Factors that influence elementary teachers' use of computers

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ABSTRACT

The purpose of this quantitative study was to examine the ways elementary teachers use computer technology for instructional purposes and the factors that influence their use of computers. The population consisted of recent graduates from the elementary teacher preparation program at a mid-Atlantic university.

Data were gathered using a survey instrument. The instrument addressed the four factors that support teachers' use of computers: access and availability, preparation and training, leadership, and time. Descriptive and inferential statistics were employed in this study.

The response rate was 89 percent. The findings indicated that 84 percent of the teachers felt either well or very well prepared to integrate technology into curriculum, and that they were able to overcome the typical barriers to computer use in elementary classrooms. The teachers overwhelmingly indicated that computers have considerable potential for allowing students to discover or construct ideas for themselves and supported constructivist pedagogies when referring to computer use in elementary classrooms. Teacher preparation, teacher philosophy and grade level were identified as influential factors in the use of computers by the elementary teachers and the elementary students.

Since the mid-1980s, interest in computer use in the nation's K-12 public schools has been increasing. Over the past ten years, the United States has spent $38 billion to bring technology and Internet access to our schools (Benton Foundation, 2001). The National Center for Educational Statistics (NCES) reported, for example that in 1994, only 35% of public elementary and secondary schools, and 3% of all instructional rooms had access to the Internet. Today, 99% of public elementary schools and 86% of elementary instructional rooms have access to the Internet (National Center for Education Statistics, 2002).

Even though an elementary school has current equipment and Internet access, relatively few teachers feel well prepared to integrate educational technology into classroom instruction. The NCES (2000, 2002) reported than only about one-third of elementary teachers in the United States felt well prepared or very well prepared to use computers and the Internet for classroom instruction, and less experienced teachers felt better prepared to use technology than their more experienced colleagues.

The extant literature (Becker, 1991; Becker, 1999, 2000a, 2000b; Becker, Ravitz, & Wong, 1999; National Center for Education Statistics, 2000, 2002) on the current use of computers in K-6 elementary schools indicates that elementary teachers use computers primarily for administrative and preparatory tasks and not for instructional activities with students. Computers are not being used as often or as effectively as they could be in instruction (Becker, 1986, 1991; Becker, 1999, 2000a; Becker et al., 1999; Cuban, 2001; National Center for Education Statistics, 2000, 2002). Lack of teacher preparation is cited as one of the factors that hinder computer use by elementary teachers (Calvert, 2001; Dawson, 1998; Espey, 1999; Guha, 2000; Michael, 2001; National Center for Education

Statistics, 2000). Other barriers to computer use by elementary teachers are lack of leadership, lack of time, and lack of availability and access to computers.

We would expect that as teachers enter the profession being better prepared to integrate technology into curriculum, we would see elementary students and teachers using computers more frequently and throughout the curriculum. By investigating computer use of teachers who are well prepared to integrate technology into curriculum, the researcher sought to understand whether or not the factor of teacher preparation and training is the critical factor to classroom use of computers or if other factors outweigh teacher preparation and training.

The teacher preparation program at this mid-Atlantic university is accredited by the National Council for Accreditation of Teacher Education (NCATE) and the Teacher Education Accreditation Council (TEAC). Integrated throughout the teacher preparation is a significant educational technology strand. Students take a skills-based educational technology course, and technology is integrated into their methods courses (mathematics, social studies, language arts, and science) as well as into many of their education courses. Throughout the past several years, the College of Education has received numerous awards for preparing teachers to teach with technology, and the teacher preparation program is considered to be among the finest in the nation. On the basis of the school's commitment to technology and in light of the many awards it has received for the integration of technology into the teacher education program, one can assume that compared to most other preservice teachers, those graduating from the mid-Atlantic university are among the best prepared to use technology in their teaching.

Methodology

The intent of this study was to identify how elementary teachers who are recent graduates of the School of Education use computers for instructional purposes, and what factors influence their use of computers. The criterion variable for this study was how much and in what ways teachers use computers. The predictor variables were the factors of leadership, time, and access and availability.

Survey methodology was used to test the hypotheses. The instrument addressed the four factors that support teachers' use of computers. The research questions were: (a) In what ways are graduates using computers in their elementary classrooms? (b) What factors influence graduates' use of computers in their elementary classrooms?

The null hypotheses were:

1. There will be no significant relationships between the computer use of graduates and the measures of support of leadership, time, and access and availability.
2. There will be no significant relationships between the degree to which graduates indicated that they were prepared to teach with technology in their teacher preparation program and their current uses of computers.

Participants

The population for this study consisted of all 121 recent graduates (2000-2002) from the elementary teacher preparation program with addresses in the United States. Naturally, some of these graduates were not teaching and many of them did not have current mailing addresses on file, so the actual population size was less than 121.

