Trends in Accessibility and Use of Technology in Florida's Schools

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Trends in Accessibility and Use of Technology in Florida's Schools Abstract

While access to computers in schools has increased, there remain questions about whether Low socio-economic status (SES) schools have equitable access to relevant software or equitable integration of the technology in the curriculum. This research uses statewide data from three school years to investigate significant trends in access to technology and how technology is being integrated into the curriculum by school level and SES. Results show that access to software is equitable in high and middle schools, but not elementary schools. By 2005-06, there were no differences in the use of software by High and Low SES students at each school level.

Trends in Accessibility and Use of Technology in Florida's Schools

Perspective

The term *digital divide*, which addresses the disparity between individuals who have and do not have access to information and communication technology, became part of educators' vocabulary in the mid-1990s (Wilhelm, Carmen, & Reynolds, 2002). Since then, many efforts have been put forth to equip K-12 schools with the resources and technology necessary for student success in the information age. The *Internet Access in U. S. Public schools and Classrooms: 1994-2003* reported that the student to instructional computer ratio decreased from 12:1 in 1999 to 4.4:1 in 2003 (Parsad & Jones, 2005). In addition, DeBell and Chapman (2006) reported that 80% of students from families with incomes less than $20,000 used computers at schools serving Nursery to 12th grade, while 86% of students from families with incomes more than $75,000 used computers at these schools.

Hawkins and Oblinger (2006) recommended looking at the "'second level digital divide,' which can be caused by several factors: machine vintage; connectivity; online skills; autonomy and freedom of access; and computer-use support." (p. 12). Eamon (2004) found that High SES children were 2.78 times as likely to have a computer at home than their Low SES counterparts. In 2003, 37% of families with less than $20,000 income, while 88% families with more than $75,000 income had computers at home (DeBell & Chapman, 2006). Differences also exist by SES in where students access the Internet -- home - High SES (66%) vs. Low SES (19%) or school - High SES (52%) vs. Low SES (32%). These differences demonstrate that the digital divide continues to be a relevant issue (DeBell & Chapman, 2006).

In addition, studies have found that all students do not use computers in the same way at school. When contrasting types of uses, Wayne, Zucker and Powell (2002) found that students in

Low SES schools used computers significantly more often for drill and practice and for free time, corroborating Wenglinsky's (1998) results that the students in Low SES schools spend more time using computers for practice and drill than High SES schools. SES was also related to how teachers used computers professionally. While research has shown that access to computers in schools has increased, there remain questions about whether Low SES schools have equitable access to relevant software or equitable integration of the technology into instruction methods.

Research investigating the relationship between SES, technology access and integration has produced mixed results. For example, Adelman, Donnelly, Dove, Tiffany-Morales, Wayne, and Zucker (2002) found that students in Low SES schools had less access to modern computers in school, less Internet access in school, and less access to computers at home. In contrast, as a result of federal funding programs, Anderson and Becker (2001) found little difference in the initial infrastructure of computer hardware and software between schools with high and low proportions of students eligible for Title 1 funding. Similar findings were noted by Benner, Shapley, Heikes, and Pieper (2002) in a large scale study about technology integration in Texas schools. Schools that served the most economically disadvantaged students, and consequently were recipients of Technology Literacy Challenge Funding, had the greatest number of classroom Internet connections. Indeed, over the past five years, Texas schools with the greatest number of students at poverty level made the most gains in technology resources. Wenglinsky (1998, 2005) also found that the gap between High and Low SES students for access and use of technology for math instruction had diminished at the debut of the study, which used secondary data collected by National Assessment of Educational Progress (NAEP) in mathematics.

However, when expenditures were examined after the initial investment for infrastructure, differences arose. At the school level, the SES of a school, as determined by the

community in which the school is located, was related to the amount the school spends on technology, especially for hardware and support. Schools in economically advantages areas spent 173% more in technology expenditures per student than low income area schools (Anderson & Becker, 2001). When separated by hardware, software and support, schools in high income areas spent 155%, 14%, and 413% more per student than low income areas, respectively (Anderson & Becker, 2001).

