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Implementing Computer Technologies: Teachers' Perceptions and Practices

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This study investigates personal and setting characteristics, teacher attitudes, and current computer technology practices among 764 elementary and secondary teachers from both private and public school sectors in Quebec. Using expectancy-value theory, the Technology Implementation Questionnaire (TIQ) was developed; it consists of 33 belief items grouped under three broad motivational categories: perceived *expectancy* of success, perceived *value* of technology use, and perceived *cost* of technology use. In addition, teacher demographics, teachers' current uses of technology, and availability of resources were also surveyed. The study found that: (a) expectancy of success and perceived value were the most important issues in differentiating levels of computer use among teachers; (b) personal use of computers outside of teaching activities was the most significant predictor of teacher use of technology in the classroom; and (c) teachers' use of computer technologies was predominantly for "informative" (e.g., World Wide Web and CD-ROM) and "expressive" (e.g., word processing) purposes. Results are interpreted in light of the extent to which the expectancy-value model can explain the variation in teacher beliefs related to computer technology use. As a heuristic, the core of our model of technology use reduces to a simple teacher motivation "equation": (.39 x Expectancy) + (.15 x Value) – (.14 x Cost) = Technology Use.

We are experiencing exponential growth in the use of computer technology for learning in K-12 schools. Indeed, there is sufficient optimism in the potential of technology that governments have dedicated substantial research funds to identifying and promoting ways to deliver or enhance instruction with the use of technology (Kleiman, 2001). To some, computer technology can be a powerful and flexible tool for learning (Bereiter, 2002; Harasim, Hiltz, Teles, & Turoff, 1995). For example, in the Report to the U.S. President on the use of technology, the Panel (1997) wrote:

> A number of different approaches have been suggested for the improvement of K-12 education in the United States, one common element of many such plans has been the more extensive and more effective utilization of computer, networking, and other technologies. (p. 6)

Coley, Cradler, and Engel (1997) surveyed American schools and found evidence that some computer-based instruction can promote learning. The findings of four meta-analyses of tutorial-based computer assisted instruction applications found the average gain varying between 25% and 41% of a standard deviation (Bangert-Drowns, Kulik, & Kulik, 1985; Burns & Bozeman, 1981; Hartley, 1978; Kulik, Kulik, & Bangert-Drowns, 1990). Effects established to date, however, are limited in scope and duration; there is clearly the need for additional research as usage grows and applications evolve.

At the same time, there is sufficient concern (Noble, 1998; Russell, 1999) that technology integration is problematic. Cuban, Kirkpatrick, and Peck (2001) argued that without major and fundamental changes to the organization of schools, product reliability and cost, as well as increased technical support "…only modest, peripheral modifications will occur in schooling, teaching and learning. Teachers will adapt innovations to the contours of the self-contained classroom. New technologies will, paradoxically, sustain old practices" (p. 830). Based on these emerging concerns, our research emphasized the intersection between teachers' instructional design strategies, school culture, motivation, and personal factors that influence the degree to which computer technologies are implemented into teaching and learning practices.

NATURE OF TECHNOLOGY IMPLEMENTATION

Student-centered approaches to learning (American Psychological Association, 1997) have encouraged teachers to modify instructional strategies and integrate computer technologies across the curriculum. The development of the World Wide Web (WWW or Web), as well as interactive and collaborative instructional software, makes technologies increasingly powerful and flexible tools. Despite efforts to expand computer use within the classroom, levels of integration among teachers remain extremely varied (Evans-Andris, 1995; Faison, 1996; Hadley & Sheingold, 1993).

It is generally accepted that as teachers gain experience with computer technology their use in the classroom evolves into using more computer applications, more often and more flexibly (Ertmer, Addison, Lane, Ross, & Woods, 1999; Marcinkiewicz; 1996). Recent studies, however, have raised questions about whether teachers' computer use tends to support existing teaching styles (Cuban et al., 2001). In their evaluation of computer technology use in schools, Hadley and Sheingold (1993) found that technologies are often peripheral to learning and seen as an "add-on activity or simply technological versions of the workbook approaches that are already prevalent…" (p. 265). In examining technology implementation it is necessary to examine the range of teachers' instructional applications of technology.

PERSONAL AND SCHOOL- RELATED FACTORS AFFECTING COMPUTER IMPLEMENTATION

Researchers and staff developers have suggested numerous and disparate factors that may influence the degree to which teachers implement and persist in the implementation of educational innovations in general. These include personal and demographic factors related to teachers, the quality of professional development offered to teachers, the extent to which administrative and curricular support is available to teachers, as well as the quality of teacher access to computer resources.

Several studies have reported relationships between demographic characteristics of teachers and their reported use of technologies; age, gender, race, education level, socio-economic status of students taught, years of teaching, years of technology use, specializations, and size of school were among the factors reported in key literature (Becker, 1994; Ely, 1999; Hadley & Sheingold, 1993; Jaber & Moore, 1999; Marcinkiewicz, 1995).

Another key factor affecting the integration of computers is the technology-related training offered to teachers (Chin & Hortin, 1993, 1994; Dupagne & Krendl, 1992). Technology-related training plays a crucial role in developing teacher's competency with computer applications (Gilmore, 1995) as well as influencing teachers' attitudes towards computers (Becker, Ravitz, & Wong. 1999).

The absence of a systematic policy and proven planning strategy can also hamper teachers' efforts to incorporate computers into the classroom (Cuban, 2000; Morton, 1996). In a critical evaluation of technology adoption in two "high-tech" schools, Cuban et al. (2001) warn that "…the prevailing assumptions guiding policy on new technologies in schools are deeply flawed and in need of re-assessment" (p. 830). Direction is needed from the research community on how schools can develop curricular plans and policies that are relevant and sensitive to issues related to computer integration.

The role of school administration extends beyond policy to include leadership within the school. Both Hadley and Sheingold (1993) and Marcinkiewicz (1996) suggested the need for a perception within the teachers' professional environment that computer integration is an expected and necessary component of the job. This perception can be established through modeling the use of computers by administration, colleagues, students and the larger professional community (Coley et al., 1997; Hannay & Ross, 1997; Wiebe, 1999).

Finally, researchers have contended that access to reliable and functional computer resources is a key factor in the use of computers for instructional activities (Gilmore, 1995; Jaber & Moore, 1999). Marcinkiewicz (1996), however, contended that increased availability of computers might not be sufficient to promote classroom integration. In a survey of 4,083 teachers, Becker et al. (1999) noted that only 5% of upper-elementary, 4% of middle grade and 13% of high-school teachers were currently integrating computers, despite increased availability. Another study by Cuban et al. (2001) provided further evidence that increased access to computers and related resources does not necessarily lead to its more widespread classroom use.

In a survey of connectivity and technology integration in Canadian elementary and secondary schools, Plante and Beattie (2004) found that the overall ratio of students to computers is now five to one in Canada. Almost all principals reported that their schools used computers for educational purposes such as activities directed towards lesson preparation, execution, or evaluation during the school year. At the same time, slightly more than half the principals were unable to report that the majority of their teachers had the necessary qualifications to effectively engage learners in using technology to enhance their learning.

MOTIVATIONAL FACTORS RELATED TO COMPUTER IMPLEMENTATION

How do personal and school related factors impact on a teacher's decision to implement and persist at the integration of technology for learning?

Researchers have been interested in investigating the motivational factors, which influence a teacher's tendency to try innovative educational practices, work towards succeeding at them, and persist at these efforts over time (Hativa & Lesgold, 1991; Ertmer et al., 1999).

A series of studies have looked at teacher's attitudes towards computer technology. Studies to date have focused mainly on investigating (a) how technology impacts the teachers' perceptions and attitudes about their role in the classroom (Chin & Hortin, 1994; Dupagne & Krendl, 1992); (b) the relationship between self-efficacy beliefs and actual computer use in the classroom (Marcinkiewicz & Regstad, 1996; Ross, 1994); (c) levels of computer anxiety among teachers (Bradley & Russell, 1997; Gressard & Lloyd, 1985); and (d) the relationship between teachers' personal teaching philosophy and computer technology use (Briscoe, 1991; Rich, 1990; Sparks, 1988). Missing from the literature, however, are investigations, which apply broad motivational frameworks for examining the relationship between teachers' beliefs about computer technology and their classroom practice.

EXPECTANCY—VALUE THEORY OF MOTIVATION

Expectancy-value theory has emerged as a model for understanding and predicting behavior in the process of adopting innovations. Models of expectancy-value have been largely applied to industrial and occupational settings (Vroom, 1964; Mitchell, 1977), and have been found to be an accurate predictor of productivity (Kopelman, 1979).

Building on Shepperd's (1993) model of productivity within groups, we aim to apply expectancy-value theory to construct a model of the diverse issues involved in a teacher's decision to integrate computer technologies in their teaching. We believe that such a model may offer a more parsimonious as well as predictive model of teacher use and integration of technology for instruction. According to this model, innovations are more likely to be adopted if the perceived value of the innovation and the likelihood (or expectancy) of success are high, as well as if these benefits outweigh the perceived costs of implementation. That is to say, teachers' decisions to use an innovation, such as computer technology, in the classroom relate to (a) how highly they value the innovation; (b) how successful they expect their application of the innovation to be; and (c) how highly they perceive the costs of implementation and use to be.

Thus, in our model we discuss expectancy, value and cost as three distinct constructs. More precisely, *expectancy* items probe teacher perceptions of the contingency between their use of the strategy and the desired outcomes. These include internal attributions (e.g., self-efficacy) and external attributions (e.g., student characteristics, classroom environment). *Value* items assess the degree to which teachers perceived the innovation or its associated outcomes as worthwhile. These include benefits to the teacher (e.g., congruency with teaching philosophy, career advancement), and to the students (e.g., increased achievement, enhanced interpersonal skills). *Cost* items assess the perceived physical and psychological demands of implementation operating as a disincentive to applying the innovation (e.g., preparation time, effort, etc.). We predict that the classification of these items within a theoretical framework will allow us to determine whether those items which distinguish users from nonusers cluster within expectancy, value or cost issues.

Our research is designed to examine the relationship between motivational, instructional, and school factors that impact the nature and frequency of computer technology integration in schools. Thus, our research not only describes current practices but also employs a theoretical model related to teachers' use of technology for learning. Specifically we ask:

1. What is the extent and nature of teachers' classroom computer technology use? Are there significant differences in the ways technology is being implemented in classrooms?
2. What values, expectations and costs do teachers associate with the implementation of computer technologies? To what extent does the expectancy-value model provide a framework for explaining variability in teacher technology use?
3. To what extent do factors related to school environment, demographics and computer accessibility relate to the nature and extent of computer implementation?

METHOD

Questionnaire Item Generation

To generate an initial pool of items, we identified studies that explored factors affecting teacher implementation of technology. From these studies, we extracted (a) items used in previous research instruments, and (b) factors, both positive and negative, identified as affecting integration. In addition, a preliminary survey of 51 teachers, aides, and administrators as well as a small focus group with 5 teachers was conducted to corroborate factors that emerged from the literature. To categorize the hundreds of generated items, we first separated them according to whether they addressed expectancy, value, or cost concerns as defined through the expectancy-value theory of motivation.

Questionnaire Construction

To reduce the number of items we selected only those items that appeared frequently in either the literature (i.e., minimum of three citations) or among teachers (i.e., minimum of three respondents). We pilot tested the initial version of the Technology Implementation Questionnaire (TIQ) with 31 teachers and subsequently, modified our Likert scale to six-points, from A ("Strongly Disagree") to F ("Strongly Agree"), thereby removing a potential "undecided" category to allow for greater variability in responses. Further revisions left 33 items (Section I, Appendix A) concerning attitudes and beliefs towards computer technology use, worded both positively (e.g., "The use of computer technology in the classroom eases the pressure on me as a teacher") and negatively (e.g., "The use of computer technology in the classroom will increase the amount of stress and anxiety students experience"). Among the belief items there were 10 expectancy, 14 value, and 9 cost statements. The inter-rater reliability coefficient for classification of items into expectancy, value, and cost categories, as measured by Cohen's Kappa, was 0.86 (p<.001).

Section II contained seven questions related to personal and school demographics. Section III contained three items pertaining to teachers' self-reported proficiency and current use of computers. Section IV consisted of 12 items; 10 of which were adapted from Hadley and Sheingold's (1993) "functional purposes" (p. 273) or instructional uses for computers in the classroom. We also adapted A. L. Russell's (1995) six-stage process of "learning to use technology" (p. 175) to identify teachers' perceptions of their current stage of integration (see item 55 in Appendix A). Finally, Section V consisted of two open-ended questions soliciting teachers' views on how to reallocate resources for improved instructional uses of computers. The final version of the TIQ can be viewed in Appendix A. The survey was made available to teachers in French and English.

Data Collection Procedure

The TIQ was distributed to 2213 teachers working in elementary and secondary schools in the province of Quebec, Canada. The researchers received the active cooperation of 60 schools from 7 public school boards, as well as 5 private schools. For 19 of the public schools, a research assistant was present to administer the questionnaire to teachers. Each administration took approximately 30 minutes to complete. All other questionnaires were completed by way of a mail-out procedure. Teachers were free to refuse or discontinue participation at any time. Individual responses were available only to members of the research team. All data collection was conducted in accordance with the ethical standards of the American Psychological Association.