These graduates received dual Bachelor of Arts and Master of Teaching (BA/MT) degrees or postgraduate Master of Teaching (PG/MT) degrees from the mid-Atlantic university. This population was chosen as the extant literature (Becker, 1986, 1991; Becker, 1994, 1999, 2000a; National Center for Education Statistics, 2000) suggests that beginning teachers use technology more than experienced teachers, and the program of coursework for these students strongly emphasized educational technology use.

Instrumentation

A survey was constructed after review of the research literature on classroom teachers' use of computer technology (see Appendix). Two tested instruments, the *Teaching, Learning, and Computing: 1998 Survey* [TLC] (Becker & Anderson, 1998) and the *Fast Response Survey System* [FRSS] (NCES, 2000) were used to develop the survey for this study. These instruments have been used in large, wide-scale surveys of K-12 teacher computer use. The findings of the TLC and FRSS indicated that classroom teachers are using computers primarily for administrative and preparatory tasks and not for classroom instruction. Validity and reliability information for the TLC survey is not available. The FRSS was established to 1975 to collect and report data on key education issues at the elementary and secondary level with minimum response burden. "Data collected through FRSS surveys are representative at the national level, drawing from a universe that is appropriate for each study" (NCES, 2000, p. B-1). The sample for the NCES (2000) report on *Public School Teachers Use of Computers and the Internet* consisted of 2,019 full time public school teachers in regular elementary, middle and high schools in the 50 states and the District of Columbia. The sampling frame was stratified

by instructional level and school size. Completed questionnaires were received from 91 percent of the eligible teachers. (NCES, 2000, Appendix B) The findings of the TLC and FRSS indicated that classroom teachers are using computers primarily for administrative and preparatory tasks and not for classroom instruction.

Survey questions were designed to address the factors that contribute to classroom teachers' use of computers: access and availability, teacher preparation and training, leadership and time. Dillman's (2000) Tailored Design Method (TDM) was used in the instrument design. TDM is a protocol for implementing effective mail survey research. This protocol included criteria for question development and ordering as well as graphic design of the instrument. Validity and reliability were sought through the modified piloting procedures suggested in TDM.

Given the small population size (N=100), conducting a typical pilot study was not feasible. Therefore, pretesting (a modified pilot study) was conducted. Three people with expertise in elementary education, technology and survey design completed and reviewed the survey in the presence of the researcher. After each stage of the pretest, the survey instrument was revised based upon the assessment of the reviewers. Stage one of the pretest was a review by knowledgeable colleagues and analysts. The purpose of stage one was to finalize the substantive content of the instrument. Stage two consisted of cognitive interviews to evaluate the cognitive and motivational qualities of the instrument. During these think-aloud interviews the three participants were asked to respond to the questionnaire in the presence of the researcher who asked them to think out loud as they went through the draft questionnaire. The think-aloud interviews were designed to produce information when the respondent was confused or unable to answer

a question. Retrospective interviews with different respondents were conducted for stage three. Respondents were asked to complete the questionnaire as if they received it at home, and to complete it as they would if the researcher was not present. The researcher watched while the respondents completed the questionnaire, noted skipped questions, hesitations, and confused expressions. After the questionnaire was completed, the researcher asked questions about potential problems. The retrospective interview was particularly helpful in revealing navigational difficulties in the questionnaire. The final stage of pretesting was to ask two people, who had no involvement in the previous stages, to sit down by themselves and complete the survey. This stage served as the final check to look for errors (Dillman, 2000). It was hoped that by following this protocol the response rate would be increased and errors of measurement decreased.

Data Collection

The survey instrument was mailed to all members of the population. Implementation procedures suggested in the TDM (Dillman, 2000) were followed to influence response rate positively. The five elements suggested in TDM that have been shown to improve response to mail surveys were followed. These elements were:

1. A respondent friendly questionnaire
2. Up to five contacts with the questionnaire recipient
3. Inclusion of stamped return envelopes
4. Personalized correspondence
5. A token financial incentive that was sent with the survey request

As suggested in element two, multiple contacts consisted of four contacts by first class mail with an additional fifth and final special contact that used priority mail. The five contacts were a brief prenotice letter, a questionnaire mailing, a thank you postcard, a replacement questionnaire, and a final contact.

Data Analysis

Inferential and descriptive statistics were employed in this study. Data were coded and reduced using a statistical analysis software program. Frequencies and percentages, means, and standard deviations for each survey question were computed, and the data were reported in tables. Multiple regression analysis was used to test for relationships stated in the null hypotheses. Multiple correlations were computed and tested for significance.

Results

The survey response rate was 89 percent. Surveys were mailed out to all 121 elementary teacher preparation graduates from the years 2000-2002. Of the 121, eight were returned with “no longer at this address” information. Therefore, the available population was 113. Of the 113, 100 surveys were returned. It is possible that the remaining 13 surveys were not received by the graduates. Of the 100 returned, sixty-eight surveys were used in the actual data analysis of the study. The majority of the respondents were current elementary classroom teachers of grades K-6 in self-contained classrooms. However, a significant percentage of them were not currently teaching. The

respondents who indicated *other* were working in school districts as specialists or were teaching middle school and were excluded from this study. The majority of the population had been teaching for three or fewer years. It is likely that the teachers who had been teaching for more than three years had a number of years teaching full or part time in private schools or in schools that did not require licensure before attending the School of Education. All members of the population were 2000-2002 graduates from the School of Education: 28 percent graduated in 2000, 41 percent graduated in 2001, and 30 percent were 2002 graduates. One respondent did not answer this question.

Nearly 77% of the teachers indicated that their philosophies of using computers for instruction were aligned with constructivism defined as

> a theory that defines knowledge as temporary, developmental, socially and culturally mediated, and thus, non-objective. Learning from this perspective is understood as a self-regulating process of resolving inner cognitive conflicts that often become apparent through concrete experience, collaborative discourse, and reflection (Brooks & Brooks, 1993, p.vii) in (Sandholtz, Ringstaff, & Dwyer, 1997,p.7)

These same teachers indicated that computers have considerable potential for allowing students to discover or construct ideas for themselves. In addition to describing their philosophies of using computers during instruction, the teachers were also asked how well prepared they were to use computers for classroom instruction. A significant 84% of the teachers indicated that they were either well or very well prepared to teach with computers, and none of them indicated that they were not at all prepared to teach with technology. Over half of the teachers indicated that, to a large extent, their preparation to

teach with technology occurred at the School of Education as compared with preparation during professional development activities, independent learning or other college coursework.

Although the relationship between teachers' philosophies and preparation to teach with computers was not significant at the .05 level, the data indicate that when their philosophies about using computers were more constructivist in nature, their indicated degree of preparation was higher (see Tables 1 and 2).

Table 1

Frequencies and Percent Scores for Elementary Teachers' Philosophy on Computer Use (N=68)

	Frequency	Percent
Doesn't fit my style	3	4.4
Only has limited use	6	8.8
Best for drill and practice	7	10.3
Considerable potential for student discovery and construction of ideas	52	76.5
Total	68	100.0

Table 2

Summary of Regression Analysis for Predicting Teachers' Preparation for Using Computers in Classroom Teaching (N=67)

	B	*SE*	β	t	Sig.
Limited use	.167	.469	.070	.356	.723
Drill and skill	.190	.457	.086	.416	.679
Discover or construct	.667	.394	.417	1.693	.095

Note. R^2=.066 (p=.062). 1 case missing.

Teacher Use of Computers

Nearly three-fourths of the teachers indicated that they used computers for teaching during class time. A factor analysis of the data was conducted in order to measure what the variables had in common. The factor analysis indicated that this population used computers primarily in four ways: (a) locating and gathering materials, (b) communication, (c) posting information, (d) writing lessons (see Table 3).

Locating and gathering materials is essentially the preparatory work that teachers do before writing a lesson or unit. In many ways, this factor is the gathering and rounding up of the resources needed to plan for a lesson, write a unit, or prepare for instruction. The second factor, communication, is the use of email for communicative purposes. The third factor, posting information is the factor that connects the classroom work and activities to individuals outside of the classroom whether it is posting of assignments on the World Wide Web for students and parents to access or posting attendance and grades on the school server for the administrative staff to access. The final factor, writing and developing lesson plans, includes the actual act of creating instructional materials such as the teacher sitting down at the computer and typing and designing a lesson.

Table 3

Factor Analysis for Ways Elementary Teachers Use Computers

	1	2	3	4
	Locating/ gathering materials	Communication	Posting information	Writing lessons
Access research and best practices for teaching.	.815			
Use camcorders, digital cameras, or scanners to prepare for class.	.750			
Access model lesson plans.	.751			
Gather information for planning lessons.	.692			
Get information or pictures from the Internet for use in lessons.	.502			
Communicate with colleagues or other professionals.		.872		
Communicate with students' parents.		.732		
Exchange computer files with other teachers.		.604		
Administrative record keeping.			.583	
Post homework or other class requirements.			.748	
Post student work, suggestions for resources, etc. on the WWW.			.698	

Table 3 (cont'd)	1	2	3	4
	Locating/ gathering materials	Communication	Posting information	Writing lessons
Create instructional materials (handouts, etc.)				.774
Prepare multimedia presentations for class.				.566

Note. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 6 iterations.

Student Use of Computers

Student use of computers in an elementary school setting is generally dependent upon the teachers and other staff members at the school site. The elementary teachers in this study tended to assign projects that required their students to use computers inside of their classrooms rather than outside of their classrooms (i.e. computer labs/media centers). However, Internet use was more frequent outside of the classroom due to the fact that not all classrooms have Internet access. The exceptions to any computer use were the two teachers who teach in schools that do not allow students to use computers.

The ways in which elementary students used computers varied by grade level. Primary (K-3) students tended to use computers more for drill and practice activities whereas older students spent more time word processing. Students of all grade levels used the WWW to a significant degree. Grade level also made a difference in frequency of computer use. The higher the grade level, the more often students used computers.

The results of a factor analysis indicated that these students used computers primarily in three ways: (a) general software applications, (b) complex/multimedia and communication tasks, and (c) practice/simulations (see Table 4). General software applications include the software programs that are typically found in an elementary classroom or computer lab such as graphics for drawing and painting and a program that includes word processing, spreadsheets, and presentation/slide show. Stand-alone programs specifically designed for elementary schools might include Kid Pix for graphics and word processing, Graph Club for spreadsheets, or Reader Writer for authoring. Complex/multimedia and communication tasks include more sophisticated uses of computers such as email, data analysis, and HyperStudio for multimedia authoring. Practice/simulations include a variety of computer software applications designed specifically to reinforce drill and skill development. Such software includes Math Blaster Plus, Reader Rabbit, and simulations such as Oregon Trail.

Table 4

Factor Analysis of Ways Elementary Students Use Computers

	1 Software applications	2 Multimedia/ communication	3 Practice/ simulations
Presentation software	.745		
Word processing	.794		
Spreadsheets	.554		
WWW	.737		
CD-ROM research	.597		
Graphics	.608		
Email		.875	

Table 4 (cont'd.)	1 Software applications	2 Multimedia/ communication	3 Practice/ simulations
Analyze data		.834	
Drills			.890
Games for skills			.868
Simulations			.718

Note. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 5 iterations. Percent of variance explained—Factor 1: 24.88%; Factor 2: 24.44%; Factor 3: 19.22%.

The response rate to the open-ended question that asked teachers to share their greatest success in using computers with students was 62%. Of the responses to this question, Internet use was noted 39% and was the most frequent success mentioned. Student use of the Internet for research was mentioned in 27% of the responses, and 12% shared webquests. Additionally, 25% of the responses mentioned writing and word processing, 22% indicated PowerPoint, and 8% mentioned HyperStudio. The kindergarten teachers stated using computers in centers was their greatest success.

A typical statement about word processing was "We use the computers most often for typing papers and publishing. They love to type a story and then use Kid Pix to illustrate their work." Student use of PowerPoint spanned the content areas of social studies, science, language arts and mathematics. One teacher wrote,

> My greatest success using computers with students would be the completion of PowerPoint presentations. For most, if not all of my students, their first social studies project exposed them to the PowerPoint presentation software. They were

all excited and enthusiastic that they learned a new use for technology while creating a presentation to share with peers.

One of the teachers who noted that having students complete webquests was her greatest success wrote about a 4th grade solar system webquest that resulted in the 4th graders using Adobe Page Maker to create pages on each of the planets and uploading them to the Internet, as well as the student development of mini-webquests in social studies.

Three of the teachers indicated that they had great access to technology as each elementary student had their own laptop. One teacher wrote, "The computers empower them and me because instructional opportunities are increased." Another teacher wrote,

> I am blessed to be at a school that has more technology than I ever expected a school would have. Because of this I have been able to apply all of the skills I gained in the School of Education. One of my greatest successes was teaching Internet research skills culminating in voice recorded/animated PowerPoint presentations. I have also had a lot of success with social studies webquests.

A teacher with laptops for each student wrote,

> My greatest success in using computers with my students has come through the use of our wireless lab, consisting of 20 laptops that may be checked out for classroom use. I have used this lab to integrate technology into every subject area, including Internet research, word processing, spreadsheets/graphing, PowerPoint and more.

Another teacher from a technology-rich school stated, "Probably software that gives students experiences that I can't: For example, dissection. Another would be

building circuits and using conductors and insulators—the software allows them to test pickles!" Pickles are conductors of electricity and glow when electrically stimulated.

The greatest successes shared reflect technology integration into curriculum. Students were using computers to enhance learning and also learning to use computers in different ways and to varying degrees than the uses and frequencies described in the extant literature.

Although these elementary students used computers in similar ways as the research literature indicated other elementary students use computers, the elementary students in this study also used computers to greater extents for complex/multimedia and communication tasks and used the World Wide Web to a much greater extent.

Barriers

The elementary teachers indicated that their greatest barriers to computer use were (a) too much curriculum to cover, (b) lack of time in daily schedule, and (c) high stakes testing (see). Grade level had no significant statistical relationship with any of the perceived barriers to computer use.

The elementary teachers in this study felt quite prepared to use technology in their teaching, and they overwhelmingly indicated that computers had considerable potential for allowing students to discover or construct ideas for themselves. As stated previously, there was a relationship between their preparation and philosophies of computer use. Teachers' uses of computers were primarily for preparatory and communicative tasks. In summary, grade level had little bearing on the ways in which teachers use computers, but grade level did have a bearing on the ways in which elementary students use computers.

Factors that Influence Computer Use

Six support factors for elementary teachers' use of computers were identified in a factor analysis (see Table 5). The factors were: (a) leadership, (b) access and availability, (c) incentives, (d) personnel support, (e) external constraints, and (f) philosophy and preparation. The leadership factor was comprised of the variables over which school site and district administrators typically have control. Access and availability were essentially the hardware and software resources. Incentives included the significant incentives that are often offered to teachers to encourage participation in professional development activities. The personnel factor was comprised of the people that support teachers in their use of computers. The external constraints included the three most significant barriers cited by the elementary teachers. This factor included variables over which the teacher has little to no control and considered to be external in nature. The philosophy and preparation factor included teachers' overall perceptions of their preparation to use computers for teaching, their preparation at the School of Education, and their philosophies of using computers in classroom instruction.

Table 5

Factor Analysis of Support Factors to Computer Use

	1	2	3	4	5	6
	Leadership	Access/ Availability	Personnel	Incentives	External	Philosophy/ Preparation
Release time for training				.777		
Expenses are paid				.774		

Table 5 (cont'd.)	1 Leadership	2 Access/ Availability	3 Personnel	4 Incentives	5 External	6 Philosophy/ Preparation
Stipends				.785		
Recertification credit						
Internet connection from home						
Additional resources given for participation				.582		
Use of computers assistance			.602			
Use of the Internet assistance			.683			
Technical support			.598			
Integrating technology assistance			.782			
Locating software assistance			.703			
Opportunity to observe colleagues						
Not enough computers		.675				
Lack of funding		.713				
Old computers		.814				
Internet access not accessible		.627				
Lack of software	.595					
Inadequate training opportunities	.723					
Lack of release time	.813					
Lack of administrative support	.689					

Table 5 (cont'd.)	1 Leadership	2 Access/ Availability	3 Personnel	4 Incentives	5 External	6 Philosophy/ Preparation
Lack of integration support	.683					
Lack of technical support	.688					
Lack of time in class schedule					.683	
Student access to material concern					.525	
Too much curriculum to cover					.831	
High stakes testing					.698	
Philosophy						.687
How well prepared						.709
UVA Arts and Sciences						.618
School of Educ.						.662
Professional development						
Colleagues						
Your students						
Independent learning						

Note. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 7 iterations. Absolute values < 0.4 suppressed. Percent of variance explained in Factor 1: 11.51%; Factor 2: 10.49%; Factor 3: 9.72%; Factor 4: 9.02%; Factor 5: 7.69%; Factor 6: 6.37%.

The identified support factors had varying degrees of statistical significance as independent (predictor) factors for teacher use of computers. The significant predictor factors for locating and gathering materials were philosophy and preparation (p=.02) and access and availability (p=.02). Leadership was the significant predictor factor of posting

information (p=.02). There were no significant predictor factors of teachers' using computers for writing and designing lesson plans or for communication. There was a significant difference between K-2 teachers' and 5-6 teachers' use of computers for writing and making lesson plans (p=.00). However, grade level had no significant relationship with the locating and gathering of materials, communication, or posting materials.

The six support factors discussed previously were also used to predict student use of computers. Philosophy and preparation was the significant predictor factor of student use of general software applications (p=.01). Access and availability was the significant predictor factor of students' use of computers for complex/multimedia and communication tasks (p=.00). Teacher philosophy and preparation was the second main predictor of student use for complex/multimedia and communication tasks. Finally, the external constraint factor was the main predictor of students' use of computers for drill/practice and simulation but not significant at the .05 level of confidence.

Furthermore, student grade level had a significant relationship with students' use of computers for general software applications (p=.00). However, there was no significant relationship between student grade level and the students' use of computers for complex/multimedia and communication tasks; nor was there a significant relationship between grade level and practice/simulations. However, students' frequency of computer use increased as grade levels increased.

The elementary teachers and students in this study used computers in significant ways. The factors that are typically barriers to computer use by many elementary teachers were not impediments to the elementary teachers in this study. In fact, although barriers

existed, these teachers seem to have been able to overcome perceived barriers. This was due, in large part, to the integration of technology into their methods courses not simply the skills-based course(s).

The first null hypotheses: "There will be no significant relationships between the computer use of graduates and the measures of support of leadership, time, and access and availability" is accepted.

The second null hypotheses: "There will be no significant relationships between the degree to which graduates indicated that they were prepared to teach with technology in their teacher preparation program and their current uses of computers" is rejected.

The results presented above indicate clearly that the elementary teachers in the study use computers in significant ways and that the factors that typically are impediments to computer use by many elementary teachers were not impediments or barriers to the elementary teachers in this study.

Discussion and Implications

It is difficult to be certain about graduates' use of computers for teaching and all of the factors that influence their computer use based on this one study. However, as noted previously, the teachers in this study indicated high levels of preparation and significant adherence to the constructivist pedagogy as it related to computer use in teaching.

A primary reason for conducting this study was to begin to understand how the elementary teacher preparation received by these classroom teachers influenced their teaching with technology. Their responses to queries about their preparation and

philosophies of computer use were surprisingly powerful. Over three-fourths of the teachers indicated that computers "have considerable potential for allowing students to discover or construct ideas for themselves." Becker (2000a) indicated that the most computer-engaged teachers are those who lean towards constructivist pedagogy. The teachers in this study frequently assigned their students complex/multimedia tasks and webquests; activities that are aligned with constructivist pedagogies. However, based on this study alone, it is not clear how this belief influenced their classroom practice or to what extent.

Michael (2001) found that although teachers indicated student-centered technology integration to be vital, in practice their technology use was teacher-centered. Their vision for technology use did not correlate with their actual use of technology and their lack of knowledge about how to teach with technology was a limiting factor in their technology use. On the other hand, the graduates were quite well prepared to teach with technology and had their students use technology in significant ways. These elementary teachers had a vision, an ideal, of how to integrate technology and curriculum but indicated that they were not able to achieve this vision due to the three major variables in the external constraint factor. Further research is needed to understand the visions of the graduates, the depth of their philosophies about technology and the relationship between their beliefs and practice.

Several of the respondents indicated that they are technology leaders at their school sites. Whether this speaks to their preparation, the lack of preparation of their colleagues, or a combination of both is unknown. However, since a high percentage of the graduates indicated they felt quite prepared to teach with technology, it is likely that

their technology leadership is a result of their preparation and their willingness to accept leadership roles.

The teachers in this study indicated that the greatest extent of their preparation to teach with technology occurred at the School of Education as compared to preparation from other sources. Although to what extent their educational technology coursework prepared them is unknown, the degrees of technology integration throughout their methods courses varied. However, the connection between the teachers' indications that they were well prepared to teach with technology and the fact that they indicated that they are using computers informs us that preparation is a key factor to use of computers for instruction.

The ineffectiveness of teacher education programs is a theme that has surfaced repeatedly in the literature (Feiman-Nemser & Buchmann, 1985; Zeichner, 1981-1982) and in current policy issues. What preservice teachers are taught in teacher preparation programs does not seem to transfer to their classrooms. Often, classroom teachers indicate that what they learned in their teacher preparation program has no application in their classroom settings (Feiman-Nemser, 1983). The typical lack of applicability and lack of worthiness of teacher preparation does not seem to hold true for these 2000-2002 graduates concerning their preparation to teach with technology.

In the seminal work, *Schoolteacher*, Lortie (1975) referred to the apprenticeship of observation, indicating that being a student for sixteen or so years serves as apprenticeship for teaching and that this apprenticeship influences the future teacher's receptivity to instruction in pedagogy. This does not seem to be a determinant for the use of computers by the teachers in this study. A study of the Introduction to Educational

Technology (EDLF 345) course taken by the graduates, found that the majority of elementary teacher preparation program students did not use computers in their K-12 schooling nor did their teachers teach with technology (Franklin, 2002). Although much more research is needed, it is reasonable to assume that their teacher preparation program, as it related to technology integration, was a significant factor in overriding their apprenticeship of observation.

Again, these elementary teachers used computers in a variety of ways and seemed able to overcome their perceived barriers. Their teacher preparation and their philosophies of using computers for instruction influenced their computer use.

One of the most surprising findings was the high use of the World Wide Web by students of all grade levels. Nearly all of the students in grades 3-6 used the web to some extent: 91% of 3-4 students and 94% of 5-6 students used the web to some extent, and over 30% of 3-4 students and 50% of 5-6 students used the web to a large extent. Although a little less than one-third of the K-2 students did not use the web at all and, in some instances, it was not available; 61% of K-2 students used the web to some extent. As grade level increased, so did students' use of the web. According to the NCES (2000) report, 44% of upper elementary students used computers for Internet research. No data was provided for K-3 students. Interestingly, about 12% of the responses to the open-ended question asking teachers to share their greatest success of using computers with students had to do with webquests and web inquiry and 27 % of the responses referred to Internet research. Although 39% does not seem all that significant, using the web was the most frequently mentioned great success. One can surmise that since much of their teacher preparation program included significant uses of the web, and since the

availability of websites and web-based applications have dramatically increased, these teachers are taking advantage of the tools available to them.

It appears that the teacher preparation received by the teachers in this study influenced the ways in which they use computers for instructional purposes. Although barriers existed for them, their uses of computers and their students' uses were more frequent and more diverse than the uses reported in the literature

Based upon the findings in this study, teacher preparation and teachers' philosophies of computer use in the elementary classroom influence teacher and student use of computers. The teachers in this study experienced significant preparation to teach with technology in their elementary teacher preparation program. To what extent their teacher preparation influenced their pedagogical beliefs is unclear, but based upon the findings there is a correlation. Therefore, as teacher educators continue to seek to prepare teachers' to teach with technology, the integration of technology into all facets of a teacher preparation program is important.

The findings indicated that curriculum integration of technology into methods courses influences curriculum integration into the elementary classroom. Likewise, simply knowing how to use technology is not the same as having *electronic pedagogical content knowledge and skill*. As Mitchell (2000) indicated, pedagogical use of computers is different from other uses of computers. Future teachers must learn to develop and implement curriculum plans that include methods and strategies for integrating technology in various subject matter areas to maximize student learning. The elementary school curriculum content influences what and how technology is used. For example, using an on-line digital history site such as the Virginia Center for Digital History

(www.vcdh.virginia.edu) could help students understand the distances that civil war soldiers walked and the changes that the war had on average citizens. However, a unit on geometry would demand a different type of technology use. Students might still use the Internet, but they might go to a website that allowed them to manipulate geometric shapes or these students might use software that provided the same conceptual development.

The NETS*T (International Society for Technology in Education, 2002) stated that classroom teachers should not only understand the nature and operation of technology systems, demonstrate proficient use of technology, use content-specific tools, but also design "developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners" (p.12). Learning how to design, implement, and assess a learner-centered lesson is no small task. However, learning to integrate technology into curriculum should be an integral part of learning how to teach.

Dawson (1998) and Becker (2000a) indicated that teacher efficacy is essential to the integration of technology, and teacher efficacy is linked to electronic pedagogical content knowledge and skill. Clearly, knowing how to use computers for one's personal use is a necessary foundation to the development of electronic pedagogical content knowledge and skill. On the other hand, simply knowing how to use computers for one's personal use is not synonymous with knowing how to teach with technology. Assuming that electronic pedagogical content knowledge and skill will automatically transfer from knowledge of how to use a computer is the same as assuming that because someone knows geography, he knows how to teach geography. The existence of methods courses

in teacher preparation programs indicate that knowing content is not the same as knowing how to teach content; a parallel exists with technology.

The focus of teacher preparation programs must include the development of electronic pedagogical content knowledge and skill. Preparing future teachers to connect curriculum and technology necessitates the integration of technology into teacher preparation. For example, just as we prepare future teachers to teach social studies in a social studies methods course, we must now prepare future teachers to teach social studies using technology in a social studies methods course.

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Appendix

General Information:

1) Including this year, how many years have you been employed as a classroom teacher? _____years
   (Include years spent teaching both full and part time and in public and private schools)

2) What year did you graduate from the University of Virginia? 2000 2001 2002

3) What grade(s) do your currently teach at this school? (Circle all that apply)

   K 1 2 3 4 5 6 other not currently teaching

Please continue ONLY if you are currently a classroom teacher. (If you are not currently a classroom teacher, please return this survey with questions 1-3 answered only. Thanks for your help)

4) Which of the following best describes your philosophy of using computers in classroom instruction/teaching?
   (Circle the letter that corresponds to the statement)

   a. Using computers for instruction doesn't really fit with my teaching style.

   b. Computers have only limited use in an elementary classroom.

   c. Computers are best used for drill and reinforcement of skills taught in class.

   d. Computers have considerable potential for allowing students to discover or construct ideas for themselves.

Computer Information:

5) How many working computers are located in your classroom? _____ How many are Macs? ___ How many are PCs? _____

6) How many of the computers located in your classroom currently have access to the Internet? _____

7) How many of these are used by students? _____

8) Does your school have a computer lab? _____

9) Do your use computers for teaching during class time? Yes….. No…….

10) Do you assign projects that require your students to use a computer:

   A. Inside the classroom? Yes…..1 No…….2

   B. Outside the classroom? Yes…..1 No…….2

11) On average, how frequently do students in your class use each of the following during class time?

	Not at all	Rarely	Sometimes	Often
Computers in the classroom……..	1	2	3	4
Computers in a computer lab or media center…	1	2	3	4
Internet from the classroom…….	1	2	3	4
Internet from a computer lab or media center ….	1	2	3	4

12) To what extent do you assign students in your class work that involves using computers in the following ways? *(If your school does not have these capabilities, please circle 5)*

	Not at all	Small extent	Moderate extent	Large extent	NA
a. Practice drills…….	1	2	3	4	5
b. Games for practicing skills…….	1	2	3	4	5
c. Analyze data …….	1	2	3	4	5
d. Word processing …….	1	2	3	4	5
e. Spreadsheets …….	1	2	3	4	5
f. Graphics oriented printing (e.g. Print Shop)…….	1	2	3	4	5
g. Simulations or exploratory environments ……	1	2	3	4	5
h. Software for making presentations (e.g. PowerPoint)…….	1	2	3	4	5
i. Research using CD-ROM…….	1	2	3	4	5
j. World Wide Web browser …….	1	2	3	4	5
k. Use email …….	1	2	3	4	5
l. HyperStudio or other multimedia authoring environment…….	1	2	3	4	5

13) To what extent, in each of the following subjects, do your students use computers?

	Not at all	Small extent	Moderate extent	Large extent	NA
a. Mathematics…….	1	2	3	4	5
b. Language Arts …….	1	2	3	4	5

c. Science ……	1	2	3	4	5
d. Social Studies ……	1	2	3	4	5
e. Other (please specify)	1	2	3	4	5

14) In the space below, please share your greatest success in using computers with students:

Questions 15-16 refer to the ways in which <u>you</u> use computers and the Internet.

15) Are the following available to you, and if yes, to what extent do you use them?