Purpose

Florida has experienced over 25% growth in public school population between the 1992-93 and 2001-02 school years (Florida Department of Education, 2005). In addition, the percent of Florida students eligible for free or reduced-price lunch has increased from 41.5% in 1993-94 to 45.4% in 2003-04 (Florida Department of Education, 2005). According to the *2006-07 Florida State Government Technology Investment Forecast*, more than 1.6 billion dollars will be spent on technology-related initiatives throughout Florida's government in fiscal year 2007 (Mathison, 2006). In addition to receiving state funding, Florida's K-12 schools obtain technology funds from federal sources. For example, the No Child Left Behind program allocated over 88 million to Florida's school districts through their NCLB Title II D grants in the past three years (State Educational Technology Directors Association, 2006). Based on the influx of funds for technology, the return on investment is an extremely important consideration for responsible decision-making. It is natural for legislators, administrators, parents, and teachers to ask the questions, "Given the level of technology funding, are we closing the Digital Divide? Are more economically disadvantaged students gaining access to the necessary tools for success? Are there differences in how students use technology based on the SES of the schools?"

While research has shown that access to computers in schools has increased at the national level, questions remain about whether Low SES schools have equitable access to relevant software or equitable integration of the technology into instructional methods. Accordingly, the purpose of this study is to examine the trends in availability and use of technology in Florida's public schools with a focus on examining relationships to SES. Specifically, this research uses statewide data to investigate significant trends in the access to technology and how technology is being integrated into the curriculum at each school level, as well as the differences between High and Low SES schools.

Method

Sample

This study spanned three school years, from 2003-04 to 2005-06. The sample included all public elementary, middle/ junior, and high schools (N= 2124) from Florida's 67 school districts that participated in the System for Technology Accountability and Rigor (STAR) survey for all three school years. The Florida Department of Education (FLDOE) asked principals and technology coordinators from every school in every district in the state to provide information about how technology is integrated within their schools via the online STAR survey (Florida Department of Education, 2006b). The response rate on the survey was very high – 97% in 2003-2004; 96% in 2004-2005; and 97% in 2005-2006.

Demographic Variables

Demographic data used in this study were obtained from the average yearly progress reports and the interactive online database maintained by the FLDOE (Florida Department of Education, 2006a). Since the focus of this study was to investigate the relationship of SES with technology integration, the proportion of economically disadvantaged students in each school

was selected to represent school-level SES. In order to compare the technology integration of schools with High SES and Low SES schools, the data were changed to a three level categorical variable by rank ordering all schools by their socio-economic status each year. Then, for each year, the top 30% of schools with the largest proportion of economically disadvantaged students were classified Low SES; the top 30% of schools with the smallest number of economically disadvantaged students were classified High SES; and the middle 40% were classified Middle SES. If no proportion of economically disadvantaged students was reported, then the mean of the other two years was used to impute the school-level SES. The data were matched by school identification number and merged with the multiple files obtained from the STAR survey (Florida Department of Education, 2006b).

Technology Variables

In order to address technology access and use in schools, composite variables were created. Multiple items from the survey were combined to represent underlying constructs. This approach provides more valid and reliable measures across schools over time than using items individually (Kiecolt & Nathan, 1985; McCall & Appelbaum, 1991).

Access to Student Software. To examine the trends in student access to tool-based and curriculum-based software, composite variables were created from the options to the item *What percentage of student computers at your school have the following software types available on them?* Responses to the following software were used to represent the proportion of students with access to tool-based software: Concept mapping; Graphics; Multimedia authoring; Presentation software; Spreadsheet; Video editing; Web authoring; Basic word processing; and Robust word processing. Curriculum-based software was represented by responses to the following software: FCAT (Florida Comprