experiences with computers; teacher's comfort with computers; specific beliefs related to the use of computers as an instructional tool; teacher's own use of computers at home and school; the challenge subscale of the WPI; and, training (the number of technology workshops attended).

The standardized canonical discriminant function coefficients represent partial contributions of each variable to the discriminant function, controlling for other measures entered into the analysis (Garson, n.d.). As shown in Table 5, variables making notable, unique contributions to the discriminant function (i.e., standardized discriminant function coefficients of .10 or greater) included the following seven variables in order from largest coefficient to smallest: positive experiences with computers; teacher's comfort with computers; specific beliefs related to the use of computers as an instructional tool; number of workshops attended; the challenge subscale of the WPI; assistance from others; and teaching efficacy.

Secondary. The same variables used in the elementary analysis were entered into a simultaneous discriminant function analysis for the secondary panel. The analysis resulted in a significant Wilks' Lambda $\Lambda = .319$, $X^2(15) = 108.025$, $p < .001$, and explained 68.1% of the separation between groups. Ninety percent of the 104 teachers in the secondary sub-sample were correctly classified by the resulting function.

Examination of the structure coefficients indicated that only four variables had coefficients greater than .30. These key variables were similar to the elementary analysis, except for the exclusion of the number of technology workshops and the WPI challenge subscale. The rest of the most important indicator variables were the same, with the same rank order: positive outcomes with computers; teacher's comfort with computers; specific beliefs related to the use of computers as an instructional tool, and, the teacher's own use of computers at home and school (See Table 6).

The standardized coefficients indicated that six variables made notable unique contributions to the discriminant function (See Table 6): positive experiences with computers; teacher's comfort with computers; specific beliefs related to the use of computers as an instructional tool; teacher's use of computer at home and at school; technical problems; and the work beliefs outward subscale.

Discussion

The primary goal of this research was to be able to discriminate variables that would predict who would be a high integrator of technology in contrast to teachers who would be less likely to successfully integrate technology. To make this comparison, the participants were divided into groups of "low" integrators, "average" integrators and "high" integrators. The discrimination was conducted using the two extremes of this scale, recognizing that we are not considering the great "middle" of the distribution. However, the distribution of teachers who are actively integrating computer technology is relatively skewed, that is, there were few teachers who are actively integrating technology and that is why "expert" teachers were purposefully "oversampled". The teachers included in the discriminant analysis do, in fact, represent a larger range in the "high" end as compared to the "low" group whose scores had less variability. To answer the question posed in this initial study regarding what predicts integration, the outcomes of the discriminant function analysis are most relevant.

The results clearly implicate both experience with computer technology and attitudes toward technology in the classroom as important variables that predict differences between teachers who successfully integrated computer technology from those who did not. Of the six variables that predicted integration among elementary school teachers, four were related to computer-related experience. Similarly, of the four variables that predicted integration among the secondary school teachers, three involved computer-related experience. These outcomes reflect opinions, expectations and findings presented in the literature (Becker, 1994; Foon Hew & Brush, 2007; Hadley & Sheingold, 1993; Rosen & MacGuire, 1990; Wood et al., 2005). Specifically, consistent with previous research, computer experience variables such as comfort with technology and higher frequency of use of computers were significant contributors to the function that separated successful elementary and secondary integrating teachers from their non-integrating peers. In addition, training with computers was important at the elementary level. The results, however, suggest that "general" exposure and use is less critical than very specific, task-relevant, and classroom-applicable experience. Specifically, the positive outcomes measure contributed the most to the discriminating function for both elementary and secondary teachers.

The positive outcomes variable measured how frequently teachers had experienced "positive" outcomes using computer technology in the classroom. These highly specific, positive experiences may add to teachers' confidence with using computers as an instructional tool above and beyond preparing them to use computers for personal use or for other general uses. The significance of the specific positive experiences with technology in the classroom for the elementary panel indicates that teachers may need to see that an innovation has the potential to improve learning or instruction before they are willing to endorse it (Evers, Brouwers, & Tomic, 2002; Fuchs, Fuchs, & Bishop, 1992). In fact, it may be the case that actual classroom success with computer technology is a prerequisite or catalyst for the integration of computers as an instructional tool (Kiridis, Drossas, & Tsakiridou, 2006).

Hands-on, direct practice with computer technology in a teacher's own classroom or teaching context may build the confidence that is necessary for a teacher to take the risk of including computers as an additional tool in their teaching repertoire. Success may come in the form of personal hands-on experience and it may also include vicarious modeling by other teachers having successful experiences in their classrooms. For example, having access to a "key" teacher on staff that is skilled in the instructional use of computer technology has been identified as an important support for encouraging less experienced teachers to adopt and integrate technology within the classroom (Wood et al., 2005). Although, computer-related variables in general, continue to impact on a teacher's ability to integrate technology, it is positive experiences with computers in the classroom context that builds a teacher's belief in computer technology and their confidence in its potential as an instructional tool.

It is interesting to note that there was no significant impact of number of years of teaching experience in our analyses. This outcome suggests that teachers at all stages of their career were equally able to integrate computer technology.

Attitudes towards computer technology also proved to be a critical contributor to distinguishing between successful and less successful integrators at both teaching levels. At both levels of teaching, attitudes towards computers as an instructional tool was the third variable identified through the discriminant function analysis. Overall, both elementary and secondary high integration groups had higher, more positive, scores on this scale. This scale measures the degree to which a teacher sees computer technology as a viable, productive, cognitive tool that is appropriate for use within their teaching context.

The predictive strength of attitudes toward computer technology as an instructional tool is consistent with recent research based on Value-Expectancy Theory (Wozney et al., 2006) and past research identifying the importance of perceived usefulness in microcomputer usage in the business world (Igbaria & Iivari, 1995). For example, Wozney et al. (2006) used regression analysis to identify important predictors of computer implementation. Their findings report that a teacher's attitude toward technology, specifically the value of the innovation, along with expected success, was one of the chief indicators of implementation. In the field of management, similar to the teachers in the current survey, business workers needed to see the computer as a useful tool before they would consider its implementation (Igbaria & Iivari, 1995). Perceived usefulness was an important component of their motivation to use computers, while organizational support and computer anxiety had only indirect effects on usage, through perceived usefulness.

It was expected that teaching efficacy would impact on integration. Teaching efficacy, however, was not an important part of the function. This sample of teachers, regardless of their level of computer integration, reported a relatively strong teaching efficacy. According to Bandura's Social Cognitive Theory (1986), individuals tend to undertake behaviours that they believe will have positive outcomes and that they believe they are capable of performing. According to this theory, we would expect that teacher self-efficacy, along with the positive attitudes towards computer technology, might differentiate those who integrate from those who do not. However, the teacher self-efficacy scale did not include items directed specifically at computer self-efficacy. It may be that teachers need a feeling of efficacy related directly to computer usage (Paraskeva et al., 2008; Poulou, 2007) and not teaching in general. The range of scores on the Teacher Self-Efficacy Scale was limited and teachers generally saw themselves as capable. As a result, teachers who integrated technology, and those who did not, did not differ in their perception of how capable they were as teachers, but they may very well have differed on a more specific computer self-efficacy measure.

Several more of the selected variables in the current study showed little or no discriminating power. The high and low integration groups did not differ in terms of gender, years of experience, technical problems they had experienced, or the enjoyment and outward motivation for their work. It may be that technology has been a part of education for a long enough period of time that teaching experience is no longer influential on computer experience, and that technical glitches have been smoothed out to some extent (e.g., Wood et al., 2005). The non-significant difference in extrinsic motivation is not surprising, considering that there are unlikely to be external rewards for teachers who integrate technology above those offered to teachers who teach with little computer integration.

The computer is seen in the literature as a cognitive tool that has great potential to support a constructivist form of teaching and learning (Brown, 1996). Although the univariate results for the elementary groups reported a significant difference between low integrators and high integrators, the constructivist subscale of the Teacher Belief Survey was not identified as a significant contributor to the function discriminating high integrators from low integrators in this study. Although underlying teaching philosophy has been suggested as a determining characteristic for computer integration, findings have been inconsistent. Schofield (1995) and Goos (2005) suggest that a change in teacher's role, and ultimately philosophy, may be a result of computer integration rather than a prerequisite for its use. Vannatta and Fordham (2004) included teacher philosophy as a possible predictor of computer usage but reported no differences between those who integrated computers and those who did not. There was, however, little variation in teacher belief scores across teachers and teachers generally scored close to neutral, suggesting that their teaching philosophy was not extreme.

There is some question as to how closely reported philosophy matches actual behaviour (Keys, 2005). Judson (2006) suggests that there is little correlation between stated beliefs and actual practice. Although the computer has the potential to support a constructivist style of teaching and learning (Lajoie, 2007; Latham et al., 2006), it may be that teachers are using the computer to enhance current practice and whatever philosophy they currently teach under is being supported by the technology.

One significant difference between elementary and secondary teaching levels in the present study was that elementary teachers who were integrating computer technology to a greater degree, reported higher scores on the WPI Intrinsic Motivation--Challenge subscale than low integration teachers, suggesting that these teachers may be more intrinsically motivated than their low integration counterparts to do their job because of the challenge it presents. It may be that integrating computers into the elementary classroom requires a great deal of effort and risk that provides few rewards outside the intrinsic satisfaction of meeting the challenge. Becker (1994) also found support for this hypothesis. The exemplary computer teachers in his study were more willing to take initiative and challenge themselves beyond the regular requirements of their position than non-exemplary computer teachers. Professional development aimed at technology specifically may not have a great impact on all teachers unless integration can be made less of a challenge. Some teachers will need to see positive outcomes and begin to view technology as an instructional tool that does not include insurmountable challenges.

Professional development and the process of integration must address the attitudes of teachers and present them with opportunities for positive computer experiences within the context of their instruction. Personal experience with technology success is necessary for any change in attitudes and increase in computer efficacy (Ross, 1996). Administration may need to identify teachers who are successfully integrating technology and develop mentor programs or workshop training to expose teachers to successful integration in a practical way. Opportunities to observe classroom practice, and the introduction of technology in more gradual ways to support current classroom practice (Ertmer, 2005), may be of more benefit than attempts to alter teaching philosophy. Teachers need to see the potential of computer technology as a cognitive tool.

In summary, the comprehensive set of variables and the random sampling of a heterogeneous group of elementary and secondary teachers from across a school board made it possible to examine the complex issue of computer integration. The large amount of variance accounted for by the variables included in the discriminating function suggests that these individual characteristics of teachers are of great importance and must be considered above contextual variables. Influential variables went beyond comfort with computers and workshop training. Clearly, professional development cannot be a one-for-all solution—setting out the challenge of computer integration may be of benefit for some teachers and not for others. Teachers need to see positive outcomes and successful practice—they need to actually experience positive events.

Study Two

As computers become more common place and students become more skilled in their use, teachers may be moving through stages of apprehension to greater exploration (Mueller et al., 2007). The results of Study One suggest that in order to accept the challenge of computer integration at a higher level, teachers need to see computer technology as a useful cognitive learning tool. One means of providing positive outcomes would be through vicarious experience of a skilled "key" teacher who is successfully integrating computer technology him/herself. Research on teachers' perceptions of barriers and supports to computer integration has identified the presence of an expert computer-using teacher to be a necessary component for successful integration for many teachers (Hadley & Sheingold, 1993; Wood et al., 2005). Professional development and training programs would benefit from the identification of such "key teachers." Despite the critical role these key expert teachers can play in moving computer integration in the classroom forward, there has been very little research on how to accurately and efficiently identify these key teachers from the many teachers in any given school board.

Many theoretical and empirical papers identify successful learners as those who engage in self-regulated learning (e.g., Paris & Paris, 2001; Pintrich, 1995; Zimmerman, 1989). In other words, these learners have extensive domain knowledge, are intrinsically motivated to learn, engage in metacognitive behaviors that allow them to monitor their behavior and performance, set goals, use sophisticated strategies, and often coordinate many strategies at once

(Perry, VandeKamp, Mercer & Norby, 2002; Willoughby, Wood, & Kraftcheck, 2003). Experts exhibit the skills associated with self-regulated learners, that is they have extensive domain knowledge, repertoires of strategies and engage in metacognitive behaviors. In general, cognitive research has shown that providing less knowledgeable learners with strategies that allow them to navigate material more effectively promotes learning (e.g., Schneider, 2000). Expert teachers have the potential to provide their novice peers with the computer skills, strategies, and knowledge necessary to efficiently move through stages of computer integration.

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Professional development and training programs would benefit from the identification of such expert teachers. In addition, peer support and peer mentoring program would be facilitated if experts could be readily identified. Only a couple of studies have examined the critical issue of how to identify such key teachers using nominations or comprehensive surveys (Becker, 1994; Hadley & Sheingold, 1993). An early study by Hadley and Sheingold (1993) reports on findings from an extensive survey of teachers identified as integrating computer technology to a higher degree than the average teacher. No specific selection criterion was used for nominations in the referral process. Their sample was procured through letters and phone calls to state and local directors of educational technology, hardware and software industry personnel, professional organizations, leading educators and researchers in the field, and through a magazine article that invited self-nominations. Just under half of the sample was computer coordinators who were also teaching. The process was successful in identifying teachers who were comfortable with computer technology, attended workshops and conferences about technology, and integrated computer technology in their classrooms on a frequent basis (at least weekly). The sample did not, however, allow comparison between these teachers and those who were not nominated.

In a subsequent study, Becker (1994) over-sampled "expert" computer-using teachers from a U.S. national survey in an effort to identify characteristics that set these computer-using "experts" apart from the average teacher. At this time, computer use in schools was still fairly limited—only one teacher in six was using computers in a "substantial" way in secondary school math, science and English classes in the U.S. sample (Becker, 1991). Exemplary computer-using teachers were identified using survey questions from a subject-specific questionnaire for mathematics, science, and English, and questionnaires that examined five areas of computer use: teacher goals for computer use; frequency of student use; saliency of computer approaches for major learning activities; student experience with specific types of software; and, general functions of computers in class. A pilot index was calculated for each teacher based on a set of standards devised for each subject area. The index placed teachers along a continuum of low to high computer-users with "exemplary computer-using teachers" meeting an arbitrary cut-off index score.

The "exemplary" computer-using teachers were then compared to more "typical" teachers. Standardized mean differences were used as a measure of effect size of the difference between the two groups on a number of variables within the teaching context and on individual characteristics. For example, "exemplary" teachers taught in schools with a larger number of teachers using computers, with smaller classes, and in school districts with a heavy investment in staff development and on-site technical support. These "exemplary" teachers had more formal training in using and teaching with computers and were more likely to have majored in math, science, the social sciences and humanities, while the "typical" teacher was more likely to have majored in education (with less domain specific education). Although there were significant differences between these "exemplary" computer-using teachers and the rest of the sample, the proportion of computer-using teachers was small—five percent of the sample.

Although exhaustive surveys may yield one means of discriminating expert teachers from their less skilled peers, these sampling techniques are often costly, time-consuming, and inefficient and teachers may not respond to external research requests. The resources needed to use these techniques as a way of identifying key teachers would be prohibitive for most school boards. The task of identifying key teachers most often rests with school administrators. The administrators may vary from board to board and include committees involved in school ITS support, those involved with in-service, and those who develop and implement policy. Given the important role administration plays, it is important to consider the accuracy of their nominations.

The ability of administration to easily identify computer "experts" is important for professional development, training, and computer integration projects because the presence of "mentor" teachers is a key component in the successful integration of computers by other, less skilled teachers (Becker, 1994; Wood et al., 2005).

In this study, administrators involved with the provision and development of support for computers across the curriculum were asked to identify teachers with expertise in computer integration. The nominated group was compared with a random sample of teachers from the same school board to determine whether the nominations by administration were sufficient as a means for identifying experts. The comprehensive survey was used to identify potential differences in the two samples at both the elementary and secondary levels

Method

Participants

The final sample of teachers used for comparison in this study included 85 nominated "experts" who returned the survey and 85 randomly selected teachers (47 elementary and 38 secondary in each group) from the complete larger random sample of teachers who returned the survey, chosen to match the number of "nominated experts". The majority of teachers in each group were female (55.3% expert and 75.3 % random). The mean age of the sample of teachers did not differ between the two groups (M = 42.41 expert and M = 42.13

random) nor did the number of years of teaching experience (*M* = 16.10 expert and *M* = 14.88 random). The majority of teachers in both groups had an undergraduate or graduate degree (96.5% expert and 95.3% random).

Materials and Procedure

In order to determine whether "expert" computer using teachers could be accurately identified, members of the school district computer committee were asked to nominate "experts" in computer integration from elementary and secondary schools. "Experts" were defined as teachers who were successful with computer integration. The majority of names were selected based on their role as "key contact" for computer information at their respective schools.

Selection of the "expert" teachers was conducted by the school board Computers across the Curriculum (CATC) committee. This committee is responsible for computer resource planning and policy as well as professional development and training. The elementary and secondary consultants on the committee were each responsible for nominations from their respective divisions. The random sample of teachers was drawn from across the school board.

All participants had completed the comprehensive survey described in the general method section above. The return rate for the "nominated experts" (58.9%) was higher than the return rate for the "randomly selected" group (39.8%). Portions of the survey used to compare "experts" with the randomly selected sample will be explained briefly again here. The questions utilized in this study assessed six broad areas of interest, including student use of computers in terms of location, frequency and type of activity; teacher self-reports of inclusion of technology and planning, and level of integration; teacher use of computer technology as a presentation tool; and, teachers' perceptions of their ability to integrate computer technology relative to their peers.

Student Use by Location. Teachers were asked to indicate how often students used the computers in each of four locations: classroom, lab, library/resource centre, and pod (shared work space). Answers were given on a five point scale (0 = "never", 1 = "a few times a year", 2 = "a few times a month", 3 = "a few times a week", and 4 = "every day").

Student Use by Type of Activity. A five point scale was used to measure computer use with students for five specific activities (including on-line research, tool-based software, subject-specific tutorial software, communication tools, and specific assessment tasks). Again a five point scale was used (0 = "never" 1 = "sometimes", 2 = "a moderate amount, 3 = "quite a bit", and 4 = "a great deal").

Frequency of Planning. Teachers were asked to indicate how often they assume that computer use by students will be part of their instructional plan, using the same five-point scale used for frequency of types of activities.

Level of Integration. Teachers were also asked to rate the extent to which they integrate computer technology in the classroom, on the same scale as above.

Use of Computer as a Presentation Tool. Teachers also indicated the frequency of their use of the computer as a presentation tool in their instruction. Once again, the same five-point scale was used to indicate frequency of use.

Ability in Comparison to Peers. The final question regarding computer integration asked teachers, "In comparison to the average teacher, how would you rate your ability to integrate computer technology" using a bipolar scale, 1 represented "much more skilled" and 5 represented "much less skilled", while 3 represented "equal".

Results

A MANOVA was conducted on the integration and student use measures to determine whether there were differences between the nominated group of "experts" and the randomly selected group. The Wilk's Lambda value was .487, F (13, 117) = 9.482, $p < .001$. The multivariate η^2 was fairly strong, .513. The "nominated experts" were significantly different than the "randomly selected" group on the measures of computer integration and use. The means and standard deviations for each group are displayed in Table 7.

Table 7

Means and Standard Deviations on the Dependent Variables by Group

	Random n = 66		Expert n = 65	
Dependent variables	*M*	*SD*	*M*	*SD*
Student use: classroom	1.44	1.52	2.06	1.63
Student use: lab	1.61	1.07	2.54	.94
Student use: library	1.33	1.06	1.65	1.18
Student use: pod	.42	.91	.57	.98

Activity: on-line research	1.51	1.04	2.12	1.26
Activity: tool-based software	1.56	1.31	2.65	1.17
Activity: subject-specific tutorial software	1.18	1.13	1.65	1.08
Activity: communication tools	.12	.31	.26	.89
Activity: specific assessment tasks	.54	.84	1.17	1.32
Frequency of inclusion in planning	1.31	.86	2.45	1.13
Level of integration	1.64	.87	2.75	1.02
Use as teacher presentation tool	.74	.85	1.94	1.03
Perceived ability relative to peers	3.11	.96	1.62	.65

Following the significant MANOVA, analyses of variance were examined for each dependent variable (Meyers et al., 2006). A Bonferroni correction for multiple comparisons, resulted in a significance test level of .004. Significant *F*'s were obtained for eight of the 13 comparisons (See Table 8).

Specifically, expert teachers encouraged student use of computers in labs more frequently than random sample of teachers, $F(1,129) = 28.27$, $p < .001$. Expert teachers reported a mean use of computers by students in labs as more than "a few times per month", $M = 2.54$, while the random sample of teachers reported a mean equivalent to less than "a few times per month", $M = 1.61$ (See Table 7). However, the samples did not differ in encouraging student use in the classroom, resource centre or pod, largest $F(1, 129) = 5.11$, $p = .025$, with a largest reported mean use of "a few times per month" for classroom use by experts (See Table 8).

Table 8

F Statistics and Effect Sizes for Individual ANOVAs on Dependent Variables

Dependent Variable	*F*	*df*	Sig.	*d*
Student use: classroom	5.11	1, 129	.025	.39
Student use: lab	28.27	1, 129	.001*	.93
Student use: library	2.56	1, 129	.112	.29
Student use: pod	0.77	1, 129	.383	.16
Activity: on-line research	9.38	1, 129	.003*	.53
Activity: tool-based software	25.00	1, 129	.001*	.87
Activity: subject-specific tutorial software	5.87	1, 129	.017	.42
Activity: communication tools	1.53	1, 129	.218	.22
Activity: specific assessment tasks	10.42	1, 129	.002*	.56
Frequency of inclusion in planning	41.60	1, 129	.001*	1.13
Level of integration	45.68	1, 129	.001*	1.18
Use as teacher presentation tool	52.89	1, 129	.001*	1.27
Perceived ability relative to peers	107.11	1, 129	.001*	1.81

*p < .004 corrected for multiple comparisons

Expert teachers encouraged student use of computers significantly more than the randomly selected teachers for three of the five specific computer activities listed in the questionnaire. Specifically, expert teachers reported more frequently asking students to use computers for on-line research, tool-based activities, and assessment tasks, smallest $F(1, 129) = 5.87$, $p < .001$. The means were similar to those reported in the use by location. The most frequent activity was use of tool-based software by expert users who reported using computers for this activity closer to "a few times per week", $M = 2.65$ (See Table 7). There was no significant difference between samples of teachers in frequency of student use of subject-specific tutorial software, or use of the computer as a communication tool, largest $F(1, 129) = 5.87$, $p = .017$. Reported means indicated very limited use of the computer as a communication tool overall for random teachers and experts, $M = .12$ and $M = .26$, respectively (See Table 7).

Finally, expert teachers and the random sample of teachers differed on all four measures of integration, including planning, level of integration, use as a presentation tool, and perceived ability, smallest $F(1, 129) = 41.60$, $p < .001$. Effect sizes ranged from .16 to 1.81 (See Table 8). Largest effects (over .90) were reported for measures of teacher's perceived integration, including "perceived ability relative to peers", "use of computer as a teacher presentation tool", "overall level of integration", and "frequency of inclusion in planning". These effects were clearly large (Cohen, 1992), all over 1.00. Very large effects were also found for "student computer use in a lab", $d = .93$, and "student use as a tool-based activity", $d = .87$.

Discussion

The purpose of Study Two was to evaluate the accuracy of the nomination of "computer-using expert" teachers by school board administration. Although the two samples were similar demographically, the "nominated experts" clearly differed from the random sample of their peers. Specifically, the "nominated experts" reported a higher level of computer planning and integration, used computers more frequently with students for a variety of tasks, and saw themselves as more adept at computer integration than their peers.

In fact, the effect sizes for individual variables were generally medium to large (Cohen, 1992) with the majority over .50 and several variables showing effects greater than 1.0. The effect sizes over 1.0 for the variables measuring perceived integration levels and ability indicate that the nominated experts are aware that their use of computer technology is a large part of their program and that they have skills that are unique from their colleagues. The school board computer committee was accurate in identifying teachers who certainly see computers as an integrated tool for their teaching and learning.

Similarly, large effects were found for frequency of computer use in the lab and for activities that utilize computer technology as a tool. The nominated experts were using computers in labs, more frequently, and for a variety of tasks. The mean frequency of student use for the expert teachers for tool-based activities was close to "quite a bit" on the questionnaire scale, while the randomly sampled group of teachers reported between "sometimes" and a "moderate amount." It appears that the expert teachers are integrating computer technology in their planning and teaching and are using it as a tool for learning in ways different from the randomly selected teachers who were not nominated as experts. The only non-significant differences in type of use were for subject-specific tutorial software and use as a communication tool (i.e., chat rooms, e-mail). Use of computer technology as a communication tool was extremely low for both groups. The subject-specific tutorial software was used more frequently than a communication tool but less than on-line research and tool-based software. The lack of difference between nominated experts and the random sample in this area may be due to the use of this subject specific software by specialized domain teachers (e.g., business studies, geography, etc.) and by elementary teachers for drill and practice and learning games. Teachers who use computers on a less frequent basis, particularly elementary teachers, report utilizing computer software as a motivating activity and for "play" (Wood et al., 2005). The expert teachers use the subject-specific software less often than tool-based software and on-line research tools. The school board administration was able to discriminate teachers who use technology as a learning tool in a variety of ways from those who are using computers in a limited capacity.

The consistency in the higher integration scores across location, use, and integration measures, suggest that this group of "nominated experts" was indeed integrating computers to a greater degree and in a greater number of contexts than their colleagues. The largest differences between the two groups of teachers were on variables that measured their perceived ability (i.e., comparison to peers), their intended practice (i.e., inclusion in planning), and their integration (i.e., self-reported level of integration). The non-significant differences may be related to variables over which teachers have little control, i.e., student use of computers in classrooms. Teachers may not have access to computers in their classrooms (Wood et al., 2005) even if they wished to integrate computer technology at the classroom level. Overall, the "nominated experts" reported significantly higher perceived ability, planning and integration with more student use in terms of activity type and lab computers.

Although decision making regarding computer acquisition and use is often the responsibility of administration, it is usually a grass roots movement that develops positive experiences related to curriculum and pedagogy. It is the teachers within the schools who actually implement the technology on a daily basis. Is it then practical to suggest that out-of-school staff, that is, school board administration, will be able to accurately identify those teachers? The findings of this study suggest that it is both practical and accurate.

The accuracy of the identification of "expert" teachers is of practical use to researchers. The relative ease of selection through a nomination process is beneficial for research that continues to examine the successful integration of computer technology. As technical barriers and access issues have diminished, (Mueller & Wood, 2006) research and policy have begun to examine the characteristics, attitudes and beliefs of teachers who are integrating computer technology in their classrooms (Mueller & Wood, 2006; Vannatta, & Fordham, 2004; Wozney et al., 2006). Appropriation of a large sample of teachers who fit into the "expert" category is essential for generalization of findings to a broader educational context.

School board administration is often responsible for selecting teachers targeted for pilot projects or to act as mentors to colleagues. Knowing that the administration's selections are accurate is an important foundation for building professional development and computer integration programs. The administrators' accurate identification of computer "experts" suggests that key teachers can be easily identified without costly, timely and resource-intensive tools employing comprehensive observation notes and survey results. This positive confirmation of the accuracy of the selective process of identifying computer-using teachers, acts as a foundation for future sample selection in research and participant identification in professional development and support.

The accuracy the school administrators demonstrated in identifying teachers who have computer expertise is important for professional development, training, and computer integration projects because the presence of "key" teachers is a key component in the successful integration of computers by other, less skilled teachers (Becker, 1994; Wood et al., 2005). The relatively easy identification of a large group of "expert" teachers who have successfully integrated computer technology is important for future research examining the characteristics of teachers who have conquered barriers and developed a learning environment that takes advantage of the potential in computer technology.

Study Three

The third study in this comprehensive survey of the variables influencing the classroom integration of computer technology continues to address the larger questions about *what* variables impact a teacher's decision to use computers and *how* computer technology is integrated. The final component to be addressed is the triangulation of the results of the first two studies through the qualitative analysis of the responses to the open-ended survey questions and an examination of the "educator's voice" in a qualitative response. Study Three is a content analysis of the open-ended questions included in the comprehensive survey. The specific goals of the content analysis are three-fold.

First, the open-ended responses to the current barriers and supports impacting computer integration will allow for comparison of the current research with previous work examining this issue. Specifically, after identifying the barriers and supports, the content analysis will allow us to explore how influential factors have changed as technology has changed (Levin & Wadmany, 2008; Sandholtz et al., 1997; Valdez et al., 2005; Wood et al., 2005).

The second goal of the qualitative analysis is to compare the responses of the teachers who are integrating computer technology at a high level with those who are not. This comparison will serve to confirm the differences identified in study one between high integrators and low integrators.

The third goal of Study Three leads into the next phase of the research. The content analysis of answers to questions regarding *how* computers are being used will begin to explore the outcomes of computer integration and the level of integration that currently exists in elementary and secondary classrooms. Past research has concluded that computers are still underused, or are not being used to their potential (Abrami, 2001; Cuban, 2001; Muir-Herzig, 2004; Sutherland et al., 2004). The large sample of computer-using teachers included in this study will provide information as to *how* computers are being used and at what level. This sample of teachers includes a random selection of teachers across a school district as well as a selected sample of "computer-using teachers." Much of the research that exists around computer integration has only examined computer use and student outcomes in pilot projects or innovative programs (e.g., Granger, Morbey, Lotherington, Owston, & Wideman, 2002). Teachers' responses to what "other" activities they ask students to do with computers and how they use computers to teach literacy, will begin to create a picture of what the integration of computers consists of in regular classrooms where computer technology is used as part of the everyday program. Answers will provide some insight into what computer integration means to these teachers.

Results of the Discriminant Function Analysis (DFA) in study one were inconclusive as to whether a teacher's philosophy influences computer integration or whether computer integration affects changes in philosophy. Although a teacher's beliefs and attitudes do impact the choices that they make in the classroom (Flowerday & Schraw, 2000), behaviour does not always match the philosophy to which the teacher prescribes (Judson, 2006). The forced-choice and dichotomous yes/no questions available in the survey limited choices and may have made it challenging for educators to convey their beliefs and attitudes toward technology as fully as they may have wished. Open–ended questions allow for expansion of, and elaboration on, issues measured by the forced-choice instruments (Sahin, 2003). In addition, forced-choice questions work under the assumption that each participant is using the same meaning for the terminology which may not be the case. Teachers, therefore, were asked directly to explain how technology fits, or does not fit, with their teaching philosophy using their own words. Teachers also were asked to provide information that , if examined qualitatively, may provide insight into what definitions teachers are using to describe computer integration and the characteristics of the teachers who use it.

In summary, this third study performs two functions. First, the study will triangulate the results of the previous analyses performed on the survey instrument. Second, the study will allow for a richer understanding of teacher's responses while providing an opportunity to expand our understanding through the introduction of new information or insights that could not be accessed through the traditional closed-question survey items. Overall, this qualitative examination will provide a richer understanding of teachers' experiences integrating technology in their classrooms.

Method

Participants

Participants included the complete sample of teachers, 185 elementary teachers and 204 secondary teachers. Participants were divided according to the integration levels identified in Study One (See Method section of Study One for more details). The elementary panel included 54 “low integration”, 88 “average integration”, and 52 “high integration” level teachers. The secondary panel included 51 “low integration”, 100 “average integration”, and 53 “high integration” level teachers. (See the General Method section for a more detailed description of participants).

Measures

The open-ended portion of the survey included 12 questions in total. Three questions are responses to the “other” category in a list of options and generally resulted in one word answers. The first of these questions asked teachers to indicate if they have access to computers in several locations. The “other” category provided the opportunity to list a location that is not suggested in the list of options. The second question asked how frequently a teacher asks students to do a list of different activities on the computer and included “other” as a final choice. The third question asked “What other forms of professional development (other than workshops) about computer technology and or technology curriculum integration have you engaged in during the past 3 years?”

The remaining nine questions asked participants to elaborate on a given answer or to respond to an open-ended question. Participants were asked to explain briefly, their response to the following three questions: “Do you support the concept of integrating computer technology for students in your division?”; “Does your school administration support the concept of integrating computer technology for yourself and students?”; and, “Does the integration of computer technology fit within your personal instructional style?”

Six of the nine questions required a more detailed open-ended response. Those questions include:

- □ How do you use computers to teach literacy?
- □ What currently enhances your integration of computer technology in the classroom?
- □ What currently inhibits your integration of computer technology in the classroom?
- □ When you are planning a lesson/unit, what factors make you decide to integrate the computer?
- □ If you had to define the personal characteristics of people who are excellent teachers—what would those characteristics be?
- □ Please identify characteristics that make excellent teachers who happen to integrate technology effectively, different from excellent teachers who do not.

Procedure

All written answers were transcribed verbatim and compiled by question. An anonymous identification number was used to connect written answers to the participant in the quantitative data file. The percentage of participants responding to each question was recorded in an effort to capture the representative nature of the replies (See Table 9).

Table 9

Percent of Participants Responding to Each Qualitative Question.

Question	Elementary	Secondary
1. Other locations of computers	72.4	62.3
2. Other computer activities	25.9	23.5
3. Other forms of professional development	13.5	8.3
4. Support for computer integration in division	81.6	86.8
5. Administration support for computer integration	75.1	76.0
6. Integration fit with instructional style	75.7	78.9
7. Use computers to teach literacy	58.4	32.4
8. Enhances integration of computer technology	81.6	88.7
9. Inhibits integration of computer technology	94.1	92.2
10. Factors influencing planning with computers	85.4	91.2
11. Personal characteristics of excellent teachers	97.3	98.0
12. Personal characteristics of teachers using tech.	31.9	42.2

An inductive coding technique (Strauss and Corbin, 1990) was used to develop categories or labels for responses to each individual question. Open coding of responses was conducted by a single researcher, blind to the integration level of participants (low, average or high integration) but aware of teaching level (elementary and secondary). Participants' language was used as much as possible to produce a 'data-driven' coding scheme (Guba & Lincoln, 1989). Emerging themes were recorded as responses were read and similar responses were then grouped under more abstract headings (Sahin, 2003). To protect against 'projection' and to ensure reliability of the coding scheme, an explicit code of theme labels, definitions and examples was developed (Boyatzis, 1998). The resulting coding scheme for each question was used to code 25% of the data by two independent raters with percentage agreement ranging from 81 to 94 percent agreement. Codes were compared and discrepancies were resolved through discussion between the two coders (Boyatzis,1998). Adjustments were made to the themes and definitions and the resulting coding scheme was used to code the entire response set.

The resulting coding scheme and definitions for each question provided a qualitative "picture" of technology integration, and the barriers and supports that teachers are facing in their classrooms. Following the content analysis of the qualitative answers and code development, frequencies were calculated for the percent of responses in each theme for each question. The total percentages for each question did not always sum to 100 as some responses included more than one theme. The frequency reports allowed for assessment of the prevalence of each theme based on how many of the respondents indicated that theme in their qualitative response to the open-ended question. These percentages gave some indication of the issues identified as important by the largest number of participants in each group.

Simple line graphs were created to demonstrate the relative percentage of participants expressing key themes for the high and low integrators in the elementary and secondary panels. This allowed for easy comparison of those who integrate technology and those who do not, through examination of patterns of themes, presence of co-occurrence of themes, and instances of similarity and difference (Guest & MacQueen, 2008).

Results and Discussion

Results are reported according to the three goals of this study: reporting supports and barriers to computer integration; comparison of high integrating teachers and low integrating teachers on teacher belief variables; and, an exploration of how computers are being used in elementary and secondary schools. Coding themes and frequencies of responses are reported by question for each goal.

Supports and Barriers

Five questions addressed the barriers and supports or the variables that enhanced or inhibited the integration of technology. The first question concerned the location of computers, where computers were available for teacher use. The second question asked about "other" forms of professional development that teachers used in learning about technology integration. The third question addressed the support for computer integration offered by school administration. The final two questions asked teachers directly to describe variables that currently enhanced or inhibited computer integration.

Location of computers

There were a large number of responses in the "other" category for the question that inquired as to where teachers had access to computers in both the elementary and secondary panel. An overwhelming majority (94% of elementary and 86% of secondary responses) referred to having a computer available in the staff room, office or workroom. The other locations included specialty classrooms (e.g., guidance, resource room) or mobile units. It was clear that the "staff room" should have been included as an option, in addition to classroom, computer lab, library or resource centre, and pod work area, in the list of locations of computers in a school. Teachers indicated that they do have access to computers in their administrative work area.

"Other" forms of professional development

Only 24 elementary and 16 secondary participants filled in the "other" category regarding alternate forms of professional development. The only additional unique response was "talking with someone other than colleagues" (9 elementary and 2 secondary). This form of professional development—talking with other people--is less formal but something teachers may need access to in order to gain additional information or skills that may not be available within the school environment, or that may be more readily accessible at the times when they need access to information

School administration support

When asked to explain the support, or lack of support, for computer integration for students and teachers from school administration, teachers responded with five key themes for support and four of those same five themes for lack of support (See Table 10). That is, there were five ways that school administration was seen to support computer integration and a deficiency in four of those five factors was discussed by those indicating no support (i.e., training was not addressed in the "no" responses).

Administrative support came in the form of two factors directly related to the administrator in terms of "knowledge and skills" and in a "philosophy" that supported and encouraged computer technology as an important part of education. Three additional factors involved provision of materials or training for the teachers or students. These included: "resources" (hardware, software, and human resources; "access" to computers either by location or through scheduling; and, "training" provided or made available. See Table 10 for the complete coding scheme with examples.

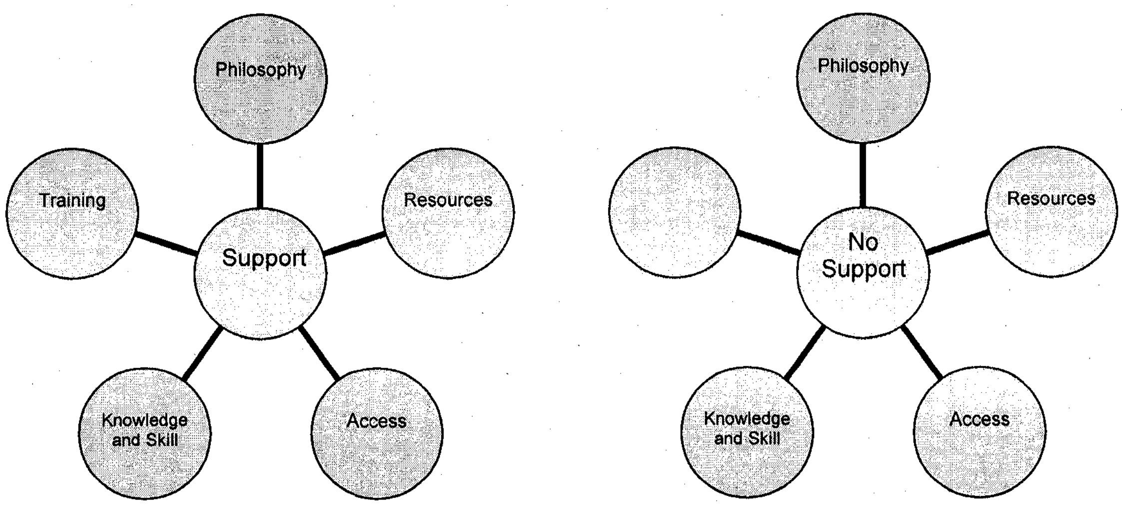

Figure 3. Themes for administration support for computer integration.

Table 10

Coding Themes, Definitions, and Examples for Responses to the Question:

"Does your school administration support the concept of integrating computer technology for yourself and students? Explain briefly."

YES—does support

a. *Philosophy*

Administration supports the concept of technology integration in theory and as an important aspect of education.
e.g., "He thinks it's important for them [students] to get ready for the real world." Or "Comments and ideas that are passed along to staff show the support." or "My school administration strongly believes that computers are an asset to the integration of computer technology."

b. *Resources*

Administration provides the resources to support the integration of computer technology, i.e., time, money, human resources, etc.
e.g., "She gives as much support as time and finances allow." Or "our administration bought computers and Ethernet drops for classrooms out of fundraising money."

c. *Access*

Access to computer technology is assured by administration in terms of lab availability, classroom scheduling, etc.
e.g., "There are computers in every pod for students and teachers to use" or "I have access to the SC lab as the programs I require need the most memory" or "encourages lab access".

d. *Training*

Training is provided or made available for staff and administration.
e.g., "supportive re conferences..." or "I've been given time to attend workshops" or "many workshops offered to teachers to help improve skills".

e. *Knowledge/skill*

Administration is knowledgeable about computer technology and/or uses technology.

e.g., "He spends a lot of time on email and is very comfortable and familiar with computer technology" or "we have superb audio/visual person (IT) who is extremely helpful with computer problems and updating."

NO—does not support

a. *Philosophy*

Administration does not support the concept of technology integration in theory or provide general encouragement to advance in that direction.
e.g., "Computer integration is not a priority" or "they will provide money but show no real interest in computer use".

b. *Resources*

Needed resources are not provided in terms of people, time, money, equipment, or technical support.
e.g., "Local administration tries to encourage use however central support money is not adequate" or "they support the concept but generally there is no money to provide reliable equipment or software."

c. *Access*

Administration does not supply or arrange for equitable and necessary access to computers to integrate the technology.
e.g., "I bought myself a laptop because I do not have regular access to a computer."

d. *Knowledge/skill*

Administration does not have the knowledge and/or skill to support technology integration.
e.g., "Without technical background, some administrators do not understand why tech studies requires high end computers to run current software."

Both elementary and secondary "NO" responses were limited. Only "lack of resources" was reported in more than 10% of secondary responses. The majority of responses indicated that school administration generally supports computer integration for students and teachers, and most frequently that support was described as provision of "resources" (See Table 11), although "philosophy" was also mentioned in close to 20% of responses. Interestingly, there appears to be a perception of general support from administration in terms of philosophy and resources with little emphasis on the technological skill and knowledge of administrators, suggesting that we are indeed headed in the right direction when we propose that the educators themselves are key in making the decision whether or not to integrate technology.

Table 11

Percent Frequency of Respondents, By Division, Indicating Themes for the Question: *"Does your school administration support the concept of integrating computer technology for yourself and students? Explain."*

Theme	Elementary *n*=138	Secondary *n*=144
YES		
Philosophy	18.1	22.1
Resources	37.0	26.6
Access	15.9	14.9
Training	21.0	9.7
Knowledge/skill	3.6	0.6
NO		
Philosophy	5.8	2.6
Resources	8.0	19.5
Access	2.9	5.8
Knowledge/skill	2.9	0.6

Enhances integration of computer technology

Participants were asked to describe what factors currently enhance their integration of computer technology in the classroom. Responses were coded according to broad categories identified in previous research (Mueller et al., 2008; Mueller et al., 2007). Five categories addressed teacher-related factors; student related factors; resources; context and access issues; and, external considerations (See Table 12 for themes, definitions, and examples).

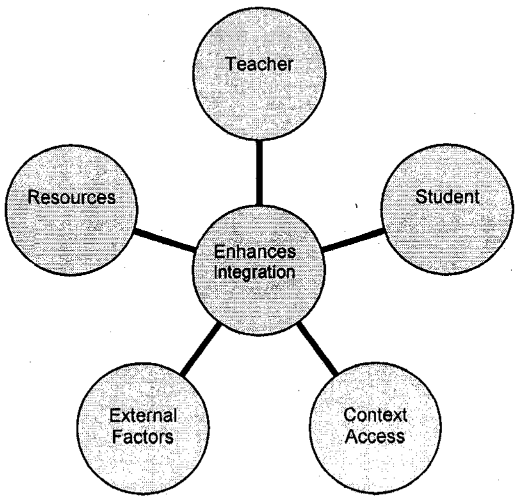

Figure 4. Themes for variables that enhance computer integration.

Table 12

Coding Themes, Definitions, and Examples for Responses to the Question:

"What currently enhances your integration of computer technology in the classroom?"

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a. Teacher-related factors

The responses in this category referred to the characteristics, attitudes, and skills of teachers; curriculum related supports; and, teaching philosophy that matches with computer technology. Other comments indicated that the teacher believed the computer was a useful tool for teaching. e.g., "my own knowledge of software, my own interest" or "on-line assignments" or, in reference to computer technology and teaching strategies--"supports research and project work".

b. Students

The responses in this category referred to the characteristics, attitudes, and skills of students and student motivation to use computers. e.g., "student interest" or "excitement of children" or "student's knowledge".

c. Resources

Comments that fit in this category included technical and human resources that support integration, as well as workshops or training that assist in development of knowledge and integration. e.g., "internet access, instructional software" or "the availability and variety of relevant career planning websites" or "owning a laptop, access to a projection machine".

d. Context/Access

These comments referred to location and access to computers as supporting integration. e.g., "when we can gather computers together to form a computer lab in the library" or "access! I have 7 computers in my room".

e. External Considerations

This category included responses referring to support that comes from outside the school; other societal influences and expectations. e.g., "students see that the use of CAD/CAM is becoming the norm in industry."

The frequencies of responses in each category give some indication of the emphasis placed on those factors by the respondents. Teacher-related factors, resources, and, the context and access to computer technology, continue to be important issues to teachers at both levels, while student-related factors and external considerations were less prevalent (See Table 13).

Table 13

Percent Frequency of Respondents, By Division, Indicating Themes for the Question: *"What currently enhances your integration of computer technology in the classroom?"*

Theme	Elementary *n*=150	Secondary *n*=181
Teachers	42.0	36.5
Students	9.3	3.9
Resources	42.0	37.0
Context/access	34.0	35.4
External considerations	0.0	1.1

Inhibits integration of computer technology

In direct opposition to the previous question, participants were asked to indicate what factors currently *inhibit* their integration of computer technology. The same five broad categories captured the responses in this category with the addition of "technical problems" (See Table 14 for themes, definitions, and examples). Factors related to teachers, students, and the computer technology in terms of resources and access were identified in the responses to this question.

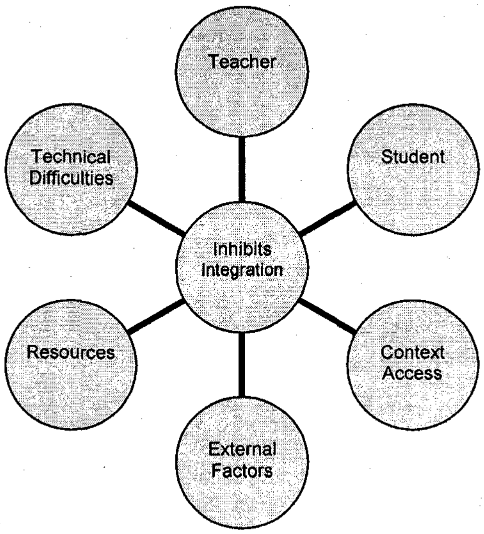

Figure 5. Themes for variables that inhibit computer integration.

Table 14

Coding Themes, Definitions, and Examples for Responses to the Question: *"What currently inhibits your integration of computer technology in the classroom?"*

---

a. Teachers

The responses in this category referred to the characteristics, attitudes, and skills of teachers that inhibited integration; curriculum related barriers; and, philosophy that does not match with computer technology. Comments that indicated that there was no time to develop skills or to fit technology in to the curriculum were also considered teacher-related variables. e.g., "my lack of knowledge" or "too much curriculum to cover" or "I don't feel it is appropriate to certain topics, levels and courses".

b. Students

The responses in this category referred to the characteristics and skill level of students that hampered integration, as well as student sabatoge of computers. e.g., "varying levels of abilities of students" or "too many small kids".

c. Resources

Comments in this category referred to lack of technical (hardware and software) and human resources to support integration, as well as, time as a resource—generally needing more time. Lack of training was included here as a resource issue. e.g., “lack of resources” or “lack of time and number of computers”.

d. Technical Problems

Technical problems included malfunctions, incompatibility and outdated computers.
e.g., “breakdowns”.

e. Context/Access

This category included reference to location of computers as not supporting integration and a lack of access to computers. e.g., “machines not always available” or “nothing except maybe time in the lab”.

f. External Considerations

This category referred to comments around competing priorities or expectations that make integration difficult. e.g., “lack of industry software to reduce prices for educational purposes”

At the elementary level, the three categories with the largest number of responses matched those of the enhancing factors: “teacher-related”, “resources”, and “context and access issues”. The same issues that are supporting integration for some, are acting as inhibiting factors for others. Although access to computer technology continues to increase in society and the workplace, the context and access to computers in schools is still being discussed as one of the most frequent barriers.

A slightly different pattern of factors was apparent for the secondary level participants. Although resources and context/access issues were most important, a much smaller proportion of respondents at this level indicated that teacher-related variables were barriers to computer integration. The secondary participants appear to be more comfortable with technology and it is the resources, and access to them, that teachers report as barriers at the secondary level.

Technical problems were mentioned by both elementary and secondary respondents as barriers, to a lesser degree than resources and access/context. Both panels had very few responses that fit into the "student related" or "external considerations" category (See Table 15).

Table 15

Percent Frequency of Respondents, By Division, Indicating Themes for the Question: *"What currently inhibits your integration of computer technology in the classroom?"*

Theme	Elementary	Secondary
Teachers	34.1	18.2
Students	8.0	6.4
Resources	38.1	47.6
Technical Problems	15.3	22.5
Context/access	40.3	43.3
External considerations	1.1	1.1

Summary of barriers and supports

Computer technology is generally available in schools with teacher access in their staff rooms and administrative areas as well as in classroom, labs, and resource rooms. Professional development is available in a variety of forms with teachers indicating that discussion with colleagues and peers is a format of training and support that they find most useful.