RESULTS

Data Screening

From a total sample of 799 teacher respondents, 35 were held aside from further analysis. Of these 35, the responses of 33 teachers were excluded because they responded to less than 90% of the 55 items in the survey. The other two cases were discarded due to noticeably unreliable responding. Among the 764 remaining respondents, any missing data on questionnaire items were replaced as per guidelines stated in Tabachnik and Fidell (2001). Only 25 respondents (3.2%) had missing values in their data sets; analyses conducted with the replaced missing values were no different than if left unreplaced. Missing responses for the 33 belief items in Section I were replaced with individual respondent's mean score for their belief statements, while those for items related to functional uses of computers (i.e., items 44 to 53) were replaced with the individual respondent's mean score for the 10 items on functional uses. Missing data for all other items, which probed personal and setting characteristics (i.e., items 34 to 43, 54 and 55), were replaced with the variable response mean. [1] Descriptive statistics revealed that although some belief item means were high (e.g., $M = 5.48$) no item had a *SD* lower than 0.99 (range *SD*s: 0.99 to 1.64). We reverse-coded 11 negatively-oriented belief statements in Section I, after data collection, to ease interpretation (Table 1). Therefore, for all 33 belief items, the larger the value of the response (on a scale of 1 to 6) the more positive the teacher attitude towards the belief statement.

Table 1

Technology Implementation Questionnaire (TIQ): Belief Items[1]

#[2]	Cat.[3]	Item Stem	*M*[4]	*SD*
1	V	Increases academic achievement (e.g., grades).	4.05	1.32
*2	V	*Does not result* in students neglecting important traditional learning resources (e.g., library books).	3.12	1.52
3	E	Is effective because I believe I can implement it successfully.	3.97	1.37
4	V	Promotes student collaboration.	4.18	1.31
*5	C	*Does not make* classroom management more difficult.	3.70	1.58
6	V	Promotes the development of communication skills (e.g., writing and presentation skills).	4.01	1.45
7	V	Is a valuable instructional tool.	4.84	1.14
*8	C	*Is not too costly* in terms of resources, time and effort.	3.48	1.56
9	E	Is successful only if teachers have access to a computer at home.	3.56	1.71
10	V	Makes teachers feel more competent as educators.	3.01	1.59
11	E	Is successful only if there is adequate teacher training in the uses of technology for learning.	5.19	1.20
12	V	Gives teachers the opportunity to be learning facilitators instead of information providers.	4.44	1.29
13	E	Is successful only if computers are regularly maintained by technical staff.	5.48	.99
*14	C	*Does not demand* that too much time be spent on technical problems.	2.88	1.36
15	E	Is successful only if there is the support of parents.	3.32	1.51
16	V	Is an effective tool for students of all abilities.	4.72	1.32
*17	V	*Is necessary* because students *will not* learn computer skills on their own, outside of school.	4.61	1.37
18	V	Enhances my professional development.	4.34	1.40

Table 1(continued)

Technology Implementation Questionnaire (TIQ): Belief Items[1]

19	C	Eases the pressure on me as a teacher.	2.61	1.47
20	E	Is effective if teachers participate in the selection of computer technologies to be integrated.	4.74	1.24
21	V	Helps accommodate students' personal learning styles.	4.30	1.29
22	V	Motivates students to get more involved in learning activities.	4.45	1.29
*23	C	*Should not reduce* the number of teachers employed in the future.	4.47	1.64
*24	C	*Does not limit* my choices of instructional materials.	4.45	1.47
*25	C	Requires software-skills training that is *not too time consuming*.	3.53	1.50
26	V	Promotes the development of students' interpersonal skills (e.g., ability to relate or work with others).	3.59	1.48
*27	C	*Will not* increase the amount of stress and anxiety students experience.	4.31	1.30
28	E	Is effective only when extensive computer resources are available.	4.43	1.52
*29	E	*Is not difficult, even though* some students know more about computers than many teachers do.	3.79	1.62
30	E	Is only successful if computer technology is part of the students' home environment.	3.08	1.44
*31	C	*Requires no extra time* to plan learning activities.	2.74	1.45
32	V	Improves student learning of critical concepts and ideas.	3.79	1.25
33	E	Becomes more important to me if the student does not have access to a computer at home.	3.67	1.53

[1]Response Scale: 1 (strongly disagree) through 6 (strongly agree)
[2] Questionnaire item number
[3] Conceptual category of item: E = expectancy, V = value, C = cost
[4] *N* = 764.
* Items negatively worded on the TIQ. Reverse-coded for all analyses.
Italicised portion identifies section that was rephrased.

Sample and Setting Descriptions

Of the 764 respondents, 488 taught in elementary schools. Almost 11% of the teachers who took part in this survey worked in the private school sector. Seventy-eight percent (78%) of the teachers were female. Twenty-three percent (23%) of the respondents completed the questionnaire in French. Teaching experience ranged from 1 to 43 years (M = 16.35, SD = 11.27). Class sizes taught by the teachers ranged from 3 to 40 students (M = 24.43, SD = 5.48).

Thirty-eight percent (38%) of respondents reported that *teacher* access to computer resource personnel in their school was either “poor” or “extremely poor.” On the other hand, 76% of teachers rated *student* access to computer resources as “acceptable,” “good,” “very good,” or “excellent.” While 56% of the respondents reported using computers for personal use between 1 to 5 hours a week, 24% reported using computers less than 1 hour a week, if at all. Finally, 17% of teachers reported receiving no inservice training on “using computer technologies in the classroom” while 39% reported receiving “more than a full day and less than a one-semester course” of inservice training on the use of computers for teaching purposes.

Levels of Computer Technology Implementation

Fifty-nine percent (59%) of teachers reported that computer technologies were integrated “occasionally” or “frequently” in their teaching activities (see item 41 in Appendix A). Only 7% reported that computer technologies were used “almost always” or “all the time.” Thirty-nine percent (39%) of teachers reported that computer technologies were “rarely” or “not at all” integrated into their classroom activities (M = 2.92, SD = 1.15).

Item 43 addressed teacher’s proficiency levels in relation to computer technologies (M = 3.71, SD = 1.07). Only 19% of respondents reported being at an “advanced” or “expert” level of proficiency, and 11% indicated being “newcomers” or “unfamiliar” with technology.

Teachers selected one of six stages that best described their personal process of integration. Teacher responses to item 55 are reported in Table 2. About 6% of the teachers described themselves at the learning stage, aware that technology exists, but not having used it. At the other extreme, slightly more than 12% of the teachers described themselves at the creative application stage, able to apply what they know about using technology as an instructional aid that is integrated into the curriculum.

Table 2
Teacher Responses For Item 55: Self-Reported Stages of Integration

Stage	Frequency	Percent
Awareness	45	5.9
Learning	110	14.4
Understanding	146	19.1
Familiarity	192	25.1
Adaptation	175	22.9
Creative Application	96	12.6
Total	764	100.0
M = 3.82		
SD = 1.41		

Teachers who reported using computers "all the time" were more likely to place themselves in the "average," "advanced,"or "expert" proficiency level, $\chi^2(36, N = 764) = 330.39, p < .001$. Similarly, all teachers who reported using computers "almost always," or "all the time" were more likely to place themselves in the "familiarity," "adaptation," or "creative application" stage of integration, $\chi^2(36, N = 764) = 367.02, p < .001$.

Preferred teaching styles (from largely teacher-centered to largely student-centered) were explored in item 37. Teachers who reported preferring student-centered styles of teaching were likely to (a) report using computers more frequently in their teaching, $\chi^2(30, N = 764) = 72.45, p < .001$; (b) rate themselves as more proficient in using computer technologies, $\chi^2(30, N = 764) = 50.45, p = .01$; and (c) place themselves at a higher stage in the process of integrating computer technologies in the classroom, $\chi^2(30, N = 764) = 67.75, p < .001$.

Manner of Technology Use

Items 44 to 53 asked teachers to report how frequently they used computers for 10 functional uses. Table 3 shows the distribution of responses. Cronbach's alpha for teacher's responses to these ten functional uses yielded a high internal consistency of .86.

Technologies appeared to be used most often for informative (i.e., Internet, CD-ROM) and expressive (e.g., word processing, online journal) purposes. More than half of the teachers surveyed reported "never" or "practically never" using computers for (a) recreational (e.g., games), (b) communicative (i.e., e-mail, ICQ, computer conferencing), (c) instructional (e.g., drill, practice, tutorials, remediation), or (d) expansive purposes (e.g., simulations, experiments, exploratory environments, brainstorming).

Table 3

Teacher Responses For Items 44 To 53: Functional Uses of Computer Technology (*N* =764)

Functional Uses of Computer Technologies	Reported Frequency of Use: Never, Practically Never, Once in A While	Reported Frequency of Use: Fairly Often, Very Often, Almost Always
Instructional (e.g., drill practice, tutorials, remediation)	77%	23%
Communicative (e.g., e-mail, ICQ, computer conferencing, LCD projector)	80%	20%
Organizational (e.g., data base, spreadsheets, record keeping, lesson plans)	69%	31%
Analytical/Programming (e.g., statistics, charting, graphing, drafting, robotics)	92%	8%
Recreational (e.g., games)	77%	23%
Expansive (e.g., simulations, experiments, exploratory environments, brainstorming)	89%	11%
Creative (e.g., desktop publishing, digital video, digital camera, scanners, graphics)	84%	16%
Expressive (e.g., word processing, on-line journal)	61%	39%
Evaluative (e.g., assignments, portfolio, testing)	69%	31%
Informative (e.g., Internet, CD-ROM)	52%	48%

Patterns of Use

Multivariate analyses of variances (MANOVAs) were conducted to investigate the mean differences in frequency of the 10 functional uses of computers (items 44 to 53) by gender, teaching sector (private vs. public), and teaching level (elementary vs. secondary). We urge moderation in interpreting the results reported in Tables 4, 5, and 6, as the effect sizes are relatively small. Male school teachers reported using computers for "communicative," "analytic," "expansive," and "creative" purposes significantly more than females. On the other hand, female teachers reported using computers for "instructional" purposes significantly more than male teachers (see Table 4).

Private school teachers reported using computers for each of the functional uses, except for "recreational" and "expansive" purposes, significantly more than public school teachers (see Table 5). It is important to note, also, that there was a statistically significant difference reported between the amount of training received by private (M = 3.14, SD = 1.08) and public (M = 2.75, SD = 1.21) school teachers, $t(105.4) = 2.97$, $p = .001$, which might explain the differences in patterns of use between the public and private sectors.

Table 4

Multivariate Tests of Differences between Male and Female School Teachers on Reported Frequencies of Functional Uses of Computers*

Functional Use	Gender	*M*	*SD*	*F*	*p*	*ES*[a]
Instructional	Male	2.43	1.45	5.38	.02	.08
	Female	2.47	1.40			
Communicative	Male	2.40	1.59	7.08	.008	.09
	Female	2.15	1.46			
Analytic	Male	2.06	1.48	51.10	<.001	.26
	Female	1.49	.93			
Expansive	Male	2.06	1.37	7.81	.005	.10
	Female	1.86	1.17			
Creative	Male	2.18	1.48	11.79	.001	.12
	Female	2.10	1.32			

* Males (N=168), Females (N=596); for all tests df =1, df (Error) = 756

[a] Effect size (ES) is calculated using Cohen's (1988) procedure, which is equivalent to $\sqrt{\frac{\eta^2}{1-\eta^2}}$, where η^2 is interpreted as the proportion of the total variability in the dependent variable that is accounted for by variation in the independent variable; η^2 is the ratio of the between groups sum of squares to the total sum of squares.

Table 5

Multivariate Tests of Differences between Private and Public School Teachers on Reported Frequencies of Functional Uses of Computers*

Functional Use	Teaching Sector	*M*	*SD*	*F*	*p*	*ES*
Instructional	Public	2.46	1.39	7.38	.007	.10
	Private	2.47	1.57			
Communicative	Public	2.08	1.42	35.98	<.001	.22
	Private	3.25	1.64			
Organizational	Public	2.62	1.64	16.16	<.001	.15
	Private	3.60	1.90			
Analytic	Public	1.56	1.02	38.54	<.001	.23
	Private	2.05	1.55			
Creative	Public	2.06	1.34	28.50	<.001	.19
	Private	2.53	1.48			
Expressive	Public	3.01	1.65	13.22	<.001	.13
	Private	3.57	1.82			
Evaluative	Public	2.62	1.61	7.96	.005	.10
	Private	3.52	1.84			
Informative	Public	3.36	1.60	12.30	<.001	.13
	Private	4.02	1.49			

* Private (*N* =81), Public (*N* =682); for all tests *df* =1, *df* (Error) = 756

Finally, elementary and secondary school teachers showed statistically significant differences in their use of computers. Elementary teachers reported more frequent "instructional," "recreational," "creative," "expressive," and "informative" use of computers over secondary teachers; secondary teachers, on the other hand, reported more frequent "analytic" use of computers over elementary teachers (all reported differences were statistically significant; see Table 6). Yet again, there was a statistically significant difference reported between the amount of training received by elementary (M = 2.96, SD = 1.18) and secondary school teachers (M = 2.50, SD = 1.20), $t(561.42) = 5.11$, $p < .001$, which might better illuminate the differences in reported patterns of use.

Table 6
Multivariate Tests of Differences between Elementary and Secondary School Teachers on Reported Frequencies of Functional Uses*

Functional Use	Teaching Level	*M*	*SD*	*F*	*p*	*ES*
Instructional	Elementary	2.60	1.37	12.48	<.001	.13
	Secondary	2.21	1.44			
Analytic	Elementary	1.51	.98	9.29	.002	.11
	Secondary	1.80	1.27			
Recreational	Elementary	2.82	1.47	7.49	.006	.10
	Secondary	1.89	1.22			
Creative	Elementary	2.22	1.40	25.71	<.001	.18
	Secondary	1.94	1.27			
Expressive	Elementary	3.13	1.63	7.11	.008	.10
	Secondary	2.95	1.75			
Informative	Elementary	3.53	1.56	3.99	.05	.07
	Secondary	3.27	1.67			

Elementary (*N* =488), Secondary (*N* =276); for all tests *df* =1, *df* (Error) = 756

Teacher Expectations, Values and Perceived Costs Associated with Computer Implementation

Thirty-three items assessed teacher attitudes, values, and beliefs towards the integration of computer technology (see items 1 to 33 in Appendix A). Cronbach's alphas (which measured internal consistency) for items falling within the three categories of belief statements ranged from moderate to high. Although data from the pilot study revealed uniform distribution across all items, frequencies from the final data set revealed that responses to expectancy items 3, 20, and 33 were skewed. Alpha for the expectancy category was .29 but increased to .61 when the skewed items were excluded; alpha for the value category was .86; and alpha for the cost category was .73. While the limited response ranges to the three skewed expectancy items detracts from the internal consistency of the data set, the information provided by the items proved to be useful for subsequent analyses.

Generally, teachers positively agreed with the 14 value statements (overall *M* = 4.10, overall *SD* = 0.80). The only value items with a mean rating of less than 4.0 were items 2, 10, 26, and 32. The two items with the highest agreement were item 7 where 91% of respondents generally agreed that computer technologies are "a valuable instructional tool"(*M* = 4.84, *SD* = 1.14); and item 16 (*M* = 4.72, *SD* = 1.32), where the majority of respondents agreed that computer technology " is an effective tool for students of all abilities." The two value items with the lowest agreement were item 10, "the use of computer technology in the classroom makes teachers feel more competent as educators"(*M* = 3.01, *SD* = 1.59); and item 2,"the use of computer[s]…[does not result] in students neglecting important traditional learning resources"(*M* = 3.12, *SD* = 1.52).

The overall mean for the 10 expectancy items was also high (overall *M* = 4.12, overall *SD* = 0.53). Items with a mean rating of more than 4.0 were items 11, 13, 20, and 28. The two expectancy items with the highest agreement were item 13, "the use of computer[s] . . . in the classroom is successful only if computers are regularly maintained by technical staff" (*M* = 5.48, *SD* = .99); and item 11, "the use of computer[s]…is successful only if there is adequate teacher training in the use of technology for learning" (*M* = 5.19, *SD* = 1.20). The two expectancy items with the lowest agreement were item 30, "the use of computer[s]… is only successful if computer technology is part of the students' home environment" (*M* = 3.08, *SD* = 1.44); and item 15, "the use of computer[s]… is successful only if there is the support of parents"(*M* = 3.32, *SD* = 1.51)

Teachers showed less positive agreement towards the nine cost items (overall *M* = 3.58, overall *SD* = 0.83) as compared to the expectancy and value items. The cost items with a mean rating of more than 4.0 were items 23, 24, and 27. The two cost items with the highest agreement were item 23, "the use of computer[s] . . . in the classroom [should not reduce] the number of teachers employed in the future" (*M* = 4.47, *SD* = 1.64); and item 24 "the use of computer[s]…in the classroom [does not limit] my choices of instructional materials"(*M* = 4.45, *SD* = 1.47). The two cost items with the lowest agreement were item 19, "the use of computer[s] . . . in the classroom eases the pressure on me as a teacher"(*M* = 2.61, *SD* = 1.47); and item 31, "the use of computer[s]…[requires no extra time] to plan learning activities"(*M* = 2.74, *SD* = 1.45).

Characterizing Teacher Use of Technology: Composite User Variables

To better explore the factors that might be predictive of teachers' use or nonuse of technology, we decided to create a composite of item 41 (teacher's self-reported frequency of integration of computers into teaching activities), item 43 (teacher's self-reported proficiency at computer use) and item 55 (teacher's self-reported stage of computer integration), as these three items best reflected teacher use of and general proficiency with technology. Significant, positive correlations between items 43 and 55 ($r = +.702$, $p < .001$), items 41 and 55 ($r = +.507$, $p < .001$), and items 41 and 43 ($r = +.430$, p

< .001) provided sufficient evidence to create composite variables representing teacher use and proficiency with technology. Initially, we created an unweighted composite variable, *Teacher Use (Unweighted),* for each respondent by simply adding respondents' scores for items 41, 43, and 55.

Teacher Attitudes and Technology Use

To better investigate the motivational factors related to technology use we decided to create a weighted composite variable. This weighted variable was based on a canonical correlation between the set of items 41, 43, and 55 and the set of 33 expectancy, value, and cost items (i.e., items 1 to 33). The nonstandardized coefficients for the single root extracted from the canonical correlation analyses were .36 for item 41, .09 for item 43, and .46 for item 55, thereby yielding a weighted *Teacher Use (Attitudes)* variable. We elected to use the weighted composite variable in our regression analyses because the variance explained by this variable was slightly better than the unweighted variable. The *Teacher Use (Attitudes)* variable predicted 3% more variance in teachers' use of technology than the *Teacher Use (Unweighted)* variable did. However, the significant predictor variables remained unchanged regardless of whether we used weighted composites or not. In addition, we compared the analysis when skewed items were first normalized, versus when they were not. Here too, there were no differences in total variance explained and which predictors were significant.

Teacher Attitudes Predictive of Technology Use

We regressed the *Teacher Use (Attitudes)* variable on the 33 belief items (p to enter $< .05$; p to remove $> .10$). Overall, we were able to explain a meaningful proportion of variance in the degree of technology use, with five significant predictors, $R^2 = 0.33$, $F(5, 758) = 74.05$, $p < .001$.

Two of the five predictors focused on teacher expectations of the use of computers in their classrooms. The values of β, the standardized regression coefficient reported later, represent the unique variance explained by each predictor. Shared variance is not included in the results of our analyses. The larger expectancy predictor was item 3, that computer use "… is effective because I believe I can implement it successfully" ($\beta = .33$), while the other expectancy predictor was item 29, that computer use is not difficult even though "…some students know more about computers than many teachers do" (β = .18). Two other predictors were value statements. The larger value predictor, item 18, was that the use of computers "…enhances my professional development" (β = .13); while the smaller value predictor, item 2, was that computer use in the classroom does not "…result in students neglecting traditional resources (e.g., library)" (β = .08). Only one significant predictor, item 25, focused on the costs of computer use in the classroom, namely that using technology in the classroom "…requires software-skills training that is [not] too time consuming" (β = .13).

Subsequently, we regressed the *Teacher Use (Attitudes)* variable separately on each of the three sets of expectancy, value, and cost statements (p to enter $< .05$; p to remove $> .10$). The 10 expectancy statements predicted the most amount of variance in teacher use and proficiency with technology, with four significant predictors, $R^2 = 0.30$, $F(4, 759) = 80.83$, $p < .001$. The regression analyses conducted on the 14 value items yielded five significant predictors, $R^2 = 0.19$, $F(5, 758) = 34.70$, $p < .001$. Finally, the lowest amount of variance predicted was from the set of nine cost items, with four significant predictors, $R^2 = 0.18$, $F(4, 759) = 40.23$, $p < .001$. As with the regression of *Teacher Use (Attitudes)* on the entire set of 33 attitude statements, the two largest expectancy predictors were items 3 and 29, the two largest value predictors were items 18 and 2, while the largest cost predictor was item 25.

Using our regressions on the three separate sets of attitudes, we saved three sets of predicted values, one each for expectancy, value and cost. We then regressed *Teacher Use (Attitudes)* on the three predicted values of expectancy, value, and cost (p to enter $< .05$; p to remove $> .10$). The total variance explained for *Teacher Use (Attitudes)* was 33% ($R^2 = 0.33$, $F(3, 760) = 126.81$, $p < .001$). The regression coefficients calculated were β = .39 for the predicted value of expectancy, β = .15 for that of value and finally, β = .14 for that of cost. These regression coefficients were used to construct an equation relating teacher use of technology to the expectancy, value, and cost items, namely (.39 x Expectancy) + (.15 x Value) – (.14 x Cost) = Technology Use.[2]

Predictive Teacher Personal and School Setting Characteristics

To create a second weighted composite variable we conducted canonical correlation analyses between the set of items 41, 43, and 55, and the set of nine items related to teachers' personal demographic and school setting characteristics (i.e., items 34 to 40, 42, and 54). The unstandardized canonical coefficients for the single root extracted from the analysis were .18 for item 41, .63 for item 43, and .19 for item 55, which yielded a weighted *Teacher Use (Personal and Setting)* variable. Here also, we elected to use the weighted composite variable in our regression analyses because the variance explained by this variable was better (by 6.25%) than the unweighted variable. Once again, significant predictor variables remained unchanged regardless of whether we used weighted composites or not.

We next regressed *Teacher Use (Personal and Setting)* on the nine demographic and setting characteristics items (p to enter < .05; p to remove >.10), and found seven significant predictors, $R^2 = 0.49$, $F(7, 756) = 105.06$, $p < .001$. The largest predictor was the amount of computer use by teachers for personal purposes outside of teaching activities ($\beta = .57$). The other six predictors were total amount of inservice training ($\beta = .15$), years of teaching experience ($\beta = -.17$), teachers' rating of student access to computers in their schools ($\beta = .10$), gender ($\beta = .12$), preferred teaching methodology ($\beta = .07$), and level of teaching (e.g., elementary versus secondary, $\beta = -.06$).

To determine the total amount of variance the TIQ explained in teacher use and general proficiency in technology, we regressed Teacher Use (Unweighted) on the combined set of 33 attitude statements and the 9 items on demographic and setting characteristics. Overall, we were able to explain 55% of the variance, with 11 significant predictors, $R^2 = 0.55$, $F\ (11, 752) = 82.83$, $p < .001$. The highest predictor of use was item 42, the amount of time teachers used computers for personal use outside of teaching ($\beta = .44$).

DISCUSSION

This study investigated the motivational, demographic, and school conditions, which relate to teachers' implementation of computer technology. Consistent with other findings, our study found that technology implementation is a dynamic process mediated by subjective teacher characteristics and by conditions within the school.

Spectrum and Nature of Use

In response to recommendations in previous research (Becker, 1994; Cuban et al., 2001), our study investigated not only how often computers were being used but the nature of that implementation. We found significant correlations between teachers' self-reported measures of: (a) how frequently they integrated computers; (b) how proficient they were with computer applications; and (c) at what phase of the integration process they were. Our findings support the use of more dynamic definitions of "use" that look beyond dichotomous categories of "use" and "nonuse" to allow for a spectrum of potential integration processes (Ertmer et al., 1999). The frequency of computer use among teachers in our study was consistent with recent research (Jaber & Moore, 1999) with two-thirds of the respondents reporting that they used computer technologies at least "occasionally," and only a small percentage of teachers reporting extensive use of computers (Marcinkiewicz, 1996, Cuban et al., 2001).

Our study found that teachers use computers more often for informative and expressive purposes like the World Wide Web, word processing, and online journals. This finding was consistent with Becker et al. (1999). In fact, less than half of the teachers in our study reported using computers for drill, practice, tutorials, or remediation. However, the general lack of computer use for more complex purposes (i.e., communicative, creative, and expansive) may support Cuban et al.'s (2001) claims that computers may simply maintain existing instructional practices that traditionally focus more on transmitting information then helping learners actively construct knowledge.

Demographic and Setting Characteristics

The results pointed to a number of demographic and setting characteristics related to both the frequency of computer use and the manner in which technologies were being used. Major findings included significant differences in the extent of technology use based on (a) teaching styles, (b) frequency of computer use outside of teaching activities, (c) amount of technology related training, and (d) accessibility of resources within the school.

Teaching styles. According to our results, teachers who prefer more student-centered approaches towards instruction are more likely to (a) integrate computer technologies more frequently; (b) perceive themselves as having a higher level of computer proficiency; as well as (c) report themselves as being at a more sophisticated stage of integrating computers in classrooms. Our findings are encouraging in light of Cuban et al.'s (2001) concern that new technologies run the risk of sustaining existing teacher-centered practices. We encourage future studies to research the impact of computer integration on well-established and dominant teaching practices.

Personal computer use. Teachers' personal use of computers outside of teaching activities was the strongest predictor of technology use in the classroom. This finding supports Jaber and Moore's (1999) argument that teachers' access to computers at home influences computer use in the classroom. When asked what resources would contribute to improving their instructional use of computers, teachers in our study frequently made comments such as:

> Teachers should have time to play and learn with different applications already available in schools…[P]laying gives ideas on how you use computers with students…[I] would like to see more release time or having computers available including a laptop for teachers to take home for extra practice [and] preparation.