		If available, extent of use			
	Not available	Not at all	Small extent	Moderate extent	Large Extent
a. Computers in your classroom ……...	N/A	1	2	3	4
b. Computers somewhere else in the school ……..	N/A	1	2	3	4
c. Computer at home ……	N/A	1	2	3	4
d. Internet in your classroom……	N/A	1	2	3	4
e. Internet at home…….	N/A	1	2	3	4
f. Email at school ……	N/A	1	2	3	4
g. Email at home……...	N/A	1	2	3	4

16) For each objective listed below, please indicate how much you use computers to accomplish this objective.

	Not at all	A little	A lot
a. Create instructional materials (handouts, tests, etc.).....	1	2	3
b. Gather information for planning lessons …….	1	2	3
c. Access model lesson plans …….	1	2	3
d. Access research and best practices for teaching ……	1	2	3

e. Prepare multimedia presentations for the classroom…….	1	2	3
f. Administrative record keeping (grades, attendance, etc.) …	1	2	3
g. Communicate with colleagues or other professionals…….	1	2	3
h. Communicate with students' parents …….	1	2	3
i. Post homework or other class requirements …….	1	2	3
j. Get information or pictures from the Internet for use in lessons…….	1	2	3
k. Use camcorders, digital cameras, or scanners to prepare for class…….	1	2	3
l. Post student work, suggestions for resources, or ideas and opinions on the World Wide Web…….	1	2	3
m. Exchange computer files with other teachers…….	1	2	3
n. Other (*please specify*) _____	1	2	3

Factors:

17) Which of the following types of incentives are available to you for participation in training to use computers?

	Yes	No	Don't know
a. School provides release time from classes or other responsibilities	1	2	3
b. Expenses are paid……...	1	2	3
c. Stipends are provided …….	1	2	3
d. Course credit towards re-certification is offered …….	1	2	3
e. Connection to the Internet from home through your school's network	1	2	3
f. Additional resources for you or your classroom (i.e. hardware, software)…….	1	2	3

18) Please indicate who at your school provides computer related assistance to you for each of the following:
(Check all that apply)

	Use of computers	Use of the Internet	Technical support	Integrating technology	Locating software
a. Technology coordinator……	_____	_____	_____	_____	_____
b. Library/media specialist ……	_____	_____	_____	_____	_____
c. Classroom teacher(s) …….	_____	_____	_____	_____	_____
d. No assistance provided ……	_____	_____	_____	_____	_____
e. Other *(please specify)*_____	_____	_____	_____	_____	_____

19) Does your district or school provide you the opportunity to observe colleagues teaching lessons that integrate technology in curriculum?

Yes No Don't Know

20) Please indicate to what extent, if any, the following are barriers to your use of school computers for instruction.

	Not a barrier	Small barrier	Moderate barrier	Great barrier
a. Not enough computers ……..	1	2	3	4
b. Outdated, incompatible, or unreliable computers...	1	2	3	4
c. Internet access is not easily accessible ……..	1	2	3	4
d. Lack of good instructional software ……..	1	2	3	4
e. Inadequate training opportunities ……	1	2	3	4
f. Lack of release time for teachers to learn/ practice/plan ways to use computers or the Internet	1	2	3	4
g. Lack of administrative support ……..	1	2	3	4
h. Lack of support regarding ways to integrate technology into the curriculum ……	1	2	3	4
i. Lack of technical support or advice ……..	1	2	3	4
j. Lack of time in schedule for students to use computers in class……	1	2	3	4
k. Concern about student access to inappropriate material ……	1	2	3	4
l. Lack of funding ……	1	2	3	4
m. Too much curriculum to cover ……	1	2	3	4
n. High stakes testing ……	1	2	3	4

o. Other (please specify)_____ 1 2 3 4

Preparation:

21) In your opinion, how well prepared are you to use computers for classroom instruction?

Not at all prepared……1 Somewhat prepared…..2 Well prepared…..3
Very well prepared…..4

22) To what extent has each of the following prepared you to use computers for teaching?

	Not at all	Small extent	Moderate Extent	Large Extent
a. UVA College of Arts and Sciences …….	1	2	3	4
b. School of Education …….	1	2	3	4
c. Professional development activities …….	1	2	3	4
d. Colleagues …….....	1	2	3	4
e. Your students …….....	1	2	3	4
f. Independent learning…….....	1	2	3	4

23) To what extent do you think your teacher preparation program at the School of Education prepared you to integrate technology into curriculum in the following content areas?

	Not at all	Small extent	Moderate Extent	Large Extent
a. Mathematics …….	1	2	3	4
b. Science …….	1	2	3	4
c. Language Arts…….	1	2	3	4
d. Social Sciences……..	1	2	3	4

24) As a classroom teacher, have you integrated technology into your lessons that were the same as or similar to integrated lessons that you developed while at the School of Ed.? Yes No

If so, how many? _____

25) As a classroom teacher, what suggestions do you have for the Curry teacher preparation program concerning teaching with technology?

Thank you for completing the survey. Please return it in the self-addressed, stamped envelope.