The barriers and supports to computer integration continue to be grouped according to categories that include both teacher-related and resource-related variables with limited focus on student-related variables, similar to the variables identified in the framework developed by Wood et al. (2005). Teachers are still having "technical difficulties" that impact integration but it is not the single, most important barrier.

Teacher-related variables are still an important support for both elementary and secondary panels, although teacher-related variables are not identified as a barrier for secondary teachers to the same extent that they are for elementary teachers.

Although we might have expected context/access and resource issues to be lessening as computer technology becomes more prevalent in general society, these issues continue to be seen by some teachers as barriers to computer integration in the classroom for both elementary and secondary teachers. Even those who are identified as "high integrators" in this study, indicate that access to the resources can be a deterrent.

Comparison of High Integrators and Low Integrators

The second goal of the qualitative component of the comprehensive survey was to compare "high integrators" and "low integrators" on a number of teacher belief and attitude variables. Since teacher-related variables are still an important barrier and support to computer integration, we expect that these variables will further discriminate the high and low integrators. Five questions addressed teacher-related variables, including consideration of a teacher's support for computer integration in their division, the fit of technology with their instructional style, their perceptions of what makes an excellent teacher and how that might differ for technology-using teachers, and, what factors they consider when planning to use computer technology.

The issues addressed by these five questions are reported below in figures that identify the themes extracted from the responses; in tables that include the themes, definitions and examples; in frequency tables of responses; and in coloured line graphs demonstrating the pattern of those themes across elementary and secondary levels and between "high" and "low integrators". The patterns of responses are also represented as histograms in Appendix J.

Support for computer integration

Teachers were asked if they "support the concept of integrating computer technology for students in [their] division?" and asked to elaborate. Five major themes were identified for both positive and negative responses to the question of support (See Table 16). Teachers who support the concept of computer integration see it as a "valuable resource", a current and effective "pedagogical tool", and a "necessary skill". They also indicated that computer technology "provides variety and motivates students", and is effective in providing "differentiated or individualized instruction". Teachers who did not support the integration of computers for students in their respective division, gave reasons related to lack of support when asked to elaborate on their opinion, that is they did not support integration because of the "time" it takes to integrate computers, the lack of "resources" and "skills of teachers", and difficulty with "access." Only one theme was related to the computer as a tool—"inappropriate pedagogy"—based on the age and stage of development of the students and other more preferred teaching methods. Table 16 includes complete definitions of categories and examples for each theme for both "yes" and "no" answers to the support question.

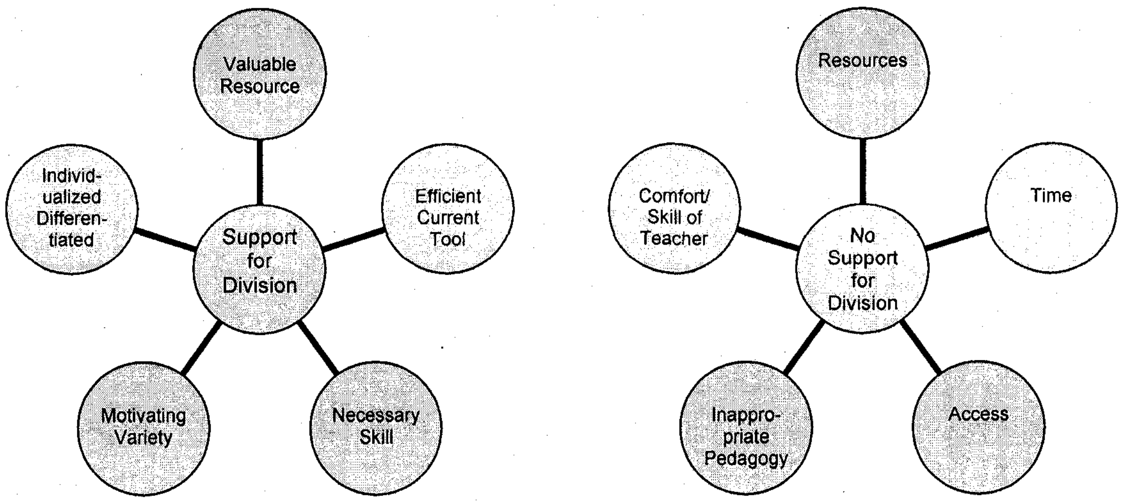

Figure 6. Themes for support and no support for integration of computers in respective divisions.

Table 16

Coding Themes, Definitions, and Examples for Responses to the Question: *"Do you support the concept of integrating computer technology for students in your division? Please elaborate."*

YES—support the concept

a. *Valuable Resource*

Computer technology is seen as a valuable resource in terms of hardware, software, or available information. Mention is made of technology being applicable to specific curriculum areas or more generally as a good resource. e.g., “many types of software and websites to enhance my teaching in wide variety of subject areas” or “I feel that integrating computers in the areas of math and language are the most beneficial and easy to do”.

b. *Efficient/pedagogically current tool*

Computer technology is seen as a tool that can be used for specific applications, such as researching, teaching, word processing. It is seen to improve the efficiency of existing tasks or teaching methods, i.e., faster, or easier; and, to offer additional pedagogical choices, such as, hands-on learning.
e.g., “integrate research on-line with the students producing their work in the lab instead of writing on paper (cut out a step)”.

c. *Necessary skill*

Technological knowledge and skill is seen as a necessary life or academic skill that students will need in the future. Includes references to the necessity of “keeping current” with children’s world and supporting children’s existing skills and/or experience.
e.g., “necessary skills for future” or “children are very computer literate and we must support this” or “gets them ready for grade 1”.

d. *Motivating/variety*

Computer is seen as a motivational tool that gets students involved and captures their attention or suggests that technology provides variety in instruction and learning.
e.g., “The students love it and I always try to give them a new task before playtime”.

e. *Individualized or differentiated instruction*

Computer technology is seen as useful in individualizing or differentiating instruction for students, may be those learning English or students with learning disabilities.
e.g., “When I am working with various special education students at different levels, computers are very useful”.

NO—do not support the concept

a. *Time*

Responses indicated that the computer is time consuming in terms of learning to use it, setting it up, and completing activities.
e.g., “It takes time to become familiar with our changing software.”

b. Resources

Computer technology is not available in terms of number of computers, quality of computers, software, etc. Includes human resources, class size and technical support as resource issues.
e.g., "When things don't work (printers, Internet), the lesson falls apart."

c. Access

Indicates a difficulty in getting access to computers when needed due to scheduling or location of computers. Access is not equitable across classes, grades, etc.
e.g., "but it is very difficult to take a class of 20 JK students to the lab by myself".

d. Inappropriate pedagogy

Technology is seen as inappropriate for age and developmental level of students or for particular topic or subject. Suggests that the focus needs to be on other skills (e.g., social skills, writing, reading, etc.).
e.g., "As long as computer technology is used for learning beyond itself, I don't think grade ones need computer for the sake of computer."

e. Comfort and skill of teachers

Teachers own lack of comfort and experience is seen as a barrier.
e.g., "With more training the teachers would feel an increased level of comfort with the concept of integrating technology." Or "If I knew how."

Table 17

Percent Frequency of Respondents, By Division and Integration Level, Indicating Theme to the Question: *"Do you support the concept of integrating computer technology for students in your division? Explain."*

Theme	Low *n*=49	High *n*=32	Low *n*=35	High *n*=49
YES				
Valuable resource	10.2	18.8	17.1	26.5
Efficient pedagogical tool	12.2	34.4	22.9	32.7
Necessary skill	12.2	18.8	8.6	22.4

Motivating/adds variety	14.3	18.8	5.7	10.2
Differentiated instruction	8.2	9.4	0.0	4.1
NO				
Time consuming	6.1	0.0	11.4	0
Lack of resources	16.3	6.2	17.1	4.1
Lack of access	8.2	0.0	2.9	2.0
Inappropriate pedagogy	12.2	3.1	14.3	0
Lack of comfort/skill	10.2	3.1	2.9	0

A quantitative measure of the frequency of responses helps to indentify which of the established themes are more common amongst educators (See Table 17). The most commonly identified theme for the elementary high integrators and the secondary teachers at both levels of integration, who responded to this question, was the efficiency of the computer as a "pedagogical tool."

Elementary respondents showed a similar pattern of distribution across themes for both high and low integrators in explaining their support for integrating technology, with the exception of the more frequent reference to "efficient pedagogical tool" by high integrators. Generally, computer technology was seen as a valuable resource, an efficient pedagogical tool, and a necessary skill that motivates and adds variety. A smaller percentage of responses included the "differentiated instruction" theme.

Figure 7 demonstrates the pattern of themes in the "yes" responses for both elementary and secondary participants at low and high integration levels.

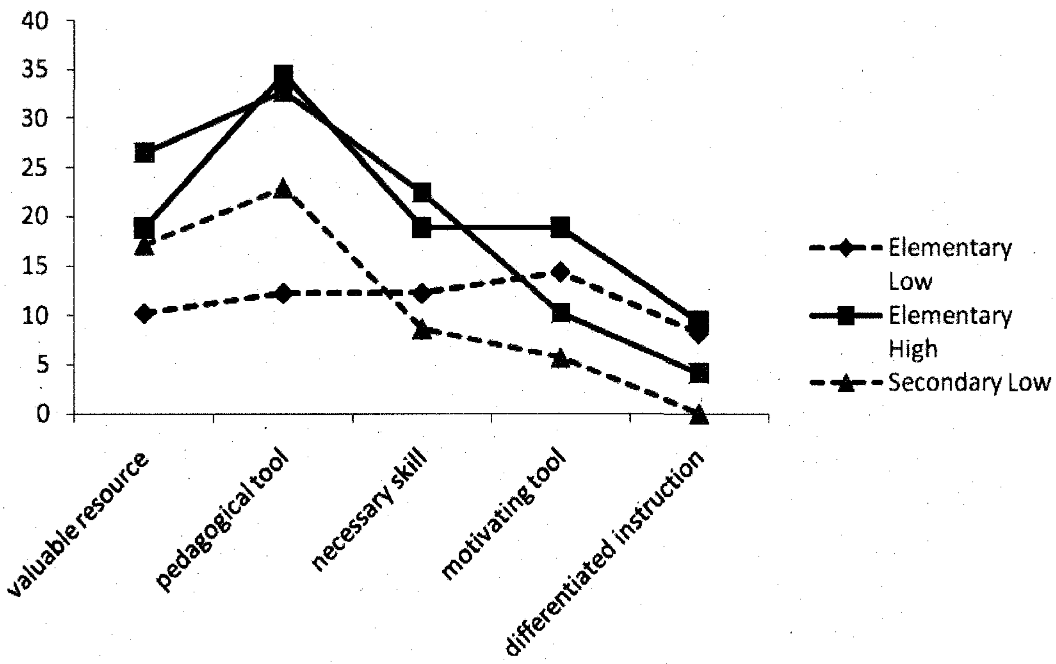

Figure 7. Patterns of themes by division and integration level for the question: *"Do you support the concept of integrating computer technology for students in your division? Explain."*

Figure 8 presents the pattern of themes for reasons that teachers gave for not supporting the integration of computer technology. The most prevalent theme for those who did not support the concept of integrating computer technology, in both divisions, was a "lack of resources". More than ten percent of the "low integrators" in both the elementary and secondary divisions also indicated that they believed computer integration was an "inappropriate pedagogy" for a number of reasons. The "lack of comfort/skill" and "lack of access" were not commonly identified by "low integrators" in the secondary division as reasons for lack of support for the concept of integration. Elementary teachers, however, had a broader variety of reasons for not supporting integration, including their own "comfort and skill level"; the "time" it takes, and "lack of access" to computers (generally in their classrooms).

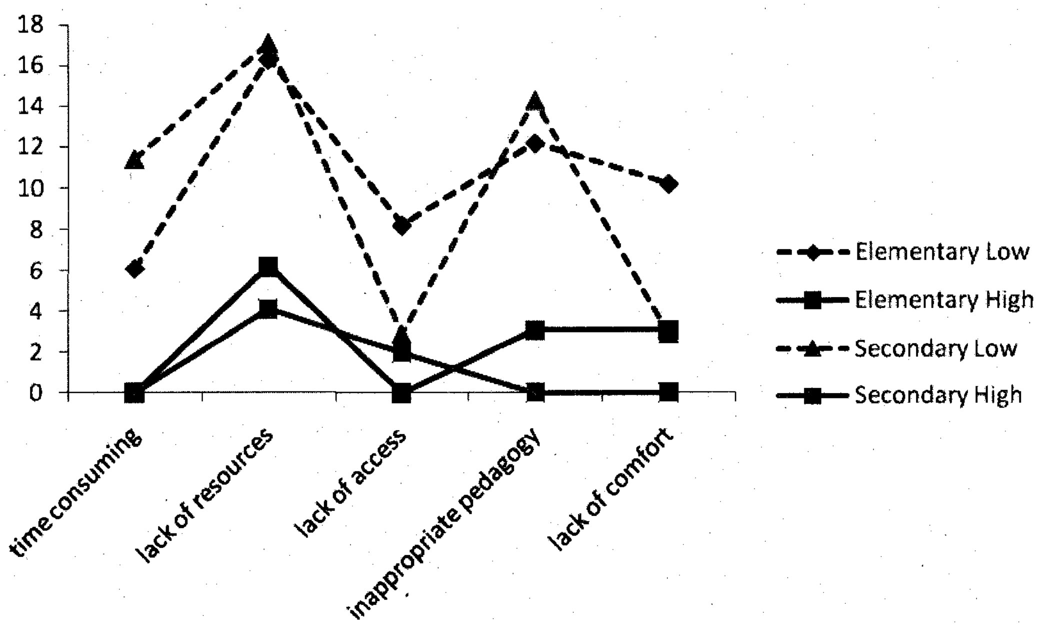

Figure 8. Patterns of themes by division and integration level for the question: *"Do you support the concept of integrating computer technology for students in your division? Explain."*

Fit with instructional style

The responses to the question regarding the fit between the teacher's instructional style and computer integration resulted in both positive and negative responses. The responses indicating a "fit" were captured by eight themes, while the "does not fit" responses were captured by five general themes. The teacher's instructional style had to be inferred, as it was not often stated explicitly. The computer was described as a "current part of students' lives"; allowing for "active, authentic learning"; promoting "self-regulated/independent learning"; and making "differentiated learning" possible. Often the computer was referred to more generally as another "tool" that adds to those already used. In addition, teachers included reference to positive "student outcomes" using computers and the "motivational power" of the computer for students. The final category in the "fit" responses referred to the teacher's comfort and experience with computers.

The reasons for computer integration "not fitting" with a teacher's instructional style, were less varied. Again teachers indicated that "teacher's comfort and knowledge around computers" was important; that there were "too many restrictions" around computer resources and "curriculum"; that there is "not enough interaction" when using computers; and, that "other teaching methods were preferred" (See Table 10 for definitions and examples).

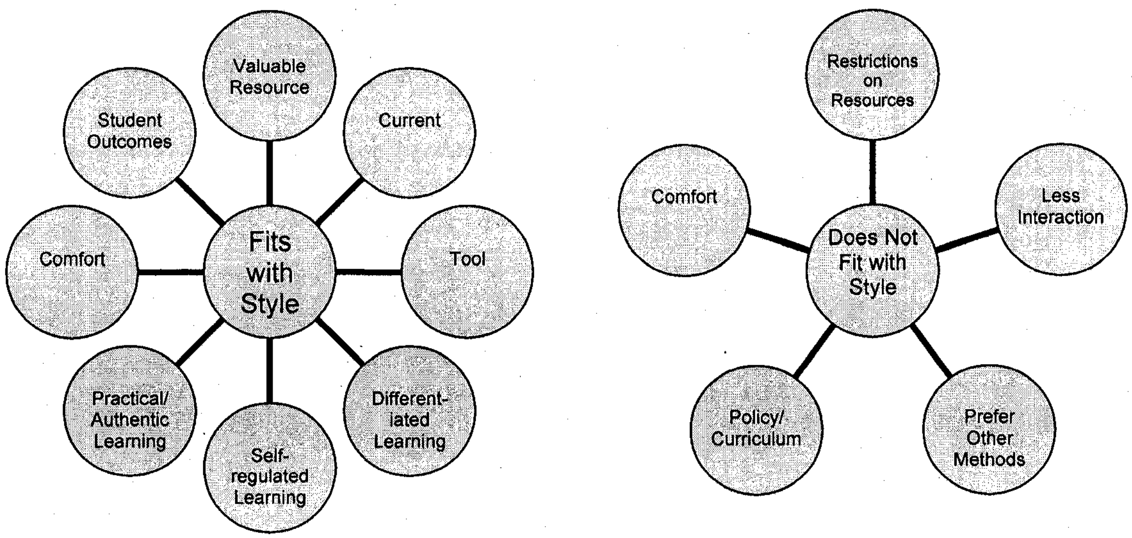

Figure 9. Themes for fit with instructional style.

Table 18

Coding Themes, Definitions, and Examples for Responses to the Question:

"Does the integration of computer technology fit within your personal instructional style? Explain briefly."

YES—does fit instructional style

a. *Current/part of their lives*

Responses indicate that it is important to integrate technology to keep current; technology is part of students' lives outside of school as well. e.g., "I believe in being current...computers are changing and I want to keep students up to date." Or "expand learning opportunities".

b. *Practical/authentic/active learning/exploration*

Responses support idea that computer technology can provide practical and authentic learning tasks. Students are able to be active constructors of knowledge and take part in their learning with computer technology. e.g., "I believe in hands-on learning so I often take my students to the lab to have them try different things." Or "to show notes, provide handouts and other hands-on learning, computers are essential to my teaching style."

c. *Self-regulated learning/independent*

Comments indicate a belief that computer integration allows students to take control of their own learning and work independently to meet specific goals. e.g., "I like for students to have the freedom to work at their own pace and explore their own special interests within an area of study." Or "Students take control of their learning when using computers. It is a less teacher directed lesson."

d. *Use as a tool*

Responses suggest that computers should be used as another tool that assists students in their learning; it may complement other tools. Includes comments about computer as an effective tool generally. Computer technology is seen as part of the curriculum or adds variety to methods already used. e.g., "I use computers as a tool, an easier or more effective way to learn material or report information." Or "limitless possibilities" or "I consider the computer to be a very useful and dynamic tool. As a compliment and advance to the overhead and blackboard."

e. Motivates learning

Computer technology is seen as motivating for students; encourages students to learn. e.g., "I like how computers engage my students and motivate them."

f. Improves student outcomes/impacts student learning/matches student characteristics

Computer technology is seen to produce positive outcomes for student learning. e.g., "student performance has improved since I started using my laptop in teaching"

g. Differentiated learning

Responses suggest that computer technology allows for differentiation and individualized instruction according to language, disabilities, learning styles, multiple intelligences. e.g., "depends on the student and planning for what her capabilities are" or "I like to teach on different learning styles and multiple intelligences. Computers are another tool to let me do this." Or "I enjoy working in a student-centred classroom where I can work one-on-one with students. Specific individualized instruction is rewarding."

h. Teacher's comfort

Comments in this category relate use of technology to teacher's comfort and/or experience with computer technology. e.g., "I feel comfortable using computers and want my students to feel the same" or "It doesn't always suit the topic, but I am comfortable enough with computers that it doesn't hamper my style."

NO—does not fit instructional style

a. Not comfortable with technology, need training and knowledge

Responses indicate that teacher is generally not comfortable with technology or needs training and knowledge. e.g., "as a newer teacher, it is sometimes hard to integrate subjects, let alone computers"

b. *Too many restrictions (need computers, lab time, money, etc.)*

Responses suggest that computer technology doesn't fit with philosophy because of the many technical problems, lack of resources, etc.
e.g., "I'd love to use it more but there are too many restrictions, such as not having enough computers." Or "I also have only 30 minutes per day with each class. This would probably become 20 minutes if I tried to walk a class to the

computer lab and back during the French period."

c. Less interaction (students can't see, don't interact)

Respondents see computer technology as socially isolating or that it does not allow for students to interact with teacher. e.g., "I do like to be animated in front of my students and sometimes computers do not allow this."

d. Doesn't match ministry policies/curriculum

Reponses suggest that computer technology doesn't fit in overcrowded curriculum and with the emphasis on standardized testing. e.g., "sometimes pressure to cover curriculum interferes" or "I strongly believe that students need to be taught the skills of software/hardware use. Hard to find the time to do this with the mandated curriculum of the ministry and policies of the WRDSB."

e. Prefer other teaching methods, such as paper and pencil

Teacher prefers to use class discussion, paper and pencil methods—something different than computer technology allows. e.g., "I am more of a discussion oriented teacher."

Although there were a variety of themes to explain how computer integration fit or did not fit with instructional style, the most frequent themes for all but the "high elementary integrators" was reference to computer technology as another "instructional tool" (See Table 19). A clear divisional difference existed on the theme of "general tool" in that almost half of the secondary teachers who responded, indicated that they use computers as a tool, while just more than a quarter of the elementary teachers did (See Figure 10). The elementary "high integrators" had a noticeably higher percentage of responses related to "teacher's comfort", suggesting that perhaps elementary teachers see comfort with technology more closely connected to matching computer knowledge and skill with instructional style. A large percent (20%) of elementary "high integrator" respondents also suggested that the potential for computers to promote "self-regulated learning" fit with their personal instructional style. The secondary "high integrators" were also different from the rest of the teachers with 21.7 percent of teachers indicating that the "practical/authentic/active learning potential" of the computer fit with their instructional style.

Although there were a greater number of responses in the "does not fit" themes in the "low integrator" categories, the highest frequency was only 18.2 for the elementary panel and 16.7 for the secondary panel in the "too many restrictions" theme. The "low integrators" were not making strong statements against technology in terms of instructional style and did in fact indicate frequently that they see it as another instructional tool but are not mentioning the potential of technology in terms of providing differentiated, authentic active learning opportunities or promoting self-regulated learning.

Table 19

Percent Frequency of Respondents, By Division and Integration Level, Indicating Theme to the Question: *"Does the integration of computer technology fit within your personal instructional style? Explain briefly."*

Theme	Elementary Low n=44	Elementary High n=30	Secondary Low n=30	Secondary High n=46
YES				
Current/part of lives	2.3	6.7	0.0	6.5
Practical/authentic/active	2.3	13.3	3.3	21.7
Self-regulated learning	9.1	20.0	0.0	6.5
Use as a tool	29.5	23.3	43.3	47.8

Motivates learning	4.5	0.0	3.3	4.3
Impacts student learning	4.5	3.3	0.0	2.2
Differentiated learning	2.3	3.3	3.3	6.5
Teacher's comfort	9.1	26.7	6.7	8.7
NO				
uncomfortable/need training	9.1	3.3	10.0	2.2
Too many restrictions	18.2	0.0	16.7	2.2
Less interaction	2.3	3.3	3.3	0.0
Doesn't match ministry policy	2.3	3.3	3.3	0.0
Prefer other teaching methods	4.5	0.0	0.0	0.0

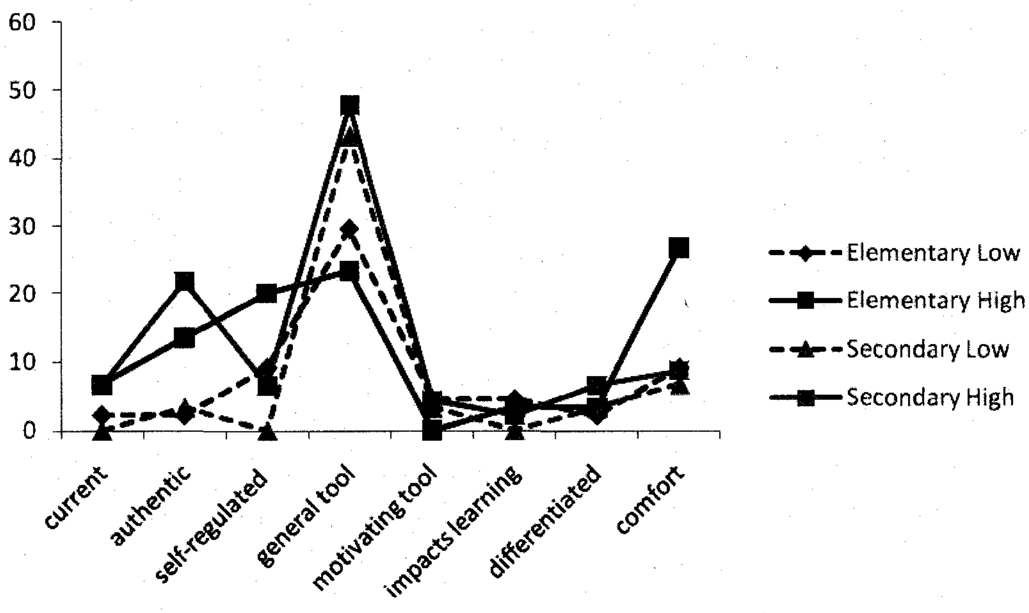

Figure 10. Patterns of themes by division and integration level for the question: *"Does the integration of computer technology fit within your personal instructional style? Explain briefly"* for positive responses.