Technology-related training. In line with findings by other researchers, the amount of technology-related inservice training was significantly related to computer use in the classroom (Becker, 1994; Gilmore, 1995; Zambo, Buss, & Wetzel, 2001). Teachers in our study generally reported the need for inservice training and when asked what resources could make their implementation easier, teachers referred to applied training that goes beyond skill development. One teacher wrote:

> I would like to learn an application that I need and my students need. I want to use what I learn. It is fine to know how to take a photo and make a book or calendar but is that truly what a class computer should be used for? What are the things students will need to know in the future?

Access to computer resources. Finally, our results suggest that student access to computer resources continues to be a predictor of technology integration, as was suggested in Gilmore (1995) and Jaber and Moore (1999). One teacher commented,

> Computers could easily become an integral element within the classroom...[i]f there were several computers per class. I have three in the classroom and use them everyday for a variety of purposes. Having upwards of eight computers would allow for total integration. Students should not have to constantly wait their turn.

Although teachers in our study highlighted the importance of access to computer resources, a recent study of a sample of 21 teachers by Cuban et al. (2001) found that access to equipment and software seldom led to widespread teacher and student use. Our results, which highlight the impact of motivational factors offers one explanation for why increased access to computers does not necessarily lead to consequential usage of technologies in the classroom.

Teacher Attitudes Towards Integrating Computers

A major purpose of this research was to explore whether we could employ a particular theoretical model to organize apparently disparate reasons teachers implement and persist at using an educational innovation, notably the uses of technology for learning. We believe we have made substantial progress towards achieving that objective. We were able to conceptually classify a lengthy list of explanations into a coherent theoretical framework and relate these explanations to implementation variability. In particular, teacher motivation to use technology for learning was substantially related to self-reported use. Teacher attitudes toward the successful use of technology, the value of implementation and the costs associated with implementation explained a substantial amount (33%) of the difference observed in the degree to which computers were being integrated. As a heuristic, the core of our model reduces to a simple, teacher- motivation-to-use-technologies "equation":

$$(.39 \times \text{Expectancy}) + (.15 \times \text{Value}) - (.14 \times \text{Cost}) = \text{Technology Use}$$

Which of the global factors from the expectancy-value model exerted the most influence on teachers' attitudes towards technology use? Factors related to expectancy of success were the most predictive of computer use. Teachers who believe that they have the skills to implement computers successfully and who valued the outcomes associated with integration were more likely to be at the high end of the "technology user" spectrum. One teacher's comment highlights the importance of possessing positive attitudes: "I know or am confident that I can figure out how to use aspects of computer capabilities with my students, but I want a lot of time to play around with classroom applications before using them in my class."

To maximize the implementation of educational innovations, our findings suggest that professional development must attend to the enhancement of teachers' expectations of success. Teachers need to believe that they can successfully implement the innovation within their own context; if not, they may neither take the initial risk nor continue to persevere in implementing it. This suggests that it may be useful, but not sufficient, to show teachers how successful others have been with technology applications and to create communities of practitioners providing mutual support.

Teachers also need to be convinced of the value of technology as a tool to supplement and improve classroom practice. Technology, which is well integrated into the curriculum, rather than merely added to it, may be one means by which skeptical teachers may develop positive beliefs about the role of technology as a tool for learning. When asked about the “ideal” way to integrate computers in the class, teachers highlighted the value of computers for the learning experience:

> I believe [computer technology] is an essential tool in today’s school environment. It motivates students and encourages them to explore and to learn in a way previously unavailable to them. [I am] [U]sing computers to create projects, learn and discover various subject areas, too numerous to mention…[I]t is a tool that cannot be ignored.

Despite concerns that the costs associated with implementation would be the major barriers to use (e.g., maintenance by technical staff, time consuming training), cost did not figure as prominently a predictor of technology use in our study. However, when asked what resources would improve their use of computers, teachers commented on the availability of resource personnel and product reliability; for example, one teacher wrote: “The resources provided by school administration should cover many areas. Resources are needed for both teachers and students and should consist of such things as computer training, available computer programs as well as technical support from on-site technicians.”

LIMITATIONS AND IMPLICATIONS FOR FUTURE RESEARCH

A major objective of this research was to determine whether we could employ an expectancy-value model of motivation to organize teacher attitudes, values, and beliefs toward computer integration in the classroom. We have made tremendous progress towards developing a concise, meaningful, and powerful model of teacher use of technology. Overall, teacher attitudes as well as personal and setting characteristics, such as personal use outside of teaching, were able to account for 55% of the variance in teacher use of technology. However, a sizeable amount of variance remains to be explained.

To address this unexplained difference in computer use, future research should focus on additional factors that may affect a teacher’s decision to integrate computers. Future research could measure factors like (a) personality differences among teachers, (b) levels of computer anxiety, (c) student characteristics, (d) levels of peer-support and administrative support, and (e) the extent to which prior experiences with computers has affected teacher attitudes, all of which were not addressed in the TIQ.

Efforts were made to address methodological issues (Miskel, DeFrain & Wilcox, 1980) associated with conducting survey research. We ensured the involvement of teachers in the process of generating belief items, and validated the content validity of our items with practicing teachers as well as fellow researchers. However, the skewness of responses to some of the belief statements may point to the need for improved methods for creating items representative of the population being investigated. Future versions of the questionnaire should rephrase strongly skewed statements to increase the variability of responses, and hence increase the internal reliability of each of the three broad categories of belief items.

In addition, the use of self-reported measures of computer use, proficiency levels, and stages of integration could have affected the reliability of our analysis. Future research could involve triangulating the self-reported measures through use of observational and self-reported student data.

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Notes

1. The decision to use an individual teacher's mean scores in the case of belief statements and functional uses ensured that the replaced missing value best represented the *individual's* response to a given set of related items as opposed to a variable mean across *all* respondents. This conservative approach of replacing missing values using the mean did not change the variable mean, but the variance was very slightly reduced.
2. Cost has a negative coefficient in our equation to represent the fact that teachers use of computer technology is *negatively* influenced by any costs they associate with implementing technology in the classroom.

APPENDIX A

TECHNOLOGY IMPLEMENTATION QUESTIONNAIRE

Copies of English and French versions of the questionnaire are available at: http://doe.concordia.ca/cslp/Downloads/PDF/TIQ-QV17.pdf and http://doe.concordia.ca/cslp/Downloads/PDF/TIQF.PDF respectively.

INSTRUCTIONS

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
A	**B**	**C**	**D**	**E**	**F**

This questionnaire has five sections and consists of four printed pages. Please mark **ALL** your answers on the accompanying **Answer Sheet**. Circle the most appropriate response when answering the closed-ended questions. Space is provided to record your comments to the open-ended questions. After you have completed your responses, please return both the questionnaire and the answer sheet to your facilitator.

