

Digital Divide Created by Technology Access and Integration in Classrooms in Predominately Low Socioeconomic Environments

Nancy Pliska Robinson, Ph.D.

Abstract

This paper proposes a methodology to discover the barriers that influence teachers use of technology and its sufficient integration in the classroom. The participants in this study were 31 teachers from classrooms and schools located in a large metropolitan school district in the southeast. The schools were selected based on demographics and the number of students enrolled in a free/reduced lunch program. The survey study included participant's grade level and subject taught along with twenty-three variables influencing the integration and access of technology in the classroom with one open-ended question. The researcher defined and confirmed the reliability and validity of the questionnaire. Factor analysis was selected to determine the major factors influencing the outcome of the research. Frequency distributions were used to facilitate understanding of the extent of technology integration in the classroom and the barriers that teachers encounter in supplementing instruction with technology. The findings indicate that there are significant issues that affect low socioeconomic students who do not have access to computer resources at home to complete homework assignments.

Introduction

The way students use the Internet for school and how schools have them use the Internet links to teachers' attitudes toward its use, their inability or reluctance to integrate online tools into their classes, and the real and perceived barriers students face when they seek Internet access. Furthermore, in cases where some students might not have Internet access at home or after school, teachers may not encourage its use in supplementing assignments (Levin & Arafeh, 2002). Such impediments will cause students to spend less time using computers. As a result, with a low computer use rate, students will fall behind their counterparts in acquiring necessary computer literacy skills. Under these circumstances, students will not develop essential technical skills crucial for obtaining successful career positions in the current workforce (DeBell & Chapman, 2006).

A digital divide still exists in classroom access to the Internet, with high-poverty schools having a smaller percentage of instructional rooms connected to the Internet than more affluent ones (Easton & LaRose, 2000; Levin & Arafeh, 2002). Since research suggests that computer use can potentially improve students' academic performance, particularly for elementary and secondary grades, students without adequate labs will experience lower levels of educational success (DeBell & Chapman). Therefore, for students without the financial means to connect digitally outside school, not only are grades impacted but overall educational readiness is also affected. PEW/Internet (2005) concluded: "Internet-savvy students are remarkably different from their non-wired peers when it comes to tackling homework, communicating with their classmates and teachers, and engaging with the outside world" (p. 24).

In order to address the widening gap in technology resources between students in high-poverty areas and their more affluent counterparts, it is important to identify the major barriers inhibiting the use of technology in the classroom. Therefore, a questionnaire was developed, *Technology Access & Integration Survey*, to determine the following:

1. Accessibility, quality, and number of instructional computers with Internet access per student.
2. Restrictions to Internet use with filtering software.
3. Student and teacher e-mail use.
4. Laptop computer access.
5. Teacher's perception of the importance of Internet and computer use in classroom instruction.
6. Frequency and type of instructional technology integration in the classroom.
7. Frequency and type of instructional software used in classroom instruction.

Research Questions

The following research questions were addressed in this project:

1. What are the frequencies associated with access to instructional computers, Internet access, availability of computers and laptops after school, filtering software, and e-mail accounts?
2. How many participants issue assignments that require the use of the Internet and whether they thought it was important for students to have access to the Internet?
3. What are the frequencies associated with using computers and different types of software for various instructional activities?
4. How strongly do teachers feel regarding the use of technology in the classroom and how important is the use of computers in education?

In developing the *Technology Access & Integration Survey*, 23 measurable variables were identified in relation to teachers' integration of computers in the classroom and the importance of its use (11 items), the frequency of different types of instructional software used in instruction (12 items), and teachers' perceptions of the importance of Internet and computer use in the classroom (10 items). One of the objectives of this study was to extract the key factors from a set of measurable variables in the questionnaire.

Several measures were used to ensure the validity and reliability of the research instrument. The validity of the instrument was examined by a panel of experts ($N = 10$). The revised instrument was administered to teachers in grades 5 – 12. In order to ensure the reliability of the instrument, the Cronbach Alpha correlation statistical procedure was applied to test for internal consistency.

Participants

In this study, the researcher used the following sample as the source of participants. The target populations were from elementary schools, middle schools, and high schools in a large school district in the metro area of a major southeastern city. The populations targeted for this survey were characterized by the following risk factors: (a) 60 to 90% of students were eligible for reduced-price or free lunch program, and (b) 90 to 98% of the student population was African American with the highest rate of poverty – 38% of the 2000 population. Initially, teachers in 27 schools exhibiting these risk factors were selected to be surveyed. From the period January through March 2007, 13 schools consented to participate in the survey. Thirty-one ($N = 31$) teachers in schools from the targeted area completed the survey: (a) nineteen 5th grade teachers were from seven different elementary schools, (b) six teachers were from one middle school, and (c) six teachers from two high schools. In total, 449 surveys were hand delivered to teachers in 13 different schools. The survey period extended from March 15 to April 12, 2007. Reminder cards were delivered to each school March 22 through 24. The return rate on this survey was 7%. Potential respondents were required to volunteer; therefore, teachers could decline to take part. Thus, the sample for this study was a sample of convenience. The researcher did not know who did or did not decide to take part in this study.

Instrument

This survey for this study was formulated after reviewing the literature to identify barriers to Internet access and computer use in the classroom. Fifty-two questions divided into nine sections were developed with one open-ended question for written comments. Section one of the survey addressed the demographics of the classroom. Each respondent was asked to provide their class size, grade level, and subject taught. Section 2, computer access, asked the respondents about computer access and the number of computers used for instructional purposes as opposed to administrative purposes. This section also addressed filtering software used and requested teachers' opinion (on a six-point scale) of the condition of instructional computers located in labs or in their classroom. The third and fourth section dealt with email and laptop access. The fifth section, Internet activity, related to the use of assignments requiring Internet access and its importance to teachers. Answer choices were dichotomous, yes or no. The sixth section, integration of computers, addressed the frequency of computers for classroom instruction, e.g., as a problem-solving tool or research tool for students. Teachers were asked to indicate the frequency of use from 1 (*not at all*) to 5 (*2 or more times per week*) with an additional category of 6 (*does not apply*). Similarly, the next section, instructional software use, addressed how frequently different software was used to complete school-related activities, e.g., desktop publishing programs, games, or simulations. The subsequent section, attitude toward computer use, asked teachers on a scale of one to six to indicate their attitude toward the use of computers in the classroom from 1 (*strongly disagree*), 2 (*disagree*), 3 (*neither agree or disagree*), 4 (*agree*), 5 (*strongly agree*), and 6 (*don't know*). In the final section, overall opinion, teachers were asked to rate on a similar scale of one to six, how important they considered the use of computers in education. The last question was an open-ended question asking for additional comments on the use of computers.

Kaiser-Meyer-Olkin (KMO) measured sampling adequacy. For a satisfactory factor analysis to proceed, KMO should be greater than 0.5 (de Vaus, 2002). For this study, KMO measured 0.7 for the items measuring integration of computers (10 items), instructional software use (12 items), and attitudes toward computer use in the classroom (11 items). Exploratory factor analysis was conducted to identify the commonality of underlying factors influencing the outcome of response variables on the survey. Factor analysis will help determine if a smaller number of factors can summarize the information in the survey data. Based on the factor extraction data, eigenvalues, scree plot, and variance, three factors were rotated using a Varimax rotation procedure accounting for 67% of the shared variance for the 11 items related to integration of computers. All items loaded heavily on the first factor except for the *other/does not apply* category and *use of computers for reward/fun entertainment activity*. The highest mean score was reported for the *other* category ($M=5.68$, $SD = 0.98$). *Other* was the prevailing answer for this item. None of the items loaded heavily on the third factor. Excluding the *other* category, the items related to integration of computers should realistically be interpreted as unidimensional. For the 12 items related to instructional software use, three factors accounted for 70% of the shared variance. All items loaded heavily on the first factor and the use of games loaded heavily on the second factor. The third factor accounted for only 11% of the shared variance. Two factors were extracted for attitude toward computer use accounting for 70% of the shared variance. All factors loaded heavily on the first factor except for the statement “Computers further the gap between students along socioeconomic lines,” which loaded heavily on the second factor and “Learning computers makes high demands on my professional time,” which loaded heavily on the third factor. Although factors were extracted for each component, overall the majority related to one significant factor with minimal exceptions where noted.

Item analyses were conducted on the 11 items hypothesized to assess integration of computers. All correlations were greater than .80. The six-point scale produced an alpha coefficient of .83. Item analyses of the 12 items measuring instructional software use produced correlations greater than .84 with a coefficient of .87. Three items were considered reverse-scale items in measuring attitude toward computer use. These items were: (a) “Computers further the gap between students along socioeconomic lines,” (b) “I avoid the computer whenever possible,” and (c) “Learning computers makes high demands on my professional time.” An item analysis produced correlations ranging from .63 to .81. The 10 items for this section produced an alpha of .70. If the item relating to the gap were deleted, the alpha would be .81.

Results

Frequency distributions were performed to determine the distribution of variables among the categories under investigation. Scores from integration of computers, instructional software use, and attitude toward computer use were calculated to describe participants' frequency of computer use and teachers' attitude regarding its integration into instructional activities. The following research questions were addressed:

What are the frequencies associated with access to instructional computers, Internet access, availability of computers and laptops after school, filtering software, and e-mail accounts?

The sample consisted of 31 fifth grade teachers from seven elementary schools ($n = 19$), 6-8 grades ($n = 5$) from one middle school, and 9-12 grades ($n = 7$) from two high schools. Instructional computers were defined as computers that were used for instructional purposes, not for administrative purposes. There was an average of 36 instructional computers per the seven elementary schools participating in the survey. The middle school had 28 instructional computers and the two high schools had an average of 98. The teachers taught subjects ranging from social studies to math. All participants had access to instructional computers in a lab, library, or media. In addition, 100% of the instructional computers had access to the Internet. Out of the seven elementary schools, three provided access to instructional computers with Internet access at times other than regular school hours. Three of the teachers surveyed from the one middle school indicated that instructional computers were not available after school hours; however, four teachers indicated they did not know. For one high school, instructional computers were available after school. For the other, answers were split as to whether access was provided or not. As to how often students had access to instructional computers, 16 of the teachers stated daily availability, 11 teachers indicated availability once per month, 3 stated never available, and 1 stated availability once per semester. On a scale of 1 to 6 with high scores indicating that instructional computers were in excellent condition, 58% of the teachers ($n = 18$) rated the quality of equipment as poor or fair; 32% ($n = 10$) ranked them as good to very good ($M = 2.6$, $SD = 0.24$), whereas only two indicated the equipment was in excellent condition. One indicated he/she did not know. The two high schools provided laptop computers to students and were available on loan for one week or less. The elementary and middle school did not have a laptop program. Teachers' overall opinion on the use of computers in education was that it was very important in education ($M = 4.58$, $SD = 0.12$). With the exception of one teacher, 65% considered computers extremely important and 43% indicated very important.

Although all of the schools in this district had filtering software, when asked if this was used by their school, 24 (77%) participants answered yes and 7 (23%) indicated no. Furthermore, from correspondence with the district's school board, all students had access to a school-sponsored e-mail address. However, 16 of the teachers said students had e-mail accounts and 15 indicated students did not. Except for one, 30 teachers indicated they had a school-sponsored e-mail address.

How many participants issue assignments that require the use of the Internet and whether they thought it was important for students to have access to the Internet?

In examining Internet activity and how often teachers issue assignments that require its use, 22 (71%) teachers indicated yes and 9 (29%) indicated no. Of the nine teachers that did not issue assignments requiring the Internet, they indicated it was important, from a choice of yes or no, that students have Internet access.

What were the frequencies associated with using computers and different types of software for various instructional activities?

In determining the extent of integration of computers in classroom instruction, 11 methods of instruction were provided. One of the methods was categorized as *does not apply*. The most frequent use of computers was for research. Computers were used least frequently as a problem-solving tool and as entertainment. Table 1 reports the frequencies and significant percentages associated with the instructional categories.

Table 1.

Frequencies and Percentages of Integration of Computers in Classroom Instruction

Instructional Category	Not at all	Once per semester	Once per month	Once per week	2 or more times per week	Does not apply
Classroom instruction	3	4	3	6	14 (45%)	1
Completing assignments given to my students	4	8	5	5	8 (26%)	1
Promoting student-centered learning	3	3	4	6	14 (45%)	1
Promote independent learning	0	4	4	9	12 (39%)	2
Promote small group interaction	4	4	6	7	10 (32%)	0
Problem-solving tool	6	2	7	4	9 (29%)	3
Research tool for students	1	7	7	6	10 (32%)	0
Classroom presentation tool	7	6	8 (26%)	2	7	1
Reward/fun entertainment activity	7	3	4	11 (36%)	4	2
Tutoring	3	2	3	8	13 (42%)	2

$N=31$

With respect to the frequency of instructional software used to complete school-related activities, 12 categories including *other* were provided. A majority of the teachers did not use any instructional software to complete activities. Web browsers were the type of software used most frequently. In the *other* category, only two teachers reported using software that was not listed. Table 2 reports the frequencies and significant percentages associated with the type of software used.

Table 2.
Frequencies and Percentages of Instructional Software Use to Complete School-Related Activities

Instructional Software	Not at all	Once per semester	Once per month	Once per week	2 or more times per week	Does not apply
Spreadsheet	22 (71%)	2	3	0	1	3
Web publishing programs	19 (61%)	4	3	1	2	2
Programming tools	19 (61%)	2	3	3	1	3
Presentation software	19 (61%)	2	5	2	2	1
Web browsers (e.g., Netscape or Internet Explorer)	4	4	3	7	12 (39%)	1
Word processor programs	2	8 (26%)	7	6	8	0
Desktop publishing programs	16 (52%)	0	5	5	3	2
Drill & practice software (e.g., keyboarding)	11 (36%)	3	2	7	7	1
Games	7	2	7	6	8 (26%)	1
Simulations	17 (55%)	2	4	2	5	1
Graphic programs	17 (55%)	7	1	2	3	1

N=31

How strongly did teachers feel regarding the use of technology in the classroom and how important was the use of computers in education?

In examining teachers' attitudes toward computer use, 10 items were provided. A majority of the teachers strongly agreed with statements emphasizing computer use in the classroom. The exceptions were the statements that negatively influenced teachers' time and resistance to using computers. Over half (55%) of the teachers agreed/strongly agreed that computers further the gap between students along socioeconomic lines. Table 3 reports the frequencies and percentages in relation to teachers' attitudes regarding the use of technology in the classroom.

Table 3.

Frequencies and Distributions of Attitude Toward Computer Use in the Classroom

Technology Use	1 Strongly disagree	2 Disagree	3 Neither agree or disagree	4 Agree	5 Strongly agree	6 Don't know
Computers further the gap between students along socioeconomic lines	4 (13%)	6 (19%)	3	10 (32%)	7 (23%)	1
Computer skills are essential to my students	0	1	0	10	20 (65%)	0
Access to technology improves student performance	0	0	3	8	20 (65%)	0
It is important that every student in my classes have access to a computer at home	0	3	2	7	19 (61%)	0
Computers should be incorporated into classroom curriculum	0	2	0	8	21 (68%)	0
I would like for my students to be able to use the computer more	0	0	1	9	21 (68%)	0
Computers enhance classroom instruction	0	0	0	10	21 (68%)	0
I avoid the computer whenever possible	22 (71%)	6	1	2	0	0
Learning computers makes high demands on my professional time	10 (32%)	6	6	5	4	0
I want more technology	0	1	2	6	22 (71%)	0

N=31

Discussion

This study focused on the development of an instrument that accurately reflects teachers' use of technology in the classroom and how well it is integrated into instruction. The components identified as integral to the design of a program that properly utilizes technologies and has the potential for encouraging critical thinking and creativity were included in the *Technology Access and Integration Survey* that I developed. I also felt it was important to consider teachers' attitudes regarding the use of computers and its use to the success of their students. In order for schools and administrators to develop properly comprehensive technology programs, it is essential to obtain a complete picture of the

actual methods that are used in instructional technology and the barriers that exist that could prevent the maximization of effort in increasing students' technical skills.

The main results to emerge from this study are the perceptions that teachers have regarding the integration of computers in classroom instruction and the actual software they use to complete assignments. By that I mean that over half of the teachers felt they used technology to promote higher-order and critical thinking skills, however when asked the type of software used to attain these skills over 60% of the teachers did not use any instructional software other than web browsers and games, and only then to a limited extent. Clearly, there is a gap in perception as to the type of instruction being delivered versus what constitutes problem-solving and higher-order thinking activities. This speaks directly to the issue that teachers lack the skills and training to utilize adequately technology in the classroom. In fact, Neumann and Kyriakakis (2002) belabored this point:

The majority of efforts involving technology in education have focused on CD-ROMs or web sites containing little more than digitized versions of textbooks, or broadcast lectures with poor quality audio and video. Little has been done to design the content to take advantage of the potential of new delivery mechanisms. (p. 2)

However, what cannot be ascertained is whether the software tools that could promote critical thinking were available to all teachers. Again, the schools targeted for this study had a very high minority population and high concentration of poverty. In addition, the number of instructional computers available to students was extremely small. The frequent use of web browser software for supplementing instruction may be due to its cost effectiveness. Furthermore, the type of equipment, the equipment's age, the operating systems, and other technical features could present barriers to implementing more comprehensive technology integrated activities. This study did not try to determine the equipment issues other than requesting teachers to rank the quality of instructional computers. It should be noted that for the most part, teachers felt their computers were in poor or fair condition (58%).

According to the comments some of the teachers supplied, teachers' reluctance to issue homework assignments to students without Internet access at home and the quality of computers were integral to this study and raise some questions that require further investigation. Teachers' comments are recapped in Table 4.

Table 4.
Summary of Teachers' Responses to Open-Ended Question

Teachers' Comments

"I don't require students to use computers for homework projects because I don't feel it would be fair for students who don't have access to a computer at home. However, when projects are assigned, use of a computer is encouraged and acceptable."

"I don't think students should be required to do homework that includes the computer unless one is provided for the students who do not have one at home."

"Unfortunately there is not enough funding for every classroom to have the number of computers they need."

"With a high demand on time on task, not enough student computers, and not enough planning time, I find it very challenging to implement technology in my daily classroom instruction. I felt in order to include technology in our daily instruction, we may want to consider including it's a part of our instructional day like math and reading."

"Would like to have new updated computers that worked!"

"I would use the computers more often if the computers were updated. We currently are using a Windows 98 operating system."

Conclusion

The limitations posed for this study are its small sample size ($N=31$). As a result, it is extremely difficult and not prudent to generalize responses to a larger population. Furthermore, any more sophisticated statistical procedures would not have produced enough power to justify results. However, there were sufficient issues raised to warrant additional research in this area. Clearly, there is a need to provide Internet access to students who do not have online capabilities at home or after school. According to the Pew/Internet (2005) report, "They [experts] are unhappy that gaps exist in internet access for many groups – those with low income, those with lower levels of educational attainment, and those in rural areas" (p. iii). As such, it is essential that educational oversight institutions address the digital divide that is marginalizing our impoverished youth and prevents their academic success in a society that is increasingly becoming interdependent on technology.

References

- de Vaus, D. (2002). *Surveys in social research* (5th ed.). London: Routledge.
- DeBell, M., & Chapman, C. (2006). *Computer and Internet use by students in 2003* (No. NCES 2006-065). Washington, DC: National Center for Education Statistics.
- Easton, M., & LaRose, R. (2000). Internet self-efficacy and the psychology of the digital divide [Electronic version]. *Journal of Computer-Mediated Communication*, 6(1), 20.
- Levin, D., & Arafah, S. (2002). *The digital disconnect: The widening gap between Internet-savvy students and their schools*: Pew Internet & American Life Project.
- Neumann, U., & Kyriakakis, C. (2002). 2020 Classroom. In *Visions 2020: Transforming Education and Training Through Advanced Technologies* (pp. 52-56). Washington, D. C.: U. S. Chamber of Commerce.
- PEW/INTERNET. (2005). *The future of the Internet*. Washington, D.C.: PEW Internet & American Life Project.