The patterns of positive responses differed by integration level in that high integrators saw the computer as a tool that provided authentic learning experiences, while low integrators did not. The pattern also differed by teaching division for the theme—general tool. Secondary teachers mentioned the computer as a useful tool more frequently than elementary teachers, regardless of integration level. The elementary high integrators were unique in their frequent response of "comfort with computers" being a key reason that computers fit with their instructional style.

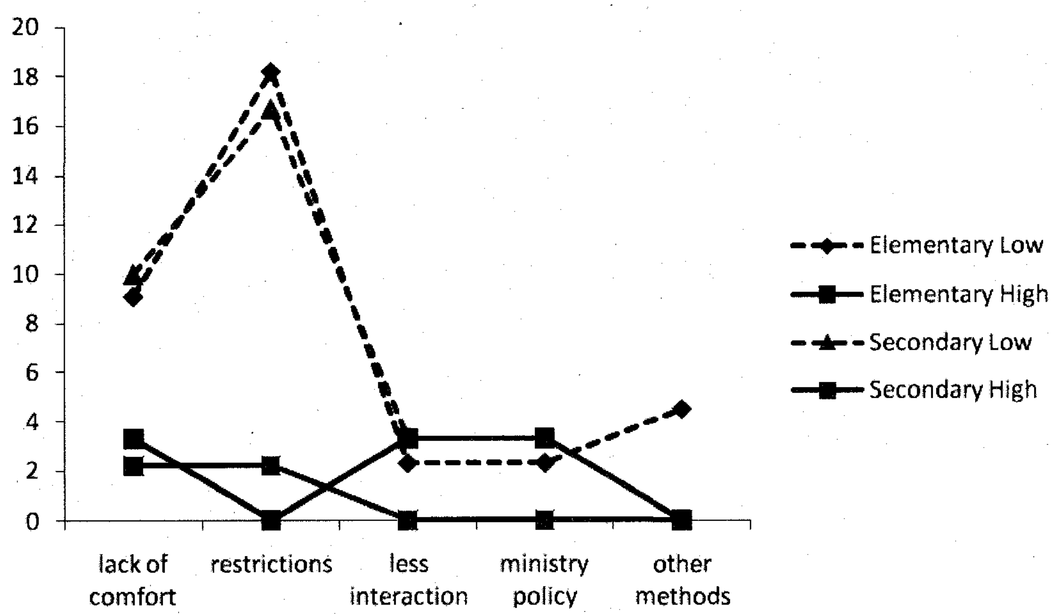

Figure 11. Patterns of themes by division and integration level for the question: *"Does the integration of computer technology fit within your personal instructional style? Explain briefly",* for negative responses.

The low integrators at both levels demonstrated a similar pattern across themes (See Figure 11) that explained why computer technology did not fit with their instructional style, with the exception of the "other methods" theme, which was unique to the elementary group. The most frequent response for "not fitting" with instructional philosophy was "too many restrictions"—most often in reference to time or resources.

Factors influencing planning with computers

The resulting coding scheme for the question related to the decision to use computers in a lesson or unit, included six distinct categories, similar to the factors that inhibit and enhance computer integration, with the addition of task characteristics. At the planning stage, teachers are indicating that they consider *what* the computer will be used for in addition to the factors related to teachers, students, resources, context/access, and external considerations (See Table 20 for themes, definitions, and examples.)

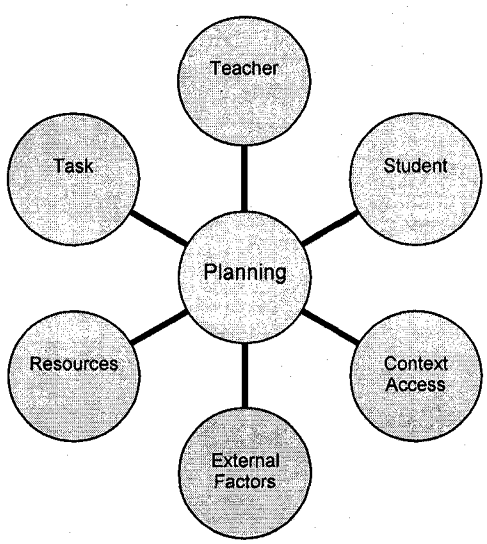

Figure 12. Themes for factors considered when planning to use technology.

Table 20

Coding Themes, Definitions, and Examples for Responses to the Question:

"When you are planning a lesson/unit, what factors make you decide to integrate the computer?"

---

a. Teacher Characteristics

This theme included responses about the teacher's own knowledge level and comfort with computers; teaching philosophy or theory of learning; and, time to learn. e.g., "previous knowledge of both teacher and student" or "programs that I am familiar with" or "subject teacher's ability"

b. Student Characteristics

Responses in this category included references to the characteristics and skill level of students; their ability to work independently; and, the impact of technology on student learning.
e.g., "age of students" or "previous knowledge of both teacher and student"

c. Resources

This theme included references to consideration of resources in terms of availability of suitable programs and computers; cost; time available; and consideration about whether computers will work.
e.g., "cheaper than photocopying" or "how many students vs number of computers, how much time we have"

d. Task Characteristics

Responses in this category referred to the characteristics of the task to be completed or taught, including the goals and objectives of the task; amount of supervision required; time for project; research necessary; topics; and, curriculum.
e.g., "ease of use" or "how long it takes in comparison to a non computer based worksheet"

e. Context/Access

Responses in this category considered access to computer labs and the context of computers outside of just the number of computers available.
e.g., "availability of computer lab" or "if the timing of the unit falls on computer day"

f. External considerations

This theme included influences outside teacher, student and task.
e.g., "feel pressured to use technology" or "cultural awareness"

"External considerations" was a very limited theme with few responses fitting into that category at either level. The most frequently coded themes for elementary teachers included the task characteristics, resources and access. Both "low integrators" and "high integrators" in the elementary panel were considering "what" was going to be done on the computer and if the technology was available—the "low integrators" to a lesser extent (i.e., fewer responses in each category). Student characteristics were considered to the same degree across integration levels but teacher characteristics were not common in the "high integrator" group (2.9% compared to 16.3% of "low integrator" group).

The same pattern of "teacher characteristic" coding applied to the secondary panel—present more frequently for low integrators. Although both integration levels in the secondary panel frequently talked about the "task characteristics" (more than 50%), the "high integration" group indicated a higher frequency of responses related to "resources" and the "characteristics of students" than the low integrators. Context/access seemed to be a consideration more so for the high integrators at the elementary level than any other group (See Table 21).

Table 21

Percent Frequency of Respondents, By Division and Integration Level, Indicating Theme to the Question: *"When you are planning a lesson/unit, what factors make you decide to integrate the computer?"*

Theme	Elementary Low *n*=43	Elementary High *n*=35	Secondary Low *n*=34	Secondary High *n*=56
Teacher characteristics	16.3	2.9	14.7	7.1
Student characteristics	16.3	14.3	5.9	17.9
Resources	37.2	37.1	17.6	33.9
Task characteristics	34.9	57.1	52.9	62.5
Context/access	25.6	42.9	17.6	10.7
External considerations	2.3	2.9	2.9	3.6

Looking at the patterns of themes by level of integration and teaching level (See Figure 13)--although there are differences in the numbers of teachers responding to each theme--the overall pattern of responses is similar for all four groups. Teachers most often consider the characteristics of the task when planning to use technology, although low integrators at the elementary level may be the exception with less than half indicating that they consider "task characteristics." Elementary high integrators also consider whether or not they will have access to computers, more frequently than either of the secondary groups.

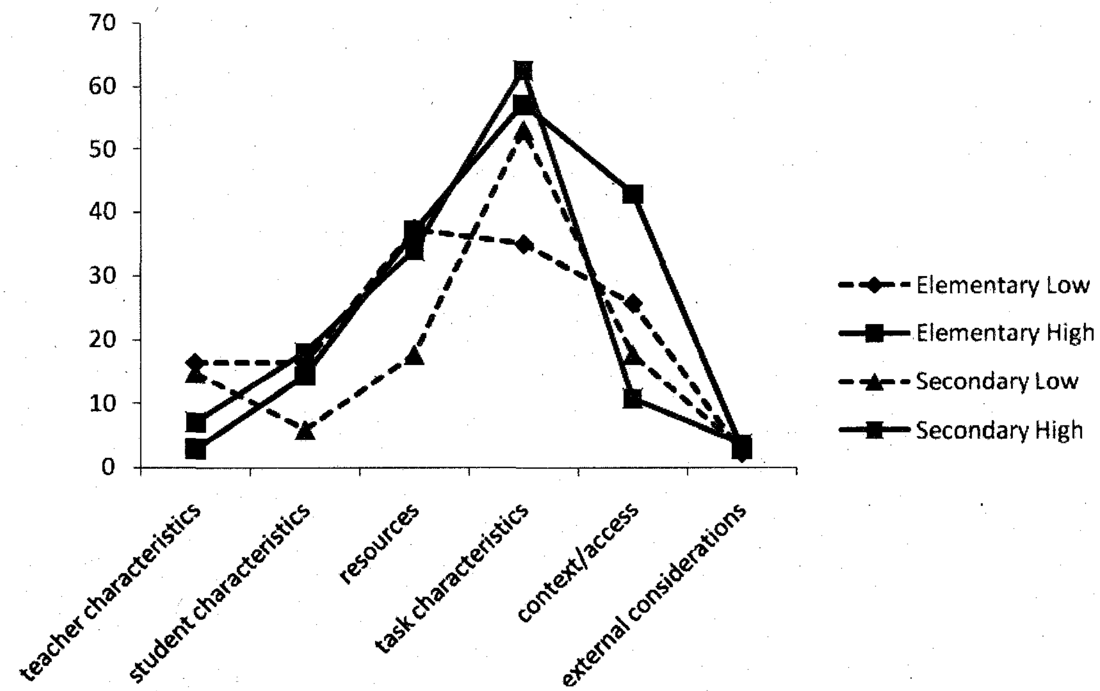

Figure 13. Patterns of themes by division and integration level for the question: *"When you are planning a lesson/unit, what factors make you decide to integrate the computer?"*

Characteristics of excellent teachers

Teachers were forthcoming with a variety of positive attributes for excellent teachers. Emerging themes grouped characteristics according to six more abstract categories: knowledge (content/pedagogical and technological); relationships; teaching style; learning style; and, other.

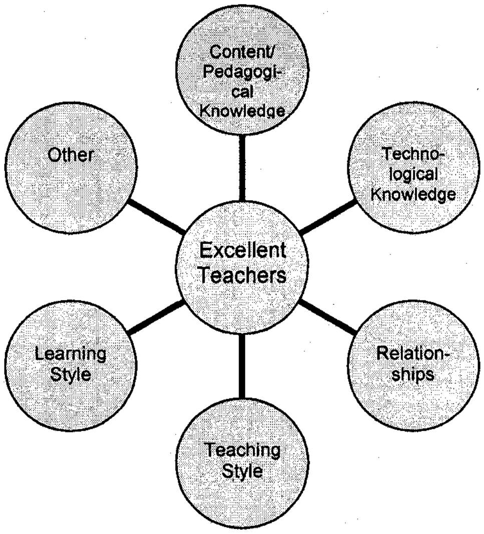

Figure 14. Themes for characteristics of excellent teachers.

Table 22

Coding Themes, Definitions, and Examples for Responses to the Question: *"If you had to define the personal characteristics of people who are excellent teachers—what would those characteristics be?"*

a. Content/Pedagogical Knowledge: included characteristics that referred to a teacher's general or subject specific knowledge as well as their knowledge of current and appropriate pedagogical knowledge. E.g., competence, knowledge of curriculum, knowledgeable in a number of areas, skilled and able to work with all abilities, up to date with curriculum

b. Technological Knowledge: included characteristics that referred to a teacher's knowledge of technology and/or experience with computers and technology. E.g., computer brain, practical experience, teach technological studies, love of technology

c. Relationships: this category included characteristics that described a teacher's relationships with others, how they treated students and colleagues. E.g., ability to connect with kids, caring, compassionate, dedicated, empathetic, fair, understanding

d. Teaching Style: included reference to how teachers presented information, how they actually taught. E.g., clarity of thought, confident, enthusiastic, good class management skills, organized, willingness to release control

e. Learning Style: this category included characteristics around how a teacher learned and kept current. E.g., accepts feedback and uses it, adaptable, flexible, lifelong learners, passionate about their subject, risk-takers, willing to experiment

f. Other: included characteristics that did not fit in the above categories. E.g., age, time, thick skinned

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The most frequent theme--the characteristic most commonly cited--for both elementary and secondary panels, was "relationships." "Learning style" and "teaching style" were also common for both elementary and secondary participants, however, "high integrators" more frequently listed characteristics related to "learning style" than did "low integrators" (89.2% vs. 73.7% and 75% vs. 56.1%, for elementary and secondary respectively). The pattern related to knowledge themes was reversed for the "content/pedagogical knowledge" theme, i.e., "high integrators" at both levels mentioned knowledge themes less frequently than "low integrators" (See Table 23).

Table 23

Percent Frequency of Respondents, By Division and Integration Level, Indicating Theme to the Question: *"If you had to define the personal characteristics of people who are excellent teachers – what would those characteristics be?"*

	Elementary		Secondary	
Theme	Low *n*=57	High *n*=37	Low *n*=41	High *n*=56
Content/Pedagogical Knowledge	38.6	21.6	43.9	35.7
Technological Knowledge	0.0	8.1	0.0	0.0

Relationships	86.0	86.5	90.2	85.7
Teaching Style	63.2	59.5	68.3	57.1
Learning Style	73.7	89.2	56.1	75.0
Other	0.0	2.7	0.0	0.0

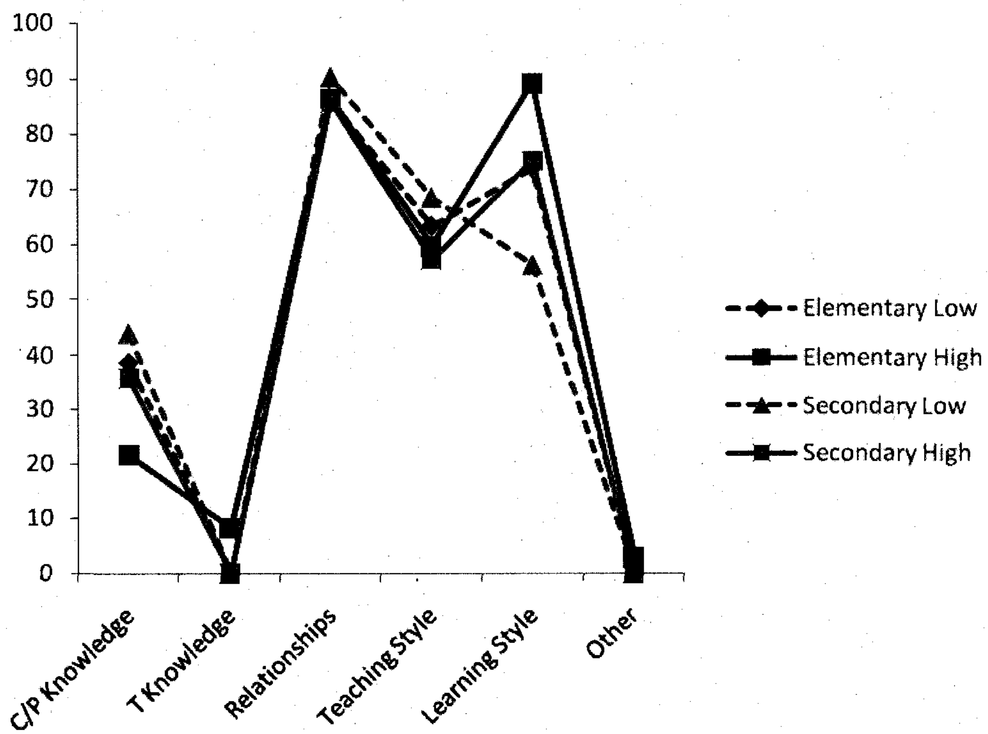


Figure 15. Patterns of themes by division and integration level for the question: *"If you had to define the personal characteristics of people who are excellent teachers – what would those characteristics be?"*

Figure 15 clearly demonstrates that, in spite of level of technology integration, teachers have very similar views of the characteristics that make an excellent teacher, with the possible exception of "learning style." In fact, the figure clearly suggests that there was considerable overlap for each of the themes. The two exceptions both occurred with the elementary high integrators who less frequently cited content/pedagogical knowledge and more frequently included "learning style" characteristics in their descriptions than other groups.

Characteristics of excellent teachers who integrate technology

When asked if excellent teachers who happen to integrate technology effectively are different from teachers who do not, less than half of the participants in any group responded with "yes". However, the "high integrators" (39.5% and 45%, elementary and secondary respectively) agreed that there was a difference more frequently than the low integrators (23.7% and 26.2%, elementary and secondary respectively).

Participants who saw excellent teachers who use technology as different from excellent teachers in general, used the same characteristics to describe them. Therefore, the same categories used to code the answers to the question, *"If you had to define the personal characteristics of people who are excellent teachers – what would those characteristics be?"* (See Table 23), were used to code the answers to the question *"Please identify characteristics that make excellent teachers who happen to integrate technology effectively different from teachers who do not."* However, the distribution of the frequencies differed somewhat. Not surprisingly, the largest number of responses in the elementary answers was in the "technological knowledge" category. Although the secondary participants also reported "technological knowledge" as a differing characteristic, high integrators at this level also referred to features related to "learning style" most frequently (See Table 24). Elementary teachers at both levels of integration also identified some characteristics related to "learning style".

A large portion of responses also fit into the "other" category, many of which referred to teachers who integrate technology as "having the time". Responses in the "content/pedagogical knowledge" category were similar across groups--between 10.0 and 16.7 percent. Many of these responses included reference to "being current and up to date" or "knowledgeable about content or pedagogy" in general. Neither elementary, nor secondary, teachers reported many features related to "relationships" or "teaching style", with the exception of more than 15 percent of "low and high" integration level secondary teachers who did indicate that "teaching style" may be different for excellent teachers who use technology (See Table 24).

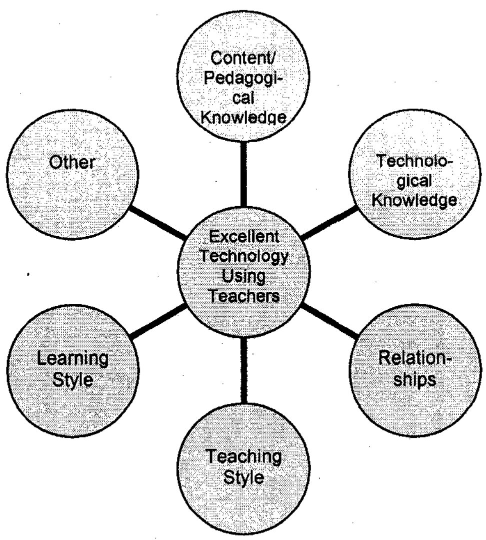


Figure 16. Themes for characteristics of excellent teachers who use technology.

Table 24

Percent Frequency of Respondents, By Division and Integration Level, Indicating Theme to the Question: *"Please identify characteristics that make excellent teachers who happen to integrate technology effectively different from teachers who do not."*

	Elementary		Secondary	
Category	Low *n*=20	High *n*=18	Low *n*=12	High *n*=26
Content/Pedagogical Knowledge	10.0	11.1	16.7	11.5
Technological Knowledge	55.0	33.3	33.3	26.9
Relationships	5.0	5.6	8.3	3.8
Teaching Style	5.0	5.6	16.7	19.2
Learning Style	25.0	27.8	8.3	73.1
Other	20.0	5.6	16.7	3.8

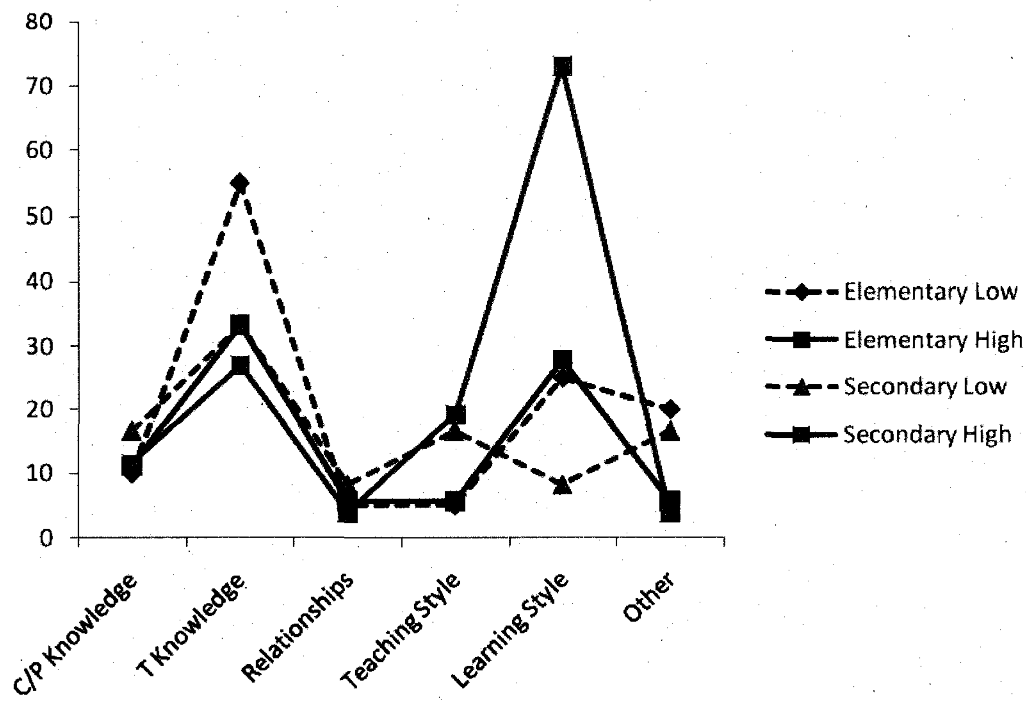


Figure 17. Patterns of themes by division and integration level for the question: *"Please identify characteristics that make excellent teachers who happen to integrate technology effectively different from teachers who do not."*

The limited number of responses to this question indicates that the majority of teachers agree that excellent teachers who integrate technology are not that different from other excellent teachers. However, examination of Figure 17 suggests differences in the number of responses from high integrators at the secondary level for the "learning style" theme. Specifically, this difference suggests that secondary teachers who use technology may be a different type of learner than those who do not. These learners were described in the qualitative analysis as risk-taking, open-minded, flexible and adaptive. The elementary low integrators saw "technological knowledge" as the key difference in tech-using teachers, suggesting that this group believes this teacher-related variable is the key to integrating technology.

Summary of comparison between low and high integrators

Considering the questions comparing the attitudes and beliefs of teachers who are low integrators and teachers who are high integrators, several similarities and differences can be identified. The participants in this study generally support the integration of computer technology in their respective divisions. They are focused on the use of computers as another tool in their repertoire of instructional methods. All four groups, (elementary and secondary, low and high integration) consider the characteristics of the task when planning for technology use with less emphasis on the characteristics of the students.

Key differences did emerge, however, between those teachers who integrate technology fully and those who do not. The low integrators, particularly at the elementary level, identify barriers to integration related to resources, time, and their own lack of comfort and skill with computers. They more often consider teacher characteristics when planning to use technology than their colleagues who are integrating more fully. Low integrators also indicate that computer technology can be an inappropriate pedagogy and sometimes prefer other methods. More high integrators than low integrators see excellent teachers who integrate technology as different from other excellent teachers. Secondary teachers in particular identified "learning style" characteristics as unique to the "tech users." Elementary integrators also listed fewer "content/pedagogical knowledge" related responses, suggesting that these technology using teachers don't need to be experts but do need to be life-long learners who are willing to experiment and take risks.

How Computers Are Being Used

Two of the qualitative questions directly addressed "how" computers were being used by elementary and secondary teachers in their classroom instruction, i.e., what they asked students to do with computers. The first question was an "other" response to a list of activities that teachers ask students to do using computer technology. The second question looked at a particular context of use, asking teachers to describe their use of technology in teaching literacy.

Types of computer activities

The list of activities included in the question that asked how frequently teachers ask students to use the computer for specific tasks as part of a lesson, appeared to be comprehensive, that is, there were a small number of responses written in the "other" category. Only 1 elementary response and 3 secondary responses did not fit within the categories listed in the question (on-line research, tool-based software, subject-specific tutorials, communication tool, or assessment tasks). The elementary response referred to the use of computers for "basic computer skills, like how to use the mouse" and the secondary responses all referred to "programming". It seems that teachers are rarely teaching "about technology" and are more frequently using computers as a tool to perform activities, such as, on-line research, tool-based software, and subject specific tutorials (as listed in the question).

Use of computers to teach literacy

Another question that addressed the use of computers, asked teachers to indicate how they used computers to teach literacy. Not surprisingly, a larger number of elementary teachers indicated that they used computers to teach literacy (58.4%) than secondary teachers (32.4%) (See Table 25). Secondary teachers are generally specialists and those who do not directly teach Languages may not report that they teach literacy skills.

Responses were coded according to emerging themes around the use of computers as a cognitive tool for teaching literacy. The variety of applications were ordered according to complexity of literacy skills addressed. That is, themes were labeled from one to five, moving from relatively low level skills to higher-order, more complex literacy skills (See Table 25). Lower level themes included automation of existing skills, such as typing, or practice of low-level literacy tasks such as spelling and punctuation. The higher level themes included construction of knowledge to create something new and sharing knowledge with others.

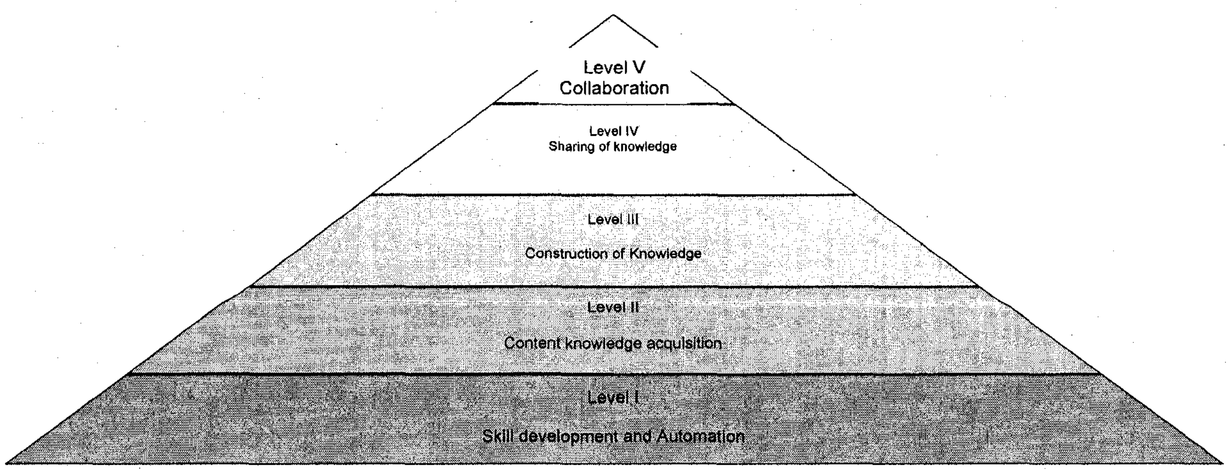


Figure 18. Themes for use of technology in literacy instruction.

Table 25

Coding Themes, Definitions, and Examples for Responses to the Question: *"How do you use computers to teach literacy?"*

Levels, Descriptions, and Examples

Level I Skill development or automation

Use at this level is focused on the development and/or practice of low level skills. Technology is used to automate mechanical processes. e.g., Typing up a final draft that was composed on paper; checking spelling; reading spelling list, etc.

Level II Content knowledge acquisition, grammar and vocabulary

The second level includes learning content knowledge and more advanced literacy skills, such as grammar, vocabulary, etc. Other higher level skills might include reading on-line to gather information and learning how to use search words. e.g., on-line research of author information and novel related issues; using word processing and grammar checks.

Level III Construction of knowledge, evaluation

The third level includes activities that involve creation of knowledge, composition of something new, or evaluation of existing information, as well as editing or reconstructing information. e.g., Writing stories, creating projects, story maps or graphic organizers; evaluating websites or literacy on-line; creating resumes and cover letters.

Level IV Presentation/sharing of knowledge

The fourth level includes literacy tasks that involve presentation of knowledge and/or sharing knowledge with others. e.g., Publishing a final draft of a story to share with others; composing newsletters on MSPub.

Level V Collaborative knowledge construction

The final level involves collaborative knowledge construction or using the technology in innovative ways. e.g., Development of literacy piece through on-line collaboration or construction of group knowledge using computer technology.

The elementary teacher responses indicated a decreasing pattern of higher level literacy activities in the "low integration" group of teachers (See

Figure 19). That is, the "low integration level" teachers used the computer for a greater percentage of low level activities than higher level activities. The sample of secondary teachers that were "low integrators" who were using computers to teach literacy was too small to draw conclusions for use at that level (n = 5). High integrating teachers at both elementary and secondary levels reported the majority of activities that were considered Level II and Level III with limited use at a level IV and V.

Table 26

Percent Frequency, By Division and Integration Level, of Highest Level Theme Indicated in Response to the Question: *"How do you use computers to teach literacy?"*

	Elementary			Secondary		
Level	Low n=17	High n=25	Total n=100	Low n=5	High n=26	Total n=59
I skill development	64.7	4.0	31.0	20.0	3.8	6.8
II content knowledge	17.6	28.0	20.0	40.0	42.3	44.1
III construction of knowledge	17.6	44.0	32.0	20.0	38.5	37.3
IV presentation/sharing	0.0	20.0	13.0	20.0	15.4	11.9
V collaborative construction	0.0	4.0	4.0	0.0	0.0	0.0

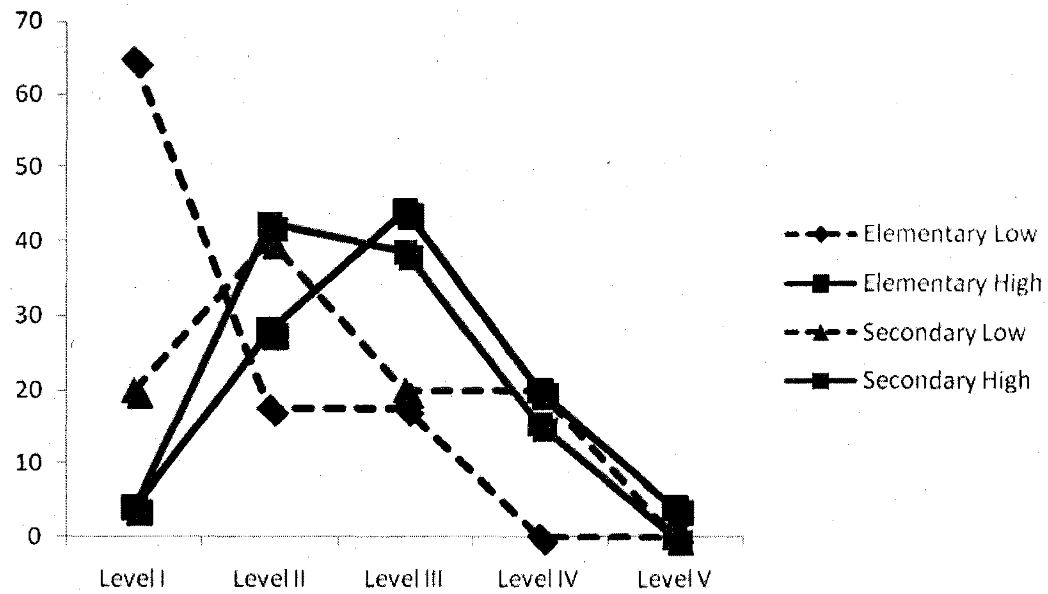


Figure 19. Patterns of themes by division and integration level for the question: *"How do you use computers to teach literacy?"*

Summary of how computers are being used

The qualitative data describing "how" computers are being used was limited. That is, only 3 responses were unique in the "other" type of computer activities category and only 5 "low integrators" in the secondary level reported using computers to teach literacy. However, the themes emerging from the description of how computers are being used to teach literacy indicated that not only are computers being used to a different degree among teachers, but the way they are being used also differs. The coding scheme identified five hierarchical levels of use for teaching literacy using technology. The low level integrators are using technology in less complex ways--to automate existing practices and improve the efficiency of low level skills. The majority of codings, even for the high integrators, were at the second and third levels. The potential of computer technology as a cognitive tool may be capitalized more fully in other content areas, such as science or mathematics, but this was not considered directly in this survey.

Conclusions

The rich qualitative data supplied by the open-ended question portion of this comprehensive survey, addressed the three goals delineated in the introduction to this third and final component of the overall study. First, the barriers and supports that continue to impact computer integration were identified in relation to the environmental and individual variables from previous frameworks (Wood et al., 2005). Second, the attitudes and beliefs of the teachers who are integrating computer technology at a high level were compared with those who are not. Finally, a qualitative exploration of how teachers are using technology to teach literacy provided an initial examination of the way computers are being used and by whom.

The barriers and supports that were discussed by the teachers in their open-ended responses were captured by the same themes that were identified in the literature—both environmental and individual (Levin & Wadmany, 2008; Wood et al., 2005). However, the themes emerging from the focus group transcriptions in the 2005 study by Wood and colleagues, included a strong affective component that was not apparent in the responses to the more directed, albeit open-ended, questions in the current survey. The qualitative answers did allow for elaboration and introduction of new elements in addition to the forced-choice questions, but did not capture emotional responses of teachers that the open discussion of focus groups may have allowed. The larger sample of answers, however, did provide the opportunity for generalization and comparison on a broader scale than the limited sample from focus groups.

The frequencies of themes indicated that elementary teachers and secondary teachers differ in their emphasis of teacher-related variables impacting their integration of technology. Secondary teachers are asking for access to the technology that exists, that is supported by administration, and that they already know how to use—it is a matter of context and access, having the resources available when they are needed. Elementary teachers are still struggling with some technical difficulties and a portion of teachers at this level are still not comfortable teaching with the technology itself. It is not surprising that the impact of technology differs across teaching levels and content areas. Although the numbers in each content area at the secondary level were too small to discriminate among subjects, the focus on content at the secondary level makes technology integration different from the elementary level. The elementary teachers, who are more generalists, are attempting to integrate computers across the curriculum, while secondary teachers are able to consider the technological content implications of computer integration. Koehler and Mishra's (2008) TPCK framework that suggests that successful integration of technology requires an understanding of the interaction of content, pedagogy and technology, makes the process complex, beyond simply knowledge about technology and access to hardware and software resources.

One key addition of this qualitative component of the larger study grew out of the comparison of those teachers who integrate technology fully with those who do not. The opportunity for teachers to explain their attitudes and beliefs resulted in the identification of some underlying barriers and supports. That is, teachers were asked to explain how computer technology fits, or does not fit, with their instructional style—giving them the opportunity to specify the features of computer technology that may not support their teaching philosophy. For example, "primary students need human interaction"; "personal presentation is still the most effective with opportunities to field questions"; and, "I like to use multiple intelligences and differentiate learning styles and I find computers only address a limited learning style."

Although teachers did not always directly state their "instructional style", they described the potential of computer technology using language related to constructivist, individualized instruction, such as "authentic tasks", "self-regulated learning", "current part of students' lives", etc. Generally, responses were positive in terms of computer technology fitting with instructional style, such as "I use computers to demonstrate concepts and show new ways of doing things"; "as a computer science teacher, I use a different style. I'm mainly a resource. I feel comfortable with this. However, I understand how traditional classroom teachers have problems adjusting to a lab given the way I change my style in a non-computer math classroom"; and, "I like how computers engage my students and motivate them. I like how they allow students to be self-directed."

Those teachers that didn't see a fit were citing restrictions due to time and resources as reasons, rather than philosophical disagreements. For example, "Due to personal obligations at home, I truly don't always have time to plan for use of computers properly"; "I'd love to use it more but there are many restrictions such as not having enough computers to teach a class"; and, "I don't think about using computers except for student research because it is such a hassle getting computer access. And they are slow. Waste too much time if they break down."

Although all four groups (elementary and secondary, high and low integrators) were similar in their reference to computer technology as a valuable resource and another tool to be used in teaching and learning, they differed on what characteristics might differentiate teachers who use technology from those who do not. The characteristics of excellent teachers in general were strikingly similar across all groups. Teachers see characteristics that support relationships (caring, compassionate, dedicated, empathetic, sense of humour) to be most important in excellent teachers, although elementary high integrators also cited learning style characteristics (accept your faults and learn with your students, flexible, energetic, life-long learners, willing to try new things) as equally important. The secondary high integrators identified learning style as unique to technology-using excellent teachers, while elementary high integrators focused on technological knowledge. The differences and similarities between high and low integrators suggest that teachers who are integrating technology may not be qualitatively different teachers, but rather qualitatively different learners.

Qualitative responses to how computers are being used gave initial insights into actual classroom practice, at least within literacy instruction. The structural coding of the responses resulted in a hierarchical structure of leveled tasks, i.e., tasks were rated as more or less complex. Teachers who were integrating technology more fully also used that technology in more complex ways, for example, "I often use the computers for students to partner up to write stories"; "we go to startfall.com and read together sites where stories are interactive"; and, "hyperstudio-planning/making/presenting multimedia responses rather than pencil/paper book reports". The teachers who were using technology to a lesser degree were using it in lower level ways (word processing, type out word wall words, spell check, when students type reports they're technical grammar must be good) often automating existing practices and improving efficiency (Maddux & Johnson, 2005). Research evaluating technological practices that include drill and practice suggest that this type of use looks promising, whereas assessment of the effectiveness of more complex uses of technology is less conclusive (Abrami, Savage, Wade, Hipps, & Lopez, 2008). Until technology is more fully integrated in classrooms and used for these more complex applications, it is difficult to measure its effectiveness.

The teachers who are using technology to a greater extent also indicated that they use technology because it allows for authentic learning tasks, that is, teachers who include authentic (real-life) tasks as part of their instructional approach are more likely to utilize computers in their teaching. It may be that these teachers see the potential of computer technology to support problem-solving of real-life issues.

Those teachers who are integrating technology as a valuable cognitive tool may have reached a level of understanding of the technological pedagogical content knowledge that Mishra and Koehler (2006) suggest is necessary for successful integration of technology. Emphasis is on task characteristics and student learning and how they can be supported with computer technology. Teachers who are still reporting barriers to computer integration may need to expand their understanding of how the content, pedagogy and technology interact (Mishra & Koehler, 2006).

This qualitative examination of teacher responses to open-ended questions has served to triangulate the findings of the first two studies, suggesting that barriers to integration still exist but are less focused on technology and more directed at the teacher as a learner and the individual attitudes and beliefs surrounding not only technology as a cognitive tool, but the teacher's own knowledge and characteristics as a learner.

General Discussion

The prevalence of computer technology in our society and the potential of technology as a cognitive tool that supports learning emphasize the need for a complete and accurate model of successful integration. The individual teacher is a key component to the implementation of any innovation in the school system and computer technology is no different. The current research project examined the barriers and supports to successful computer integration using responses from educators in the field at the elementary and secondary levels and identified the variables that are most important in distinguishing those teachers who successfully surmount the barriers to integration from those teachers who do not integrate technology.

The initial study used a discriminant function analysis to assess what variables best discriminate teachers who fully integrate technology from those who do not. The discriminant function accounted for a large amount of the variance in computer integration level. The importance of individual teacher characteristics was highlighted; and, attitudes towards computers as a cognitive tool and positive experience with computers specific to the classroom were identified as significant predictors beyond general computer use, comfort, and training. In the case of the elementary teachers, intrinsic work motivation was also a significant discriminating variable.

The second study confirmed the nominations of the school board personnel of "expert" computer users. Differences between the nominated group and the randomly selected participants were identified at the elementary and secondary level. Although the two groups were similar demographically, the "experts" reported a higher level of computer planning and integration, used computers more frequently with students for a variety of tasks, and saw themselves as more adept at computer integration than their peers. The accuracy of the nominations from school administrators suggests that teachers who integrate technology are visible different than their peers and could be easily identified for purposes such as research, professional development, or mentoring programs.

The third study triangulated the results of the first two studies in identifying barriers and supports that still exist as well as giving teachers the opportunity to include aspects of computer integration that were not directly measured by the forced-choice questions. The qualitative answers around *how* computers are being used to teach literacy gave initial insights into actual classroom practice. Teachers reported using technology for authentic tasks and frequently considered the task characteristics when deciding when to use computers. There was a great deal of language centred around a constructivist approach to instruction which matches the relatively high scores on the Teacher Belief Survey measuring constructivist and behaviorist beliefs. The attitudes of teachers toward computer integration were positive for the most part and indicate that if barriers were removed, teachers would be willing to integrate computer integration more fully.

The literature in the field of technology integration has presented "stage" theories that suggest integration moves through phases of development (e.g., Sandholtz et al., 1997; Valdez et al., 2005). These theories, however, offer little or no explanation as to what variables, other than computer experience or training, may be responsible for the movement through such phases. Additional work has introduced the individual characteristics of the teacher as key to successful integration (e.g., Fisler & Firestone). Case study and focus group research has developed frameworks that identify both individual and environmental barriers to successful integration of (e.g., Granger et al., 2002; Johnson, Maddux, & Liu, 2000; Wood et al., 2005).

Results of the current three studies support the hypothesis that the teacher is key to the successful integration of technology. A more complete model—one that suggests how individual and environmental variables interact—was developed. Both individual characteristics (learning style and motivation) and knowledge, in the form of TPCK (computer experience, attitudes toward computers as a cognitive tool, teaching philosophy), may be the necessary prerequisites before the environmental variables (human and technical resources, access and context) can support successful integration (See Figure 20).

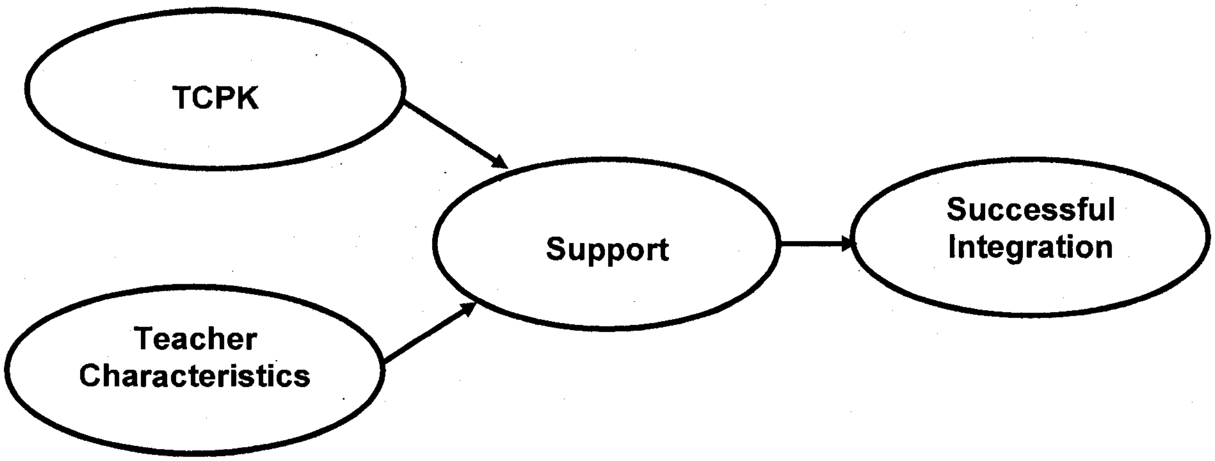


Figure 20. Model for successful integration of computer technology

The complexity of teacher change and school reform coupled with the rapid change of technological innovations has made it difficult to identify and integrate the individual and environmental factors that impact computer integration. Computer technology, by its nature, is complex and difficult to implement. Koehler and Mishra (2008) suggest that technology is not "transparent" to the user. That is, digital technologies, such as the computer, are "protean" (have multiple uses); "unstable" (rapidly changing); and, "opaque" (how they actually work is hidden from the user). This lack of transparency creates a perception that this innovation is difficult to implement and is removed from the current practice of many teachers, making it less likely that a teacher will adopt technology (Zhao, Pugh, Sheldon, & Byers, 2002).

Teachers have support in terms of access to computers and the opportunity to get technology up and running. The list of places where computers are available was comprehensive, although "resources" and "access" continue to be prominently cited barriers. Support comes from both teachers and administration. Administration is offering support in the form of philosophy and resources. Teachers themselves support computer integration for pedagogical reasons—using computers as a valuable and effective tool and most who do not are citing reasons related to lack of resources and inappropriate pedagogy as their reasons. Teacher knowledge and comfort was still an issue at the elementary level.

Early research that proposed a set of stages through which teachers progress in the implementation of technology (Hord, Rutherford, Huling-Austin, & Hall, 1987; Sandholtz, et al., 1997; Steinberg, 1991;Valdez, McNabb, Foertsch, Anderson, Hawkes, & Raack, 2005) suggest that there is an incremental increase in knowledge and integration as teachers gain experience and undergo training. However, it may be more about developing an integrated base of knowledge about technology and instruction that interacts with the individual learning and teaching style of the educator that determines degree of integration. The findings that computer technology is seen by integrators as a cognitive tool within the context of teacher knowledge, beliefs and attitudes, supported by human and technical resources, includes the TPCK model of teacher knowledge (see Figure 1) but this model is not sufficient.

This complex interaction of content, pedagogy, and technology may be the knowledge base that is a catalyst for successful integration. However, that knowledge must be supported through resources, access, training, and individual attitudes toward technology. The training that supports this knowledge construction will need to provide positive, specific, in-context experiences for teachers. This model supports the findings of the current study that suggest knowledge of technology alone does not result in successful integration but that a complex interaction of knowledge about "what" is being taught, "how" it is being taught, and "how" technology impacts these domains is necessary. The individual teacher is the central feature in any computer integration plan. However, it is ultimately a combination of the individual knowledge, beliefs, and attitudes of the teachers that impact their decision to integrate technology in the classroom. The personal characteristics of the teacher must be considered along with the complexity of knowledge required for successful integration of computer technology.

Teaching is an "intentional and reasoned act" (UNESCO, n.d.) that should be based on student learning. Before a teacher's planning and instruction can be based on student outcomes within the learning context, they must be able to look beyond their own knowledge and expertise (Sugar, Crawley, & Fine, 2004). Teachers who are using technology consider task characteristics along with student characteristics in deciding to use computers.

Recent research has examined theoretical bases that suggest that teachers' decisions to integrate an innovation are based on a teacher's perceived consequences, cost, and/or expected value of the technology (e.g., Sugar et al., 2004; Zhao & Cziko, 2001; Wozney et al., 2006). These theories require that teachers are making a planned, conscious evaluation of the potential and impact of computer technology. The results of the three studies described above suggest that teachers who have positive experiences with computer technology are more likely to integrate technology at a higher level. The reference to the potential of the computer as a cognitive tool that supports constructivist pedagogy (e.g., self-regulated learning, differentiated instruction, and collaboration) suggests that teachers do indeed need more than technological knowledge--teachers need to integrate that technological knowledge with the content they teach and the pedagogy they use. The qualitative themes emerging in response to characteristics that identify excellent, technology-using teachers included content and pedagogical knowledge, along with technological knowledge.

What then allows teachers to overcome the identified barriers to construct, and/or act on, this technological, pedagogical, content knowledge? The individual characteristics and motivation of teachers impact the model of knowledge proposed by Koehler and Mishra (2008). The TPCK model may indicate *what* teachers need to know to successfully integrate technology, but the results of the research reported here, suggest that we need to consider *how* teachers acquire this knowledge and *who* they are as individuals. That is, the learning style of the teacher and their personal motivation based on perceptions, beliefs and attitudes will determine whether or not they construct this knowledge and then act on it. The "excellent, technology-using" teachers described in the qualitative themes of Study Three in combination with the significant predictive power of the WPI Challenge subtask in Study One, suggest that teachers who are risk takers and life-long learners are more likely to integrate computer technology.

Although there was no difference in the characteristics listed by high and low integrators in terms of how they described an excellent teacher, high integrators did suggest characteristics that distinguish excellent teachers who integrate technology from excellent teachers who do not. The most frequently cited characteristics of excellent teachers fell under the "relationships" theme, i.e., understanding and caring, while high integrators recognized the importance of learning style in integrating technology. That is, they listed characteristics related to self-regulated learning (adaptability, innovative, on-going learning, self-motivated, etc.) and risk taking (risk-taker, not afraid to explore, willing to try and experiment with new ideas, etc.) as being unique to technology integrators. Surprisingly little attention was paid to the teaching style of "excellent" teachers—rather, the learning style of the technology-using teachers, along with their technological knowledge, was the key distinguishing characteristic cited by teachers.

These same themes were identified by high integrators when asked to describe how technology fit with their instructional style. Teachers who integrate are "life long learners" and focus more frequently on student outcomes when considering the use of technology. Koehler and Mishra (2008) suggest that "TPK [technological pedagogical knowledge] requires forward-looking, creative and open-minded seeking of technology, not for its own sake, but for the sake of advancing student learning and understanding" (p. 17).

The Challenge subscale of the Work Preference Inventory (Amabile et al., 1994) did distinguish low and high integrators suggesting that those teachers who are motivated by the challenge that integration of technology presents, may be more successful in its implementation. These "self-regulated learners" are more likely to seek independent strategies and pursue challenging goals.

The discriminating variables for both elementary and secondary teachers did implicate both attitudes toward technology and experiences with computers. There is no question that technological knowledge is a necessary component in successful integration, as evidenced by the continued reference to resources and access, and teacher comfort and skill (more so at the elementary level). However, the importance of highly specific, positive experiences with computers suggests that technological knowledge interacts with the content and pedagogy of teachers, as depicted in Koehler and Mishra's (2008) TPCK model.

The lack of significant impact of teacher efficacy and teaching philosophy as measured by the Teacher Belief Survey (Woolley et al., 2004) may at first be surprising considering the themes identified in Study Three that suggest high integrators see technology as supporting self-regulated learning and knowledge construction. However, the teaching efficacy scale was a general measure of a teacher's confidence that s/he can effect change in student's learning and not particularly related to computer self-efficacy (Paraskeva et al., 2008; Poulou, 2007). The limited variability on the teaching efficacy scale and the constructivist belief scale suggests that these teachers were reporting a rather homogenous philosophy toward teaching and believed themselves to be quite capable. The differences were more specific to attitudes toward computers and more complex uses of the computer.

Although teachers did not directly identify their teaching philosophy in the qualitative portion of this research study, they used internal representations of their "instructional style" in deciding if technology fit with that style and whether or not they supported computer integration for their students. Teachers who saw technology fitting with their instructional style gave responses that described the potential of computer technology as a cognitive tool, for example, valuable resource, self-regulated learning, or current tool. Those who did not see a philosophical fit were fewer in number and their responses fit in themes that were related to computer comfort, resources, curriculum, and pedagogy that did not match their preferences.

Those teachers who supported the integration of technology cited reasons that fit under themes such as, efficient tool, valuable resource, individualized learning, and necessary skill; themes related to the potential of computer technology. Those who did not support the integration for students in their divisions, gave responses more directly related to resources and skills outside the potential of the technology, such as resources, comfort, time, and access. There were some comments related to the pedagogy of computer technology being inappropriate as well but it was not the only concern.

Computer technology is generally seen to be a cognitive tool that supports a constructivist approach to learning and successful integration has been predicted by instructional design based on this approach (Johnson et al., 2000).

Learning environments that provide opportunities to explore and create individual learning outcomes, support the successful integration of computer technology. The actual use of software as a "tool to enhance learning"—defined as Type II applications in Johnson et al. (2000), rather than as a "teaching machine" (Type I applications), is also a significant predictor of successful outcomes with technology.

How computers are being used by the teachers in this study was related to teachers' beliefs about learning. The list of student activities when using computers was comprehensive, that is, the only additional activities added in the "other" category were a few comments about teaching *about* computers. Teachers are asking students to use computers for a variety of tasks, mostly on-line research at the secondary level, and for subject-specific tutorials and tool-based software applications at the elementary level. However, although teachers report asking students to do a variety of tasks on the computer the amount of use is still a "moderate amount." Computer integration is still relatively far from an "everyday" occurrence in classroom instruction. The qualitative response to how computers are used to teach literacy did identify a pattern of use where high integrators asked students to perform more complex tasks using the computer than the low integrators. Those teachers who are successfully integrating technology are using it for applications that closely resemble the Johnson et al.'s (2000) Type II applications.

Implications

The identification of a set of discriminating individual characteristics of computer integration has implications for professional development and policies related to computer integration and support. It is clear that technology training needs to move beyond basic computer skills to include curriculum-focused preparation (Zhao & Bryant, n.d.). The knowledge base should include, not only technology, but content and pedagogy as well, in an integrated fashion. The curriculum-focused training in Zhao and Bryant's study changed teachers' attitudes but not to the degree of actual integration in classroom practice. Results differed according to technology expertise (technological knowledge) and teaching experience (new teachers). Experienced teachers indicated that they got a lot out of the training and were able to incorporate programs into their lessons, while new teachers did not feel they benefited from the training and did not feel they used technology as much as they should have after training. These teachers cited similar barriers to the teachers in the current study, including access, time, support, and curriculum. Mentoring at an appropriate level and time (i.e., "just-in-time" support) was beneficial for elementary teachers in the study. This same type of timely support was identified by Granger et al. (2002) teachers in elementary schools as more preferential than workshop presentations.

The identification of "positive experiences" with technology in context, suggests that training must take place within a teacher's instructional environment and should present computer technology as a potentially useful cognitive tool that supports self-regulated, authentic learning. Voogt, Almekinders, van den Akker, and Moonen (2005) used a blended approach to technology integration support that included workshops, exemplary curriculum materials, and computer-mediated communication (via listserv and website). Training incorporated pedagogical concerns as well as technological issues and teachers indicated that this moved them through the stages of adoption to a point where they could apply what they knew about technology and use it as an integrated tool in the curriculum.

This "just-in-time" instruction could be supported by the "experts" that are present in schools and accurately identified by administration, as suggested by Study Two results. These "experts" are using technology more frequently but also for a variety of tasks that have a greater complexity than those who are integrating less frequently. Their experiences provide specific evidence that computer technology is a productive, cognitive tool that supports learning. The theories and models that consider knowledge, comfort, and resources alone do not adequately explain what might move educators over the hurdles and along a continuum of integration. Further investigation into the individual characteristics of teachers and their views of learning is necessary to refine professional development and support that best develop technology integration.

The differences between elementary and secondary teachers suggest that professional development must be differentiated for teachers according to teaching division. That is, elementary teachers were more concerned with teacher-related variables than secondary teachers. Elementary teachers were still struggling with technological knowledge and comfort, while secondary teachers were asking for access to computers with which they were already comfortable. Elementary teachers also cited “technological knowledge” most frequently in describing teachers who do integrate technology, while secondary teachers more frequently talked about the learning style of the teacher. This indicates that the needs by level are indeed different. It may be that elementary teachers feel the need for more technology knowledge and skills because they have not received enough training. Alternatively, elementary teachers may need to feel more confident with the technology because their students, being younger and less experienced, may require significantly more assistance from these teachers than the needs of students in secondary school. In elementary classrooms, teachers have to navigate even the simplest of routines (including getting to the computer lab), while these kinds of routines would be highly familiar and automatic for secondary school students. Therefore, the need for more knowledge may reflect the greater troubleshooting demands facing elementary teachers. This interpretation is supported by our data which suggests that both groups of teachers are familiar with technology –with those integrating technology more fully being significantly more comfortable with computers than their peers who are not integrating computers.

For highly skilled integrators, the emphasis on “risk taking” and “life-long learning” suggests that teachers who successfully integrate at the secondary level may seek out learning opportunities beyond those of the average teacher in that division. It is not directly about moving through the stages of adoption referred to in the literature review, but perhaps more about an approach to learning and how learning impacts instructional choices, like computer technology.

The conclusions of this research can be summarized in the contribution to the framework of successful computer integration referred to in the introduction (See Figure 2). The teacher remains at the centre of any successful integration but the individual characteristics that impact that integration have been developed to include personality variables of challenge and learning style. Knowledge of the individual that was previously considered in separate variables of computer experience, training, and pedagogy can be considered as an integration of technology and pedagogy, along with knowledge of curriculum, students, and development (teaching level). That is, Mishra and Koehler (2008) propose a model of teacher knowledge necessary for technology integration that demands the interaction of content, pedagogy, and technology. This interaction was alluded to in the original framework (See Figure 2) but was identified as an important consideration in the results of this study that suggests teachers may benefit from technology experience that is rooted in pedagogy and positive experiences within the teaching context.

The variables in the framework for implementation in Figure 2 can be found in the model suggested in Figure 20. The "familiarity with computers" is consistent with "technological knowledge; the "curriculum" is related to "content knowledge"; the "pedagogy" in the framework matches the "pedagogical knowledge"; training may represent "technological pedagogical or just technological knowledge"; and, the "student characteristics" may include "pedagogical content knowledge" in that teachers need to know how to teach a particular subject with particular students. The "location" and "support" variables are represented in the new model as "support". The "affect" and "teaching level" variables in the framework came from themes that may represent the individual "teacher characteristics" identified in the model.

Although this model is correct in suggesting that this Technological Pedagogical Content Knowledge may be necessary, it is not sufficient. Support variables, including context (lab or classroom), resources (human and technical), and administrative support are still important variables in the eyes of these educators. The framework for variables impacting teachers' integration of computer technology can be revised to create a more parsimonious model of integration that includes Knowledge, Support, and Personal Characteristics (See Figure 20). The successful integration of technology then, is dependent on a teacher's knowledge, his or her individual characteristics, and the support available. The type of support required may depend on the personal characteristics and knowledge of the teacher.

Limitations and Future Research

Continued research examining the characteristics and dispositions of teachers who are successful in integrating computer technology into the classroom will help to refine policy and practice surrounding professional technology development for teachers and how teachers can be best supported in their efforts. Barriers to integration appear to be breaking down and it is now time to build on supports that address not just technological comfort but the integration of content, technology and pedagogy (Koehler & Mishra, 2008).

The current findings, however, are based on self-report data and should be confirmed and expanded through actual classroom observation (Bain & McNaught, 2006). Judson (2006) suggests that self-reports do not often match practice and that observation is necessary for a picture of actual behaviour. The variety of measures used in the survey to represent latent constructs, such as computer use, integration, and attitudes, could be expanded through behavioural measures and built into a complex model of computer integration. It will be imperative to examine a teacher's behaviour in context, over time, to build a more complex model that includes content, pedagogical and technological knowledge as well as teacher characteristics and beliefs related to learning and instruction; and to further distinguish the development of "low integrators" and "high integrators". One caveat that should be remembered is that the discriminant function analysis, although identifying the variables that distinguish the "poles of integration", does not speak to the "average" teacher. Any professional development or support for computer integration based on the model developed here should consider this caution.

We generally know what teachers "feel" about professional development in terms of what they believe is valuable but this study did not use any measures of what teachers actually learned or whether practice changed as a result of workshops and consultations with colleagues. Future research needs to provide professional development based on the variables identified here as important to successful integration and then measure the impact in terms of learning outcomes and teacher change. Bradshaw (2002) reported that ideas in workshops go unused because teachers don't have a chance to try it or activities are not relevant to their students; however, there was a broad recognition that teachers must develop new knowledge and skills in order to integrate technology effectively.

In addition, investigation of pre-service teachers' attitudes and eventual practice would assist in determining causal direction between computer integration and the variables identified in the discriminant function analysis as strong predictors. Do the positive experiences with computer integration encourage higher levels of integration or are they a consequence of the integration? Are attitudes toward computer technology as an instructional tool, prerequisites for integration, or are they developed through experience with computer integration? What forms of professional development that allow for positive experiences with computers are most effective?

Closing Comments

Learning about technology needs to be implicit in authentic problem solving connected to content and appropriate pedagogy. Any professional development or training should include teaching content and using technology as a tool to do that. Any approach to technology integration must consider the individual learning styles and experience of the teachers involved and be directed at their specific personal characteristics and goals. What needs to be included in staff development of technology integration is the impact of technology on “how students learn” and “how teachers teach” in a digital age.

Appendix A

ABOUT THIS PACKAGE:

This package contains a survey about **computer technology in the classroom**. The survey represents a collaborative research project between three Universities and the CATC group at the Waterloo Region District School Board. You were randomly selected from a list of all educators in the board to receive this package. We are asking 300 elementary and 300 secondary teachers to participate in this research project. Your input is valuable so we hope you will take a few moments to consider completing the survey.

What's in this package:

You'll find **one survey**, **an information letter**, **a consent form**, **a draw entry form**, and **their return envelopes**. Please read the information letter first. Then, you can complete the form labeled "Consent to Participate" and put it in the envelope labeled "Consent." You can pop that stamped and addressed envelope in any Canada Post mailbox. If you decide to participate in the study, you can complete the survey and pop it in the large stamped and addressed envelope. That, too, can go in the Canada Post Mail. Finally, you can fill out the draw entry form if you would like to be entered in the draw. The draw entry form can be put in the envelope labeled "Draw" and sent by Canada Post mail. That's it!

Appendix B

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 (CATC 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 any one 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 Marr 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 form to acknowledge whether you would like to participate or not, and an entry form allowing your name to be entered in a draw. Both of these forms 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.
Psychology Department
Wilfrid Laurier University

Appendix C

SECOND MAILING

- **This survey package is a follow-up to an initial package sent to you some weeks ago. We are sending this second package because we did not receive a response (either agreeing to or declining participation) following the first mailing and we wanted to make sure that you were not prevented the opportunity to participate as a result of mailing errors.**

- **If you prefer to decline participation, please return the consent form indicating your preference not to participate in this research project.**

- **If you choose to participate, please return the consent form, draw form, and survey by December 31, 2004.**

- **If you are receiving this package for the first time, or would like to know more about this research please read on.**

Appendix D

December 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 (CATC group) and researchers at Wilfrid Laurier University, Brock University and The University of Western Ontario. We are investigating perceptions about computer technology in the classroom and feelings, experiences, and beliefs that might have an impact on those perceptions. We are hoping that you will be willing to fill-in the enclosed survey. **This survey package is a follow-up to an initial package sent to you some weeks ago. We are sending this second package because we did not receive a response (either agreeing to or declining participation) following the first mailing and we wanted to make sure that you were not prevented the opportunity to participate as a result of mailing errors. If you prefer to decline participation, please return the consent form indicating your preference not to participate in this research project. If you choose to participate, please return the consent form, draw form, and survey by December 31 2004.** If you are receiving this package for the first time, or would like to know more about this research please read on.

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. All 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 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. Individual survey items will not be presented in isolation but will only be discussed as part of the larger survey components. 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 any one 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 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 is deleted from our survey-name code, meaning that, from that point forward, no information could be traced to the original participant. **A quick follow-up check will be made, for all participants from whom no response has been received by December 31, 2004, to ensure the survey was received.** 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 ensures 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 Marr 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 are stamped and can be sent separately. There are three draw prizes for each education level (elementary and secondary): 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 odds of winning a prize depends on the number of draw entries submitted with the maximum odds being 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. We will provide a summary to the CATC group and they will distribute this to principals and teachers. 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 for taking the time to consider this request.

Sincerely,

Appendix E

CONSENT TO PARTICIPATE

Title of Research Project: Computer technology in the classroom.

I, (print name) ____ have read the information letter
outlining the collaborative research project being conducted by the Waterloo Region District School
Board (CATC group) and researchers at Wilfrid Laurier University, Brock University and The University of Western Ontario about educators' experiences, feelings and beliefs with respect to
computer technology in the classroom.

I have read and understand the information enclosed regarding the collaborative survey research project.

Please check one of the following

a) I agree to participate in this study. _____

b) I would like to decline participation in this study. ______

When compiling a final report, we may wish to include one or two quotes from the comments provided on the survey. Please indicate below whether you agree to allow your comments (with no identifying information) to be quoted.

a) Yes, I agree.___

b) No, I do not agree.___

Signature ___________________________________ Date _________________

Appendix F

PRIZE DRAW ENTRY FORM

YES, please enter me in the draw for one of 2 teaching release days or the $75.00 gift certificate.

If I win, the best way to contact me is at

Address:

____

____

____

Phone: _________________________________

My Name (Please print) ________________________________

Appendix G

Computer Use and Attitudes Survey for Secondary School Teachers

Thank you for taking the time to complete this survey. It will take approximately 30 minutes of your time. You will be asked to provide a few demographic details. The first four sections of the survey itself contain questions about your use of and attitudes towards computers, both for personal use and for teaching/work-related purposes. The last two sections ask about your attitudes toward teaching and work in general. Of course, there are no right or wrong answers to these questions. Please answer astruthfully and completely as possible. The survey will be collected, coded and analyzed by researchers at Wilfrid Laurier University in order to ensure complete confidentiality.

Demographic information

Age:		**Gender:**	Male Female
Education (circle highest level obtained):		Secondary Secondary plus some post-secondary College Diploma University degree Master's Degree Doctoral Degree	
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** __________ __________ __________ __________ __________ __________ __________ __________ __________ __________ __________ __________ __________ __________ __________ __________	
Approximate school population:		__________	
Past teaching experience: Total number of years teaching:		__________	
Total number of years throughout teaching in each division:		Primary ________ Junior ________ Intermediate ________ Senior ________ Other (________) ________	

I. GENERAL COMPUTER USE

	Very at Ease		Neutral		Very ill at Ease
A. In **general**, how at ease do you **feel** about using computers?	1	2	3	4	5
	Very enthusiastic		Neutral		Very unenthusiastic
B. In **general**, how enthusiastic do you **feel** about using computers?	1	2	3	4	5

II. HOME COMPUTER USE

A. 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. ____	...☐...	...☐...	...☐...	...☐...	...☐...

B. On average, how many **minutes** or **hours per week** do you spend on your **home computer** for the following activities?

1. Personal use: ______ mins. or ______ hrs. per wk.
2. School-work related tasks ______ mins. or ______ hrs. per wk.
3. Other (e.g. volunteer work) ______ mins. or ______ hrs. per wk.

II. HOME COMPUTER USE (continued)

C. How often do you use a **home computer** for any of the following? Check the box that best describes your level of use.

		Never	A Few Times a Year	A Few Times a Month	A Few Times a Week	Every day
1. Communication						
i. E-mail	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Chat Rooms	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Bulletin Boards	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
iv. Other ___________	iv.	…☐…	…☐…	…☐…	…☐…	…☐…
2. Entertainment						
i. Games	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Music/Movies	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Other ___________	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
3. Office Tools						
i. Word processing	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Spreadsheets/Databases	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Other __________	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
4. Multimedia						
i. Videoediting	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Photoediting	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Presentations	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
iv. Other ___________	iv.	…☐…	…☐…	…☐…	…☐…	…☐…
5. Personal Financing						
i. Banking	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Shopping	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Other _______	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
6. Work Related Tasks						
i. Marking	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Lesson preparation	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Other ____________	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
7. Study						
i. Online courses	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Research	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Other ____________	iii.	…☐…	…☐…	…☐…	…☐…	…☐

III. COMPUTER USE AT SCHOOL

Answer these questions relative to your **current situation.**

A. Do you have **access** to computers in:

1. your classroom?	1.	Yes	No
2. a lab in your school?	2.	Yes	No
3. a library or resource centre in your school?	3.	Yes	No
4. pod area?	4.	Yes	No
5. another location in your school? (please identify location _____________)	5.	Yes	No

B. 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. ...☐...	...☐...	...☐...	...☐...	...☐...
2. Lab computer..................................	2. ...☐...	...☐...	...☐...	...☐...	...☐...
3. School library/Resource room computer..	3. ...☐...	...☐...	...☐...	...☐...	...☐...
4. Pod area..	4. ...☐...	...☐...	...☐...	...☐...	...☐...
5. Computer in another location in your school	5. ...☐...	...☐...	...☐...	...☐...	...☐...

C. 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. ...☐...	...☐...	...☐...	...☐...	...☐...
2. Lab computer..................................	2. ...☐...	...☐...	...☐...	...☐...	...☐...
3. School library/Resource room computer..	3. ...☐...	...☐...	...☐...	...☐...	...☐...
4. Pod area..	4. ...☐...	...☐...	...☐...	...☐...	...☐...
5. Computer in another location in your school	5. ...☐...	...☐...	...☐...	...☐...	...☐...

D. If you are teaching in the following **curriculum or program areas,** how frequently do you use computers **with your students**:

	Never	Sometimes	A Moderate Amount	Quite a Bit	A Great Deal
1. The Arts: Music, Visual Arts, Drama, Dance	1. ...☐...	...☐...	...☐...	...☐...	...☐...
2. Business Studies	2. ...☐...	...☐...	...☐...	...☐...	...☐...
3. Canadian & World Studies	3. ...☐...	...☐...	...☐...	...☐...	...☐...
4. Classical & International Languages	4. ...☐...	...☐...	...☐...	...☐...	...☐...
5. English	5. ...☐...	...☐...	...☐...	...☐...	...☐...
6. English as a 2nd language	6. ...☐...	...☐...	...☐...	...☐...	...☐...
7. French as a 2nd language	7. ...☐...	...☐...	...☐...	...☐...	...☐...
8. Guidance & Career Education	8. ...☐...	...☐...	...☐...	...☐...	...☐...
9. Health and Phys. Ed Science	9. ...☐...	...☐...	...☐...	...☐...	...☐...
10. Interdisciplinary Studies	10. ...☐...	...☐...	...☐...	...☐...	...☐...
11. Mathematics	11. ...☐...	...☐...	...☐...	...☐...	...☐...
12. Science	12. ...☐...	...☐...	...☐...	...☐...	...☐...
13. Social Science & Humanities	13. ...☐...	...☐...	...☐...	...☐...	...☐...

14. Special Education	14. ...☐...	...☐...	...☐...	...☐...	...☐...
15. Teacher-Librarian	15. ...☐...	...☐...	...☐...	...☐...	...☐...
16. Technological Education	16. ...☐...	...☐...	...☐...	...☐...	...☐...

III. COMPUTER USE AT SCHOOL (continued)

Answer these questions relative to your **current situation.**

E. 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. ...☐...	...☐...	...☐...	...☐...	...☐...
F. How frequently do you use the computer as a teacher's tool for demonstration/presentation?	1. ...☐...	...☐...	...☐...	...☐...	...☐...

G. Circle your **best estimate** of the proportion of your **students** who have **computers at home.**	90% or greater 1	75% 2	50% 3	25% 4	Less than 5% 5
H. **Relative to your own** computer skills, how skilled are your **students**?	Much More Skilled 1	More Skilled 2	Equal 3	Less Skilled 4	Much Less Skilled 5

I. Have you participated in **professional development workshops** on any topic in the past 3 years?	1. Yes or No 2. If yes, how many of these workshops were related to computer use (estimate)? _____
J. What **other forms** of professional development about **computer technology and/or technology curriculum integration** have you engaged in during the **past 3 years**?	Please check all that apply. 1. Conferences __________ 2. Online training __________ 3. Talking with colleagues __________ 4. Videos __________

5. Journals/books ________
6. Courses ________
7. Self-directed, hands-on learning ________
8. Other ________
(Please Specify________)

K. Of the sources for professional development listed above, please identify the **most valuable source** you have used:	____________________

III. COMPUTER USE AT SCHOOL (continued)
Answer these questions relative to your **current situation.**

L. Do you use computers to teach **literacy**?	1. Yes or No

2. If yes, how?

____

____

____

____

M. How often do **you experience** the following:	Never	Some-times	A Moderate Amount	Quite A Bit	A Great Deal
1. A student shows you how to use the computer, a software package, or to find an Internet site ...	1..☐...	...☐...	...☐...	...☐...	...☐...
2. Equipment failure when using computers in the classroom or lab ...	2..☐...	...☐...	...☐...	...☐...	...☐...
3. Not enough functioning computers to carry out a planned computer exercise ...	3..☐...	...☐...	...☐...	...☐...	...☐...
4. Students finish their computer activities during class time ...	4..☐...	...☐...	...☐...	...☐...	...☐...
5. You ask a student to help you when there is a computer malfunction	5..☐...	...☐...	...☐...	...☐...	...☐...
6. You develop class assignments or activities that use computers ...	6..☐...	...☐...	...☐...	...☐...	...☐...
7. A colleague asks to use computer assignments or activities that you have developed ...	7..☐...	...☐...	...☐...	...☐...	...☐...
8. A colleague comes to you for help in using computers at school ...	8..☐...	...☐...	...☐...	...☐...	...☐...
9. You ask a colleague for help in using computers at your school ...	9..☐...	...☐...	...☐...	...☐...	...☐...

IV. YOUR VIEWS ON COMPUTERS

A. Please indicate your level of agreement with each of the following statements:	Strongly DISagree	DISagree	Neutral	Agree	Strongly Agree
1. I see computers as tools that can complement my teaching	1. ☐	☐	☐	☐	☐
2. I believe that computer technology is only appropriate in specific topic areas	2. ☐	☐	☐	☐	☐
3. Computers provide variety in instruction and in content for my students	3. ☐	☐	☐	☐	☐
4. Computers are useful for students who have special needs	4. ☐	☐	☐	☐	☐
5. I use computers to motivate my students	5. ☐	☐	☐	☐	☐
6. Having computers provides opportunities for individualized instruction	6. ☐	☐	☐	☐	☐
7. Computer technology allows me to bring current information to the class	7. ☐	☐	☐	☐	☐
8. Computers are an ideal reward for students	8. ☐	☐	☐	☐	☐
9. Computers allow students an opportunity to play while learning	9. ☐	☐	☐	☐	☐
10. Computer technology has improved my effectiveness as a teacher	10. ☐	☐	☐	☐	☐
11. I feel I am trained well enough to use computers when teaching	11. ☐	☐	☐	☐	☐
12. I do not have enough support at my school to be able to use technology in the way others seem to be using it	12. ☐	☐	☐	☐	☐
13. I find computer equipment unreliable	13. ☐	☐	☐	☐	☐
14. Whenever I plan to use computers, the machines crash or don't work	14. ☐	☐	☐	☐	☐
15. The computer equipment at my school is not up to date	15. ☐	☐	☐	☐	☐
16. Our school does not have the resources (human or financial) to maintain computers effectively	16. ☐	☐	☐	☐	☐
17. I'd like to use computers but I have trouble getting access to them when I need them for my class	17. ☐	☐	☐	☐	☐
18. My students are not old enough to use computers effectively	18. ☐	☐	☐	☐	☐
19. I spend more time planning/preparing for classes where I use computers than when I don't use computers	19. ☐	☐	☐	☐	☐
20. My students often request opportunities to use computers	20. ☐	☐	☐	☐	☐
21. I feel frustrated more often when I use computers in my classes than when I don't use them	21. ☐	☐	☐	☐	☐
22. I like to tinker or "play" with computers myself	22. ☐	☐	☐	☐	☐
23. When I use computers my teaching style changes	23. ☐	☐	☐	☐	☐
24. I had positive experiences with computers when I was younger	24. ☐	☐	☐	☐	☐
25. I have positive computer technology experiences in school	25. ☐	☐	☐	☐	☐
26. I have positive computer technology experiences at home	26. ☐	☐	☐	☐	☐
27. In general, I am interested in computer technology	27. ☐	☐	☐	☐	☐

IV. YOUR VIEWS ON COMPUTERS (continued)

B. 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

C. Do you **support** the concept of **integrating computer technology** for students in ? **your division**

1. Yes No Sometimes

2. Please elaborate. ____

____

D. Does your **school administration support** the concept of integrating computer technology for:

1. yourself, as an educator? Yes No
2. students? Yes No

3. Explain briefly. ____

____

E. Does the integration of **computer technology fit** within your **personal instructional style**?

1. Yes No Sometimes

2. Explain briefly. ____

IV. YOUR VIEWS ON COMPUTERS (continued)

F. To what extent do **you integrate computer technology** in the classroom?	A Great Deal 5	Quite a Bit 4	A Moderate Amount 3	Sometimes 2	Never 1

G. Do you see **computers** as:

1. an integrated part of the curriculum? Yes No
2. a stand-alone activity? Yes No

H. What **currently enhances** your integration of computer technology in the classroom?

____

____

I. What **currently inhibits** your integration of computer technology in the classroom?

____

____

J. 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 5	Quite a Bit 4	A Moderate Amount 3	Sometimes 2	Never 1

K. When you are planning a lesson/unit, what factors make you decide to integrate the computer?

____

____

L. In **comparison to the average teacher**, how would you rate **your ability to integrate** computer technology?	Much more skilled 1	More skilled 2	Equal 3	Less skilled 4	Much less skilled 5

V. YOUR VIEWS ON TEACHING

A. If you had to define the **personal characteristics** of people who are **excellent teachers**--what would those characteristics be?

____

____

B. Considering your response to the previous question about excellent teachers, are there any features that you would see as **different** in excellent teachers **who happen to integrate** technology effectively, from excellent teachers **who do not integrate** technology?

1. Yes No

2. If yes, please identify those characteristics. ______________________________

____

____

C. Please indicate the degree to which you agree or disagree with each statement below.

	Strongly Disagree	Moderately Disagree	Disagree Slightly More Than Agree	Agree Slightly More Than Disagree	Moderately Agree	Strongly Agree
1. When a student does better than usual, many times it is because I exerted a little extra effort	1..□..	..□..	..□..	..□..	..□..	..□..
2. When a student is having difficulty with an assignment, I am usually able to adjust it to his/her level	2..□..	..□..	..□..	..□..	..□..	..□..
3. When a student gets a better grade than he/she usually gets, it is usually because I found better ways of teaching that student	3..□..	..□..	..□..	..□..	..□..	..□..
4. When I really try, I can get through to most difficult students	4..□..	..□..	..□..	..□..	..□..	..□..
5. When the grades of my students improve it is usually because I found more effective teaching approaches	5..□..	..□..	..□..	..□..	..□..	..□..
6. If a student masters a new concept quickly, this might be because I knew the necessary steps in teaching that concept	6..□..	..□..	..□..	..□..	..□..	..□..
7. If a student did not remember information I gave in a previous lesson, I would know how to increase her/his retention in the next lesson	7..□..	..□..	..□..	..□..	..□..	..□..
8. If a student in my class becomes disruptive and noisy, I feel assured that I know some techniques to redirect him/her quickly	8..□..	..□..	..□..	..□..	..□..	..□..
9. If one of my students could not do a class assignment, I would be able to accurately assess whether the assignment was at the correct level of difficulty	9..□..	...□...	..□..	..□..	..□..	..□..

V. YOUR VIEWS ON TEACHING (continued)

D. As you respond to the **Teacher Beliefs Survey** presented below, write a number on the line beside each statement to indicate how much you **disagree or agree** with the statement.

Disagree strongly 1 2 3 4 5 6 Agree Strongly

1. It is important that I establish classroom control before I become too friendly with students. _____
2. I believe that expanding on students' ideas is an effective way to build my curriculum. _____
3. I invite students to create many of my bulletin boards. _____
4. I base student grades primarily on homework, quizzes, and tests. _____
5. An essential part of my teacher role is supporting a student's family when problems are interfering with a student's learning. _____
6. To be sure that I teach students all necessary content and skills, I follow a textbook or workbook. _____
7. I teach subjects separately, although I am aware of the overlap of content and skills. _____
8. I involve students in evaluating their own work and setting their own goals. _____
9. I believe students learn best when there is a fixed schedule. _____
10. I adjust my lesson plan based on results of homework assignments. _____
11. I make it a priority in my classroom to give students time to work together when I am not directing them. _____
12. I make it easy for parents to contact me at school or home. _____
13. I encourage students to discuss conflicts in group meetings. _____
14. I invite parents to volunteer in or visit my classroom almost any time. _____
15. I guide students in finding their own answers to academic problems. _____
16. I generally use the teacher's guide to lead class discussion of a story or text. _____
17. I prefer to assess students informally through observations and conferences. _____
18. I find that textbooks and other published materials are the best sources for creating my curriculum. _____
19. I encourage parents to follow up on classroom activities with students at home. _____
20. I believe in developing my classroom as a community of learners. _____
21. I encourage students to suggest ideas for arranging our classroom. _____
22. I often create thematic units based on the students' interests and ideas. _____
23. I encourage discussions of different opinions and reasons. _____
24. I believe it is important to involve students in revising classroom rules as needed. _____
25. I believe students learn most effectively when learning tasks are broken down into small sequential steps. _____
26. It is more effective to provide students with the information they need to know, rather than encouraging them to experiment. _____
27. I believe that encouraging competition among students motivates them to learn more. _____

VI. YOUR VIEWS ON WORK

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

		Never or almost never true of me	Sometimess true of me	Often true of me	Always or almost always true of me
1. I am not that concerned about what other people think of my work	1.	...☐...	...☐...	...☐...	...☐...
2. I prefer having someone set clear goals for me in my work	2.	...☐...	...☐...	...☐...	...☐...
3. The more difficult the problem, the more I enjoy trying to solve it	3.	...☐...	...☐...	...☐...	...☐...
4. I am keenly aware of the income goals I have for myself	4.	...☐...	...☐...	...☐...	...☐...
5. I want my work to provide me with opportunities for increasing my knowledge and skills	5.	...☐...	...☐...	...☐...	...☐...
6. To me, success means doing better than other people	6.	...☐...	...☐...	...☐...	...☐...
7. I prefer to figure things out for myself	7.	...☐...	...☐...	...☐...	...☐...
8. No matter what the outcome of a project, I am satisfied if I feel I gained a new experience	8.	...☐...	...☐...	...☐...	...☐...
9. I enjoy relatively simple, straightforward tasks	9.	...☐...	...☐...	...☐...	...☐...
10. I am keenly aware of the promotion goals I have for myself	10.	...☐...	...☐...	...☐...	...☐...
11. Curiosity is the driving force behind much of what I do	11.	...☐...	...☐...	...☐...	...☐...
12. I'm less concerned with what work I do than what I get for it	12.	...☐...	...☐...	...☐...	...☐...
13. I enjoy tackling problems that are completely new to me	13.	...☐...	...☐...	...☐...	...☐...
14. I prefer work I know I can do well over work that stretches my abilities	14.	...☐...	...☐...	...☐...	...☐...
15. I'm concerned about how other people are going to react to my ideas	15.	...☐...	...☐...	...☐...	...☐...
16. I seldom think about salary and promotions	16.	...☐...	...☐...	...☐...	...☐...
17. I'm more comfortable when I can set my own goals	17.	...☐...	...☐...	...☐...	...☐...
18. I believe that there is no point in doing a good job if nobody else knows about it	18.	...☐...	...☐...	...☐...	...☐...
19. I am strongly motivated by the money I can earn	19.	...☐...	...☐...	...☐...	...☐...
20. It is important for me to be able to do what I most enjoy	20.	...☐...	...☐...	...☐...	...☐...
21. I prefer working on projects with clearly specified procedures	21.	...☐...	...☐...	...☐...	...☐...
22. As long as I can do what I enjoy, I'm not that concerned about exactly what I'm paid	22.	...☐...	...☐...	...☐...	...☐...
23. I enjoy doing work that is so absorbing that I forget about everything else	23.	...☐...	...☐...	...☐...	...☐...
24. I am strongly motivated by the recognition I can earn from other people	24.	...☐...	...☐...	...☐...	...☐...
25. I have to feel that I'm earning something for what I do	25.	...☐...	...☐...	...☐...	...☐...
26. I enjoy trying to solve complex problems	26.	...☐...	...☐...	...☐...	...☐...
27. It is important for me to have an outlet for self-expression	27.	...☐...	...☐...	...☐...	...☐...
28. I want to find out how good I really can be at my work	28.	...☐...	...☐...	...☐...	...☐...
29. I want other people to find out how good I really can be at my work	29.	...☐...	...☐...	...☐...	...☐...
30. What matters most to me is enjoying what I do	30.	...☐...	...☐...	...☐...	...☐...

Appendix H

Computer Use and Attitudes Survey for Elementary School Teachers

Thank you for taking the time to complete this survey. It will take approximately 30 minutes of your time. You will be asked to provide a few demographic details. The first four sections of the survey itself contain questions about your use of and attitudes towards computers, both for personal use and for teaching/work-related purposes. The last two sections ask about your attitudes toward teaching and work in general. Of course, there are no right or wrong answers to these questions. Please answer as truthfully and completely as possible. The surveys will be collected, coded and analyzed by researchers at Wilfrid Laurier University in order to ensure complete confidentiality.

Demographic information:

Age:		**Gender:**	Male Female

Education (circle highest level obtained):	Secondary Secondary plus some post-secondary College Diploma University degree Master's Degree Doctoral Degree

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
Current type of assignment (circle all that apply):	Special Education Classroom Assignment Core French French Immersion ESL
Type of school:	Junior Senior Composite
Approximate school population:	____________

Past teaching experience: Total number of years teaching:	____________
Total number of years throughout teaching in each division:	Primary ________ Junior ________ Intermediate ________ Senior ________ Other (________) ________

I. GENERAL COMPUTER USE

A. In **general**, how at ease do you **feel** about using computers?	Very at Ease		Neutral		Very ill at Ease
	1	2	3	4	5
B. In **general**, how enthusiastic do you **feel** about using computers?	Very enthusiastic		Neutral		Very unenthusiastic
	1	2	3	4	5

II. HOME COMPUTER USE

A. Of the following technologies, please indicate **whether or not you have them at home** and **how frequently you use them at home:**

How Frequently Do You Use Them?

	Have at home?	**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. ____	...☐...	...☐...	...☐...	...☐...	...☐...

B. On average, how many **minutes** or **hours per week** do you spend on your **home computer** for the following activities?	1. Personal use: ______ mins. or ______ hrs. per wk. 2. School-work related tasks ______ mins. or ______ hrs. per wk. 3. Other (e.g. volunteer work) ______ mins. or ______ hrs. per wk.

II. HOME COMPUTER USE (continued)

C. How often do you use a **home computer** for any of the following? Check the box that best describes your level of use.

		Never	A Few Times a Year	A Few Times a Month	A Few Times a Week	Every day
1. Communication						
i. E-mail	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Chat Rooms	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Bulletin Boards	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
iv. Other ____________	iv.	…☐…	…☐…	…☐…	…☐…	…☐…
2. Entertainment						
i. Games	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Music/Movies	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Other ____________	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
3. Office Tools						
i. Word processing	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Spreadsheets/Databases	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Other __________	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
4. Multimedia						
i. Videoediting	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Photoediting	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Presentations	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
iv. Other ____________	iv.	…☐…	…☐…	…☐…	…☐…	…☐…
5. Personal Financing						
i. Banking	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Shopping	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Other ________	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
6. Work Related Tasks						
i. Marking	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Lesson preparation	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Other ____________	iii.	…☐…	…☐…	…☐…	…☐…	…☐…
7. Study						
i. Online courses	i.	…☐…	…☐…	…☐…	…☐…	…☐…
ii. Research	ii.	…☐…	…☐…	…☐…	…☐…	…☐…
iii. Other ____________	iii.	…☐…	…☐…	…☐…	…☐…	…☐…

III. COMPUTER USE AT SCHOOL

Answer these questions relative to your **current situation.**

A. Do you have **access** to computers in:

1. your classroom?	1.	Yes	No
2. a lab in your school?	2.	Yes	No
3. a library or resource centre in your school?	3.	Yes	No
5. pod area?	4.	Yes	No
5. another location in your school? (please identify location _____________)	5.	Yes	No

B. 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. ...☐...	...☐...	...☐...	...☐...	...☐...
2. Lab computer................................	2. ...☐...	...☐...	...☐...	...☐...	...☐...
3. School library/Resource room computer..	3. ...☐...	...☐...	...☐...	...☐...	...☐...
4. Pod area......................................	4. ...☐...	...☐...	...☐...	...☐...	...☐...
5. Computer in another location in your school	5. ...☐...	...☐...	...☐...	...☐...	...☐...

C. 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. ...☐...	...☐...	...☐...	...☐...	...☐...
2. Lab computer................................	2. ...☐...	...☐...	...☐...	...☐...	...☐...
3. School library/Resource room computer..	3. ...☐...	...☐...	...☐...	...☐...	...☐...
4. Pod area......................................	4. ...☐...	...☐...	...☐...	...☐...	...☐...
5. Computer in another location in your school	5. ...☐...	...☐...	...☐...	...☐...	...☐...

D. If you are teaching in the following **curriculum or program areas**, how frequently do you use computers **with your students**:

	Never	Sometimes	A Moderate Amount	Quite a Bit	A Great Deal
1. Language	1. ...☐...	...☐...	...☐...	...☐...	...☐...
2. French (FSL)	2. ...☐...	...☐...	...☐...	...☐...	...☐...
3. Mathematics	3. ...☐...	...☐...	...☐...	...☐...	...☐...
4. Social Studies, History, and Geography	4. ...☐...	...☐...	...☐...	...☐...	...☐...
5. Health and Phys. Ed.	5. ...☐...	...☐...	...☐...	...☐...	...☐...
6. The Arts: Music	6. ...☐...	...☐...	...☐...	...☐...	...☐...
7. The Arts: Visual Arts	7. ...☐...	...☐...	...☐...	...☐...	...☐...

III. COMPUTER USE AT SCHOOL (continued)
Answer these questions relative to your **current situation.**

E. 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. ...☐...	...☐...	...☐...	...☐...	...☐...
F. How frequently do you use the computer as a teacher's tool for demonstration/presentation?	1. ...☐...	...☐...	...☐...	...☐...	...☐...

G. Circle your **best estimate** of the proportion of your **students** who have **computers at home**.

90% or greater	75%	50%	25%	Less than 5%
1	2	3	4	5

H. **Relative to your own** computer skills, how skilled are your **students**?

Much More Skilled	More Skilled	Equal	Less Skilled	Much Less Skilled
1	2	3	4	5

I. Have you participated in **professional development workshops** on any topic in the past 3 years?

1. Yes or No
2. If yes, how many of these workshops were related to computer use (estimate)? _____

J. What **other forms** of professional development about **computer technology and/or technology curriculum integration** have you engaged in during the **past 3 years**?

Please check all that apply.

1. Conferences ________
2. Online training ________
3. Talking with colleagues ________
4. Videos ________
5. Journals/books ________
6. Courses ________
7. Self-directed, hands-on ________
8. Other (please specify) ________

K. Of the sources for professional development listed above, please identify the **most valuable** you have used:

III. COMPUTER USE AT SCHOOL (continued)
Answer these questions relative to your **current situation.**

L. Do you use computers to teach **literacy**?	1. Yes or No

2. If yes, how?

____

____

____

____

M. How often do **you experience** the following:	**Never**	**Some-times**	**A Moderate Amount**	**Quite A Bit**	**A Great Deal**
1. A student shows you how to use the computer, a software package, or to find an Internet site	1..☐	☐	☐	☐	☐
2. Equipment failure when using computers in the classroom or lab	2..☐	☐	☐	☐	☐
3. Not enough functioning computers to carry out a planned computer exercise	3..☐	☐	☐	☐	☐
4. Students finish their computer activities during class time	4..☐	☐	☐	☐	☐
5. You ask a student to help you when there is a computer malfunction	5..☐	☐	☐	☐	☐
6. You develop class assignments or activities that use computers	6..☐	☐	☐	☐	☐
7. A colleague asks to use computer assignments or activities that you have developed	7..☐	☐	☐	☐	☐
8. A colleague comes to you for help in using computers at school	8..☐	☐	☐	☐	☐
9. You ask a colleague for help in using computers at your school	9..☐	☐	☐	☐	☐

IV. YOUR VIEWS ON COMPUTERS

A. Please indicate your level of agreement with each of the following statements:

Statement		Strongly DISagree	DISagree	Neutral	Agree	Strongly Agree
28. I see computers as tools that can complement my teaching	1.	□	□	□	□	□
29. I believe that computer technology is only appropriate in specific topic areas	2.	□	□	□	□	□
30. Computers provide variety in instruction and in content for my students	3.	□	□	□	□	□
31. Computers are useful for students who have special needs	4.	□	□	□	□	□
32. I use computers to motivate my students	5.	□	□	□	□	□
33. Having computers provides opportunities for individualized instruction	6.	□	□	□	□	□
34. Computer technology allows me to bring current information to the class	7.	□	□	□	□	□
35. Computers are an ideal reward for students	8.	□	□	□	□	□
36. Computers allow students an opportunity to play while learning	9.	□	□	□	□	□
37. Computer technology has improved my effectiveness as a teacher	10.	□	□	□	□	□
38. I feel I am trained well enough to use computers when teaching	11.	□	□	□	□	□
39. I do not have enough support at my school to be able to use technology in the way others seem to be using it	12.	□	□	□	□	□
40. I find computer equipment unreliable	13.	□	□	□	□	□
41. Whenever I plan to use computers, the machines crash or don't work	14.	□	□	□	□	□
42. The computer equipment at my school is not up to date	15.	□	□	□	□	□
43. Our school does not have the resources (human or financial) to maintain computers effectively	16.	□	□	□	□	□
44. I'd like to use computers but I have trouble getting access to them when I need them for my class	17.	□	□	□	□	□
45. My students are not old enough to use computers effectively	18.	□	□	□	□	□
46. I spend more time planning/preparing for classes where I use computers than when I don't use computers	19.	□	□	□	□	□
47. My students often request opportunities to use computers	20.	□	□	□	□	□
48. I feel frustrated more often when I use computers in my classes than when I don't use them	21.	□	□	□	□	□
49. I like to tinker or "play" with computers myself	22.	□	□	□	□	□
50. When I use computers my teaching style changes	23.	□	□	□	□	□
51. I had positive experiences with computers when I was younger	24.	□	□	□	□	□
52. I have positive computer technology experiences in school	25.	□	□	□	□	□
53. I have positive computer technology experiences at home	26.	□	□	□	□	□
54. In general, I am interested in computer technology	27.	□	□	□	□	□

IV. YOUR VIEWS ON COMPUTERS (continued)

B. 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

D. Do you **support** the concept of **integrating computer technology** for students in ? **your division**

1. Yes No Sometimes

2. Please elaborate. ______________________________

____

____

D. Does your **school administration support** the concept of integrating computer technology for:

1. yourself, as an educator? Yes No
2. students? Yes No

3. Explain briefly. ______________________________

____

____

E. Does the integration of **computer technology fit** within your **personal instructional style**?

1. Yes No Sometimes

2. Explain briefly.

____

IV. YOUR VIEWS ON COMPUTERS (continued)

F. To what extent do **you integrate computer technology** in the classroom?	A Great Deal 5	Quite a Bit 4	A Moderate Amount 3	Sometimes 2	Never 1

G. Do you see **computers** as:

1. an integrated part of the curriculum? Yes No
2. a stand-alone activity? Yes No

H. What **currently enhances** your integration of computer technology in the classroom?

____

____

I. What **currently inhibits** your integration of computer technology in the classroom?

____

____

J. 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 5	Quite a Bit 4	A Moderate Amount 3	Sometimes 2	Never 1

K. When you are planning a lesson/unit, what <u>factors</u> make you decide to integrate the computer?

____

____

____

L. In **comparison to the average teacher**, how would you rate **your ability to integrate** computer technology?	Much more skilled 1	More skilled 2	Equal 3	Less skilled 4	Much less skilled 5

V. YOUR VIEWS ON TEACHING

A. If you had to define the **personal characteristics** of people who are **excellent teachers**--what would those characteristics be?

____

____

B. Considering your response to the previous question about excellent teachers, are there any features that you would see as **different** in excellent teachers **who happen to integrate** technology effectively, from excellent teachers **who do not integrate** technology?	1. Yes No

2. If yes, please identify those characteristics. ____

____

C. Please indicate the degree to which you agree or disagree with each statement below.

	Strongly Disagree	Moderately Disagree	Disagree Slightly More Than Agree	Agree Slightly More Than Disagree	Moderately Agree	Strongly Agree
1. When a student does better than usual, many times it is because I exerted a little extra effort	1..☐..	..☐..	..☐..	..☐..	..☐..	..☐..
2. When a student is having difficulty with an assignment, I am usually able to adjust it to his/her level	2..☐..	..☐..	..☐..	..☐..	..☐..	..☐..
3. When a student gets a better grade than he/she usually gets, it is usually because I found better ways of teaching that student	3..☐..	..☐..	..☐..	..☐..	..☐..	..☐..
4. When I really try, I can get through to most difficult students	4..☐..	..☐..	..☐..	..☐..	..☐..	..☐..
5. When the grades of my students improve it is usually because I found more effective teaching approaches	5..☐..	..☐..	..☐..	..☐..	..☐..	..☐..
6. If a student masters a new concept quickly, this might be because I knew the necessary steps in teaching that concept	6..☐..	..☐..	..☐..	..☐..	..☐..	..☐..
7. If a student did not remember information I gave in a previous lesson, I would know how to increase her/his retention in the next lesson	7..☐..	..☐..	..☐..	..☐..	..☐..	..☐..
8. If a student in my class becomes disruptive and noisy, I feel assured that I know some techniques to redirect him/her quickly	8..☐..	..☐..	..☐..	..☐..	..☐..	..☐..
9. If one of my students could not do a class assignment, I would be able to accurately assess whether the assignment was at the correct level of difficulty	9..☐..	... ☐...	..☐..	..☐..	..☐..	..☐..

V. YOUR VIEWS ON TEACHING (continued)

D. As you respond to the **Teacher Beliefs Survey** presented below, write a number on the line beside each statement to indicate how much you **disagree or agree** with the statement.

Disagree strongly 1 2 3 4 5 6 Agree Strongly

1. It is important that I establish classroom control before I become too friendly with students. _____
2. I believe that expanding on students' ideas is an effective way to build my curriculum. _____
3. I invite students to create many of my bulletin boards. _____
4. I base student grades primarily on homework, quizzes, and tests. _____
5. An essential part of my teacher role is supporting a student's family when problems are interfering with a student's learning. _____
6. To be sure that I teach students all necessary content and skills, I follow a textbook or workbook. _____
7. I teach subjects separately, although I am aware of the overlap of content and skills. _____
8. I involve students in evaluating their own work and setting their own goals. _____
9. I believe students learn best when there is a fixed schedule. _____
10. I adjust my lesson plan based on results of homework assignments. _____
11. I make it a priority in my classroom to give students time to work together when I am not directing them. _____
12. I make it easy for parents to contact me at school or home. _____
13. I encourage students to discuss conflicts in group meetings. _____
14. I invite parents to volunteer in or visit my classroom almost any time. _____
15. I guide students in finding their own answers to academic problems. _____
16. I generally use the teacher's guide to lead class discussion of a story or text. _____
17. I prefer to assess students informally through observations and conferences. _____
18. I find that textbooks and other published materials are the best sources for creating my curriculum. _____
19. I encourage parents to follow up on classroom activities with students at home. _____
20. I believe in developing my classroom as a community of learners. _____
21. I encourage students to suggest ideas for arranging our classroom. _____
22. I often create thematic units based on the students' interests and ideas. _____
23. I encourage discussions of different opinions and reasons. _____
24. I believe it is important to involve students in revising classroom rules as needed. _____
25. I believe students learn most effectively when learning tasks are broken down into small sequential steps. _____
26. It is more effective to provide students with the information they need to know, rather than encouraging them to experiment. _____
27. I believe that encouraging competition among students motivates them to learn more. _____

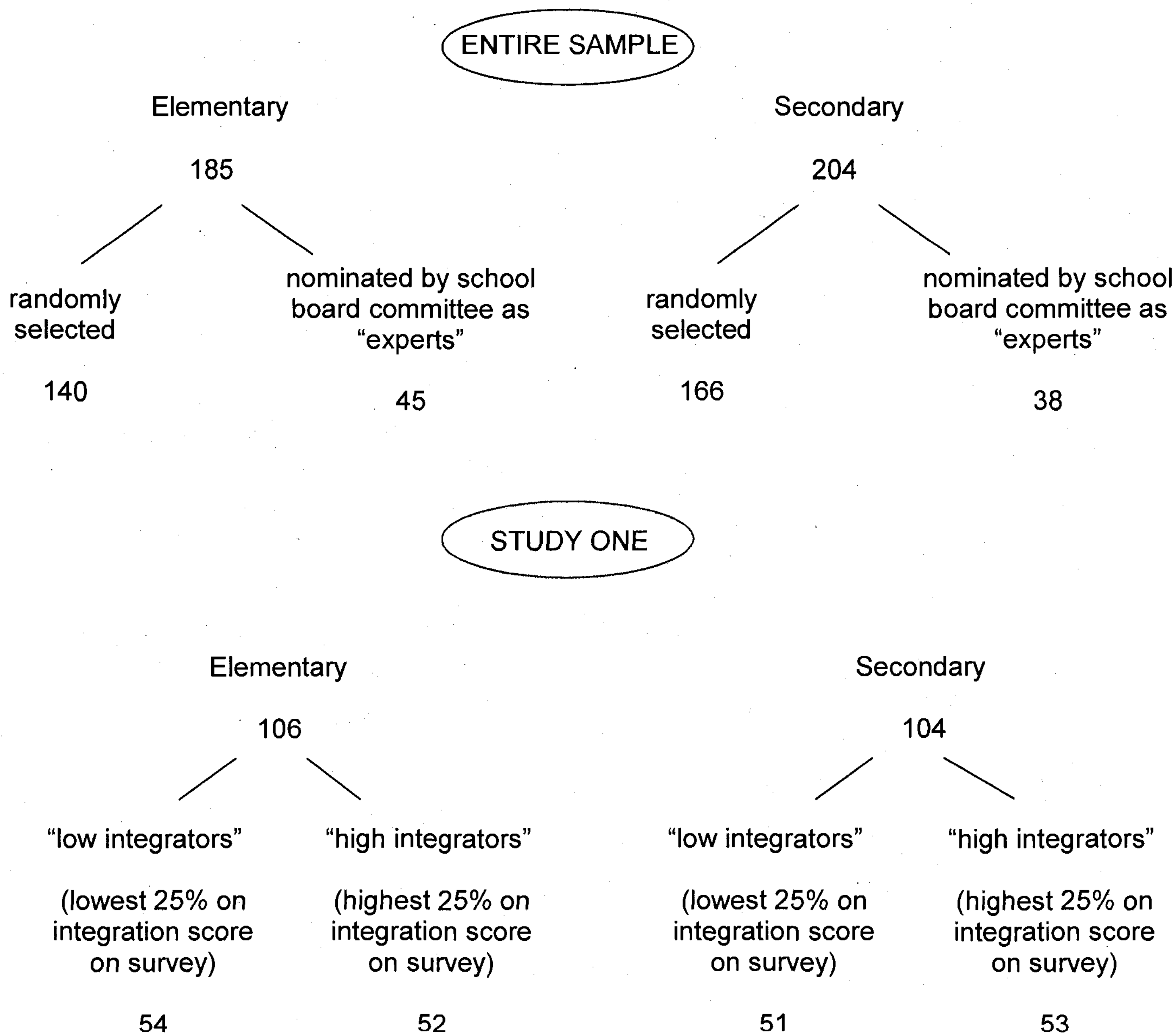
VI. YOUR VIEWS ON WORK

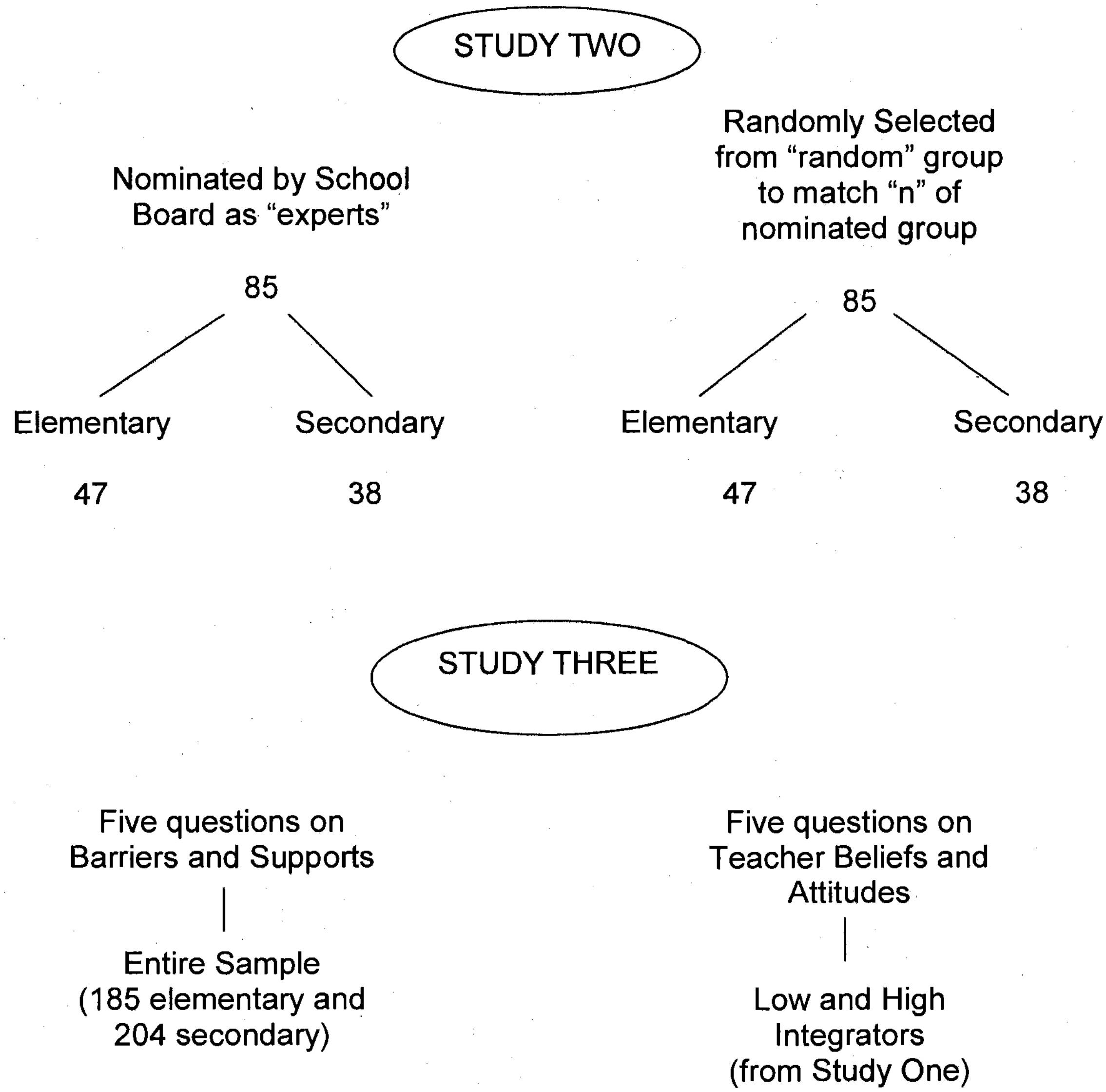
A. Please rate each item below in terms of how true it is of you.

Item		Never or almost never true of me	Sometimes true of me	Often true of me	Always or almost always true of me
1. I am not that concerned about what other people think of my work........	1.	...☐...	...☐...	...☐...	...☐...
2. I prefer having someone set clear goals for me in my work..................	2.	...☐...	...☐...	...☐...	...☐...
3. The more difficult the problem, the more I enjoy trying to solve it........	3.	...☐...	...☐...	...☐...	...☐...
4. I am keenly aware of the income goals I have for myself..................	4.	...☐...	...☐...	...☐...	...☐...
5. I want my work to provide me with opportunities for increasing my knowledge and skills	5.	...☐...	...☐...	...☐...	...☐...
6. To me, success means doing better than other people	6.	...☐...	...☐...	...☐...	...☐...
7. I prefer to figure things out for myself	7.	...☐...	...☐...	...☐...	...☐...
8. No matter what the outcome of a project, I am satisfied if I feel I gained a new experience	8.	...☐...	...☐...	...☐...	...☐...
9. I enjoy relatively simple, straightforward tasks	9.	...☐...	...☐...	...☐...	...☐...
10. I am keenly aware of the promotion goals I have for myself	10.	...☐...	...☐...	...☐...	...☐...
11. Curiosity is the driving force behind much of what I do	11.	...☐...	...☐...	...☐...	...☐...
12. I'm less concerned with what work I do than what I get for it	12.	...☐...	...☐...	...☐...	...☐...
13. I enjoy tackling problems that are completely new to me	13.	...☐...	...☐...	...☐...	...☐...
14. I prefer work I know I can do well over work that stretches my abilities	14.	...☐...	...☐...	...☐...	...☐...
15. I'm concerned about how other people are going to react to my ideas...	15.	...☐...	...☐...	...☐...	...☐...
16. I seldom think about salary and promotions	16.	...☐...	...☐...	...☐...	...☐...
17. I'm more comfortable when I can set my own goals	17.	...☐...	...☐...	...☐...	...☐...
18. I believe that there is no point in doing a good job if nobody else knows about it	18.	...☐...	...☐...	...☐...	...☐...
19. I am strongly motivated by the money I can earn..........................	19.	...☐...	...☐...	...☐...	...☐...
20. It is important for me to be able to do what I most enjoy..................	20.	...☐...	...☐...	...☐...	...☐...
21. I prefer working on projects with clearly specified procedures...........	21.	...☐...	...☐...	...☐...	...☐...
22. As long as I can do what I enjoy, I'm not that concerned about exactly what I'm paid	22.	...☐...	...☐...	...☐...	...☐...
23. I enjoy doing work that is so absorbing that I forget about everything else	23.	...☐...	...☐...	...☐...	...☐...
24. I am strongly motivated by the recognition I can earn from other people	24.	...☐...	...☐...	...☐...	...☐...
25. I have to feel that I'm earning something for what I do	25.	...☐...	...☐...	...☐...	...☐...
26. I enjoy trying to solve complex problems	26.	...☐...	...☐...	...☐...	...☐...
27. It is important for me to have an outlet for self-expression	27.	...☐...	...☐...	...☐...	...☐...
28. I want to find out how good I really can be at my work	28.	...☐...	...☐...	...☐...	...☐...
29. I want other people to find out how good I really can be at my work	29.	...☐...	...☐...	...☐...	...☐...
30. What matters most to me is enjoying what I do	30.	...☐...	...☐...	...☐...	...☐...

Appendix I

Flowchart of Data Samples across Studies

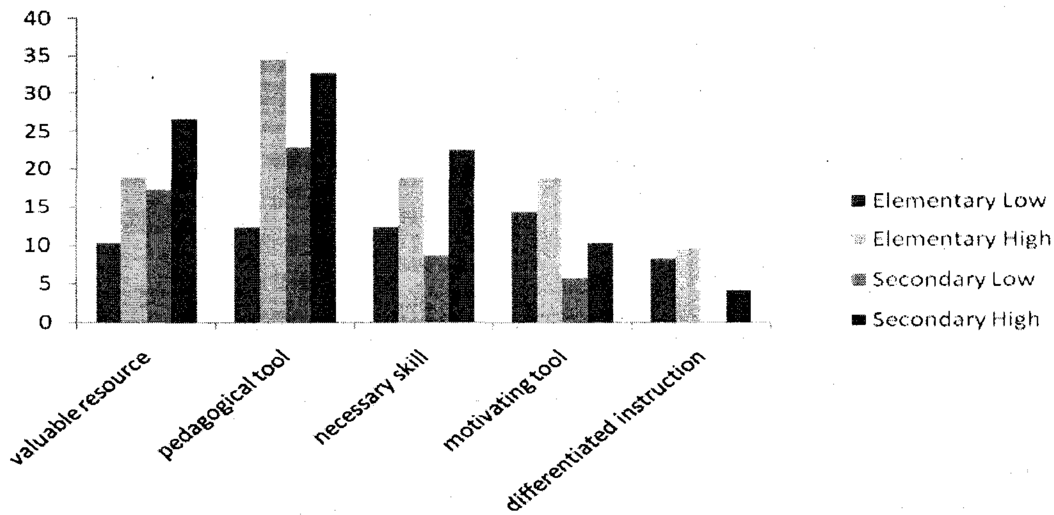



STUDY TWO
Nominated by School Board as "experts"
85
Elementary
47
Secondary
38
Randomly Selected from "random" group to match "n" of nominated group
85
Elementary
47
Secondary
38
STUDY THREE
Five questions on Barriers and Supports
Entire Sample (185 elementary and 204 secondary)
Five questions on Teacher Beliefs and Attitudes
Low and High Integrators (from Study One)

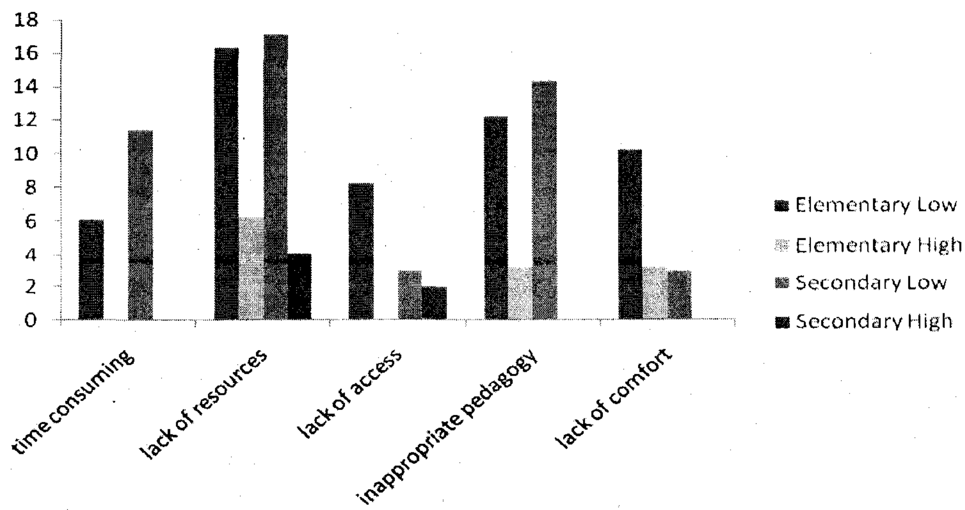
Appendix J

Patterns of Themes by Division and Integration Level in Histogram format

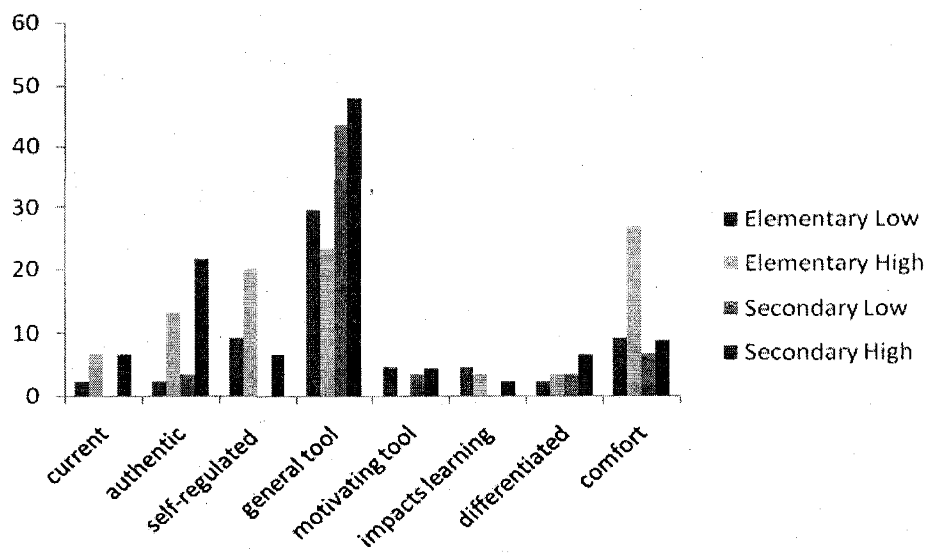
Patterns of themes by division and integration level for the question: *"Do you support the concept of integrating computer technology for students in your division? Explain"* for positive responses.



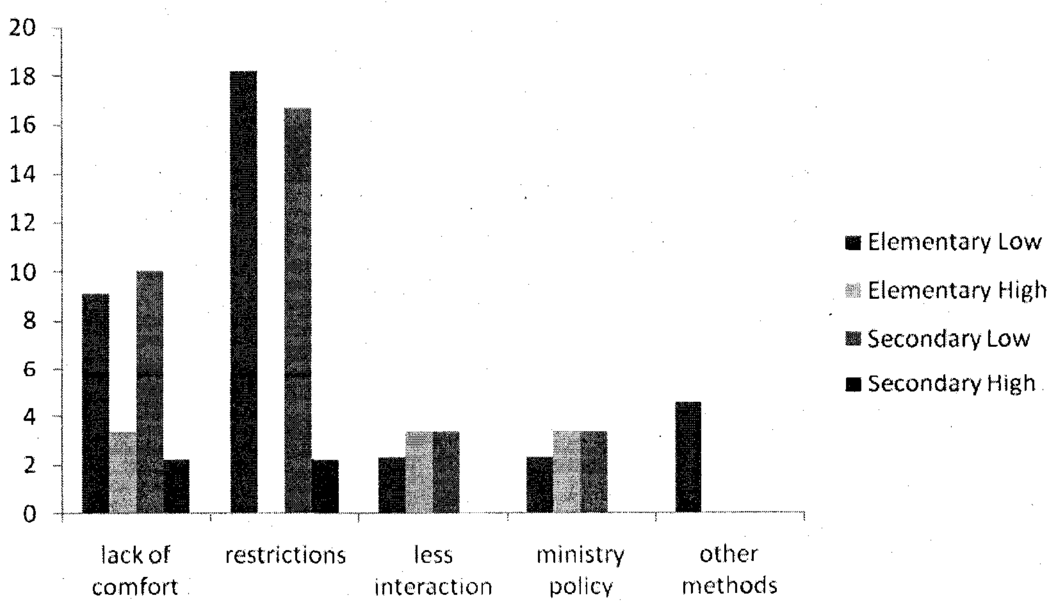
Patterns of themes by division and integration level for the question: *"Do you support the concept of integrating computer technology for students in your division? Explain"* for negative responses.



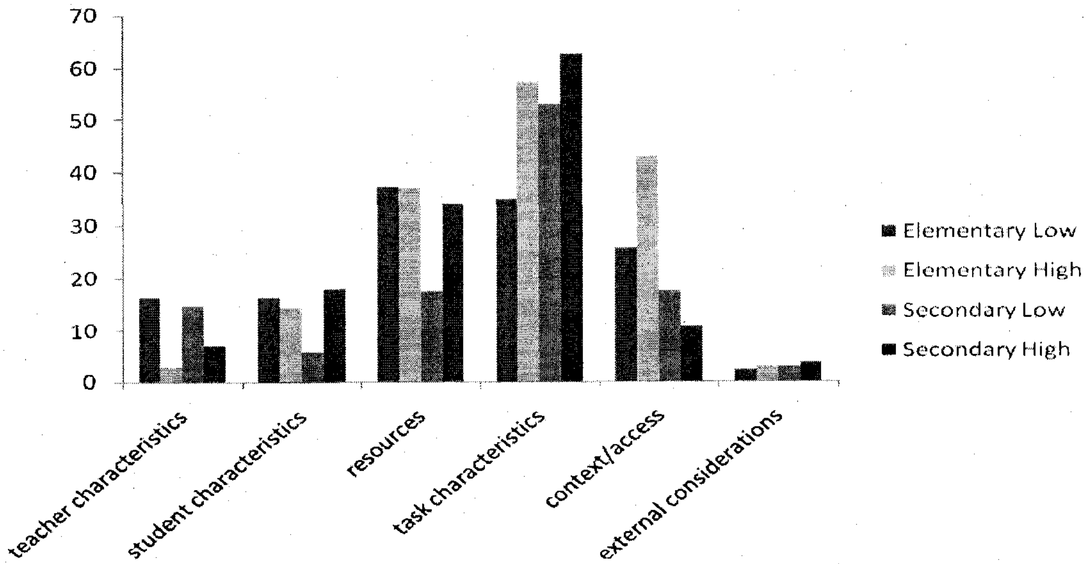
Patterns of themes by division and integration level for the question: *"Does the integration of computer technology fit within your personal instructional style? Explain briefly"* for positive responses



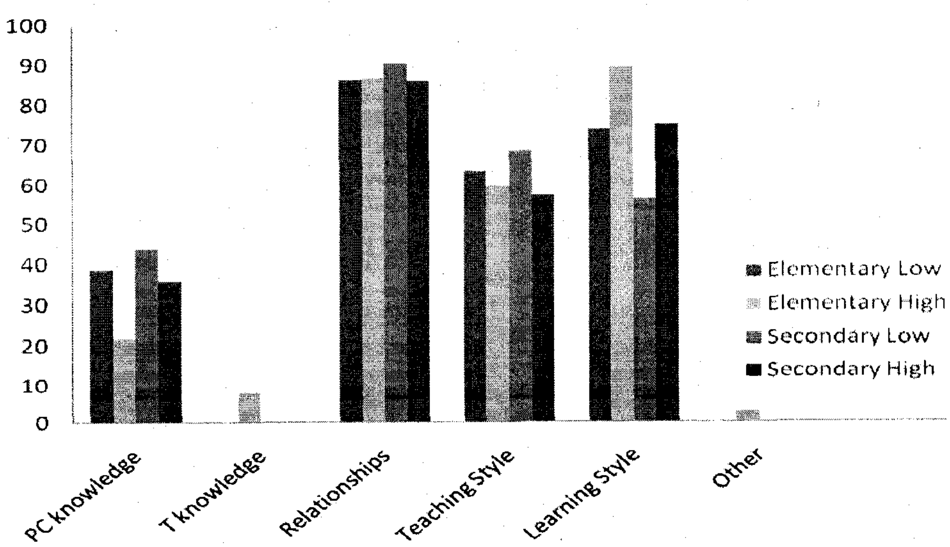
Patterns of themes by division and integration level for the question: *"Does the integration of computer technology fit within your personal instructional style? Explain briefly"* for negative responses



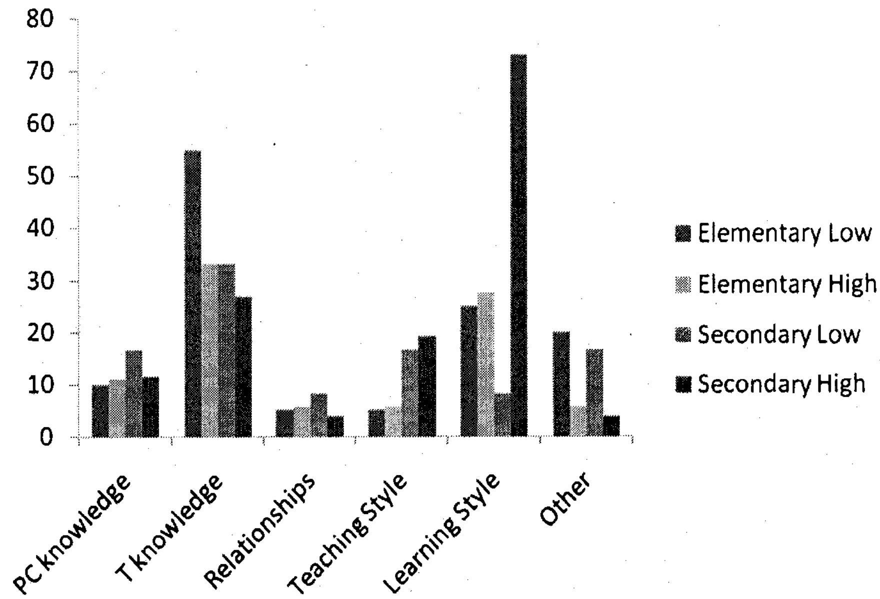
Patterns of themes by division and integration level for the question: *"When you are planning a lesson/unit, what factors make you decide to integrate the computer?"*



Patterns of themes by division and integration level for the question: *"If you had to define the personal characteristics of people who are excellent teachers – what would those characteristics be?"*



Patterns of themes by division and integration level for the question: *"Please identify characteristics that make excellent teachers who happen to integrate technology effectively different from teachers who do not."*



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