SECTION I- Your Professional Views on Computer Technology

Using the scale provided, please rate the extent to which you agree or disagree with the following statements regarding the use of computer technology in the classroom:

The use of computer technology in the classroom…

1. Increases academic achievement (e.g. grades).
2. Results in students neglecting important traditional learning re sources (e.g., library books).
3. Is effective because I believe I can implement it successfully.
4. Promotes student collaboration.
5. Makes classroom management more difficult.
6. Promotes the development of communication skills (e.g., writing and presentation skills).
7. Is a valuable instructional tool.
8. Is too costly in terms of resources, time and effort.
9. Is successful only if teachers have access to a computer at home.
10. Makes teachers feel more competent as educators.
11. Is successful only if there is adequate teacher training in the uses of technology for learning.
12. Gives teachers the opportunity to be learning facilitators instead of information providers.
13. Is successful only if computers are regularly maintained by technical staff.
14. Demands that too much time be spent on technical problems.
15. Is successful only if there is the support of parents.
16. Is an effective tool for students of all abilities.
17. Is unnecessary because students will learn computer skills on their own, outside of school.
18. Enhances my professional development.
19. Eases the pressure on me as a teacher.
20. Is effective if teachers participate in the selection of computer technologies to be integrated.
21. Helps accommodate students' personal learning styles.
22. Motivates students to get more involved in learning activities.
23. Could reduce the number of teachers employed in the future.
24. Limits my choices of instructional materials.
25. Requires software-skills training that is too time consuming.
26. Promotes the development of students' interpersonal skills (e.g., ability to relate or work with others).
27. Will increase the amount of stress and anxiety students experience.
28. Is effective only when extensive computer resources are available.
29. Is difficult because some students know more about computers than many teachers do.

30. Is only successful if computer technology is part of the students' home environment.
31. Requires extra time to plan learning activities.
32. Improves student learning of critical concepts and ideas.
33. Becomes more important to me if the student does not have access to a computer at home.

SECTION II - Your Background, Your Teaching Style and Resources Available to You

34. Gender: A. Female B. Male

35. Years of teaching completed (If this is your first year, indicate '**0**'on the answer sheet. If last year was your first, indicate '**1**', and so on.)

36. Current teaching position (If you teach in more than one subject area, choose the <u>**one**</u> that dominates your teaching schedule.)

<u>Elementary:</u>
A. Pre-K or Kindergarten
B. Cycle 1, grades 1 and 2
C. Cycle 2, grades 3 and 4
D. Cycle 3, grades 5 and 6
E. Other (e.g., Music, Phys. Ed., Science, Resource)

<u>Secondary:</u>
F. Mathematics, Science, or Computer technology
G. Language arts, Second language, MRE, Social Science
H. Special Education or Resource
I. Other (e.g., Creative arts, Phys. Ed., Vocational)

37. Preferred teaching methodology (<u>**choose only one**</u>)

A. Largely teacher-directed (e.g., teacher-led discussion, lecture)
B. More teacher-directed than student-centered
C. Even balance between teacher-directed and student-centered activities
D. More student-centered than teacher-directed
E. Largely student-centered (e.g., cooperative learning, discovery learning)

38. Average class size that you teach (please provide a whole number and not a range)

For questions 39 and 40, use the following scale to rate your responses

Extremely Poor	Poor	Acceptable	Good	Very Good	Excellent
A	**B**	**C**	**D**	**E**	**F**

39. How would you rate student access to computer technology at your school?
40. How would you rate teacher access to computer resource personnel in your school?

SECTION III –Your Experience with Computer Technologies

41. Please indicate how often you integrate computer technologies in your teaching activities.

A. Not at all B. Rarely C. Occasionally	D. Frequently E. Almost Always F. All the Time

42. On average, how many hours per week do you spend using a computer for personal use outside of teaching activities?

A. None B. Less than 1 hr C. 1 hour or more, but less than 3 hours	D. 3 hours or more, but less than 5 hours E. 5 hours or more, but less than 10 hours F. 10 hours or more

43. Please read the following descriptions of the proficiency levels a user has in relation to computer technologies. Determine the level that best describes you and circle the corresponding letter on your answer sheet.

A. Unfamiliar
I have no experience with computer technologies.

B. Newcomer
I have attempted to use computer technologies, but I still require help on a regular basis.

C. Beginner
I am able to perform basic functions in a limited number of computer applications.

D. Average
I demonstrate a general competency in a number of computer applications.

E. Advanced
I have acquired the ability to competently use a broad spectrum of computer technologies

F. Expert
I am extremely proficient in using a wide variety of computer technologies.

SECTION IV - Your Process of Integration

For Items 44 to 53:
Please indicate how frequently computer technologies are integrated into your teaching activities for each of the uses listed below. Circle the appropriate response on your answer sheet.

Never	**Practically Never**	**Once in a While**	**Fairly Often**	**Very Often**	**Almost Always**
A	**B**	**C**	**D**	**E**	**F**

44. Instructional (e.g., drill, practice, tutorials, remediation)
45. Communicative (e.g., e-mail, ICQ, computer conferencing, LCD projector)
46. Organizational (e.g., data base, spreadsheets, record keeping, lesson plans)
47. Analytical/Programming (e.g., statistics, charting, graphing, drafting, robotics)
48. Recreational (e.g., games)
49. Expansive (e.g., simulations, experiments, exploratory environments, brainstorming)
50. Creative (e.g., desktop publishing, digital video, digital camera, scanners, graphics)
51. Expressive (e.g., word processing, on-line journal)
52. Evaluative (e.g., assignments, portfolio, testing)
53. Informative (e.g., Internet, CD-ROM)

54. Total amount of inservice training you have received to date on using computer technology in the classroom:

A. None
B. A full day or less

C. More than a full day and less than a one-semester course
D. A one-semester course
E. More than a one-semester course

55. Please read the descriptions of each of the six stages related to the process of integrating computer technology in teaching activities. Choose the stage that best describes where you are in the process and circle the corresponding letter on your answer sheet.

A. **Awareness**
I am aware that technology exists, but have not used it – perhaps I'm even avoiding it. I am anxious about the prospect of using computers.

B. **Learning**
I am currently trying to learn the basics. I am sometimes frustrated using computers and I lack confidence when using them.

C. **Understanding**
I am beginning to understand the process of using technology and can think of specific tasks in which it might be useful.

D. **Familiarity**
I am gaining a sense of self -confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer.

E. **Adaptation**
I think about the computer as an instructional tool to help me and I am no longer concerned about it as technology. I can use many different computer applications.

F. **Creative Application**
I can apply what I know about technology in the classroom. I am able to use it as an instructional aid and have integrated computers into the curriculum.

SECTION V– Additional Comments

A. Suppose your school administration annually made additional resources available (example: release time) for improving computer-based instruction. In your opinion, what kinds of resources should they provide? How would you like to see these resources used in order to improve **your** instructional use of computers?

B. Please describe the ideal use, if any, of computer technology in the classroom.

Thank you very much for your participation in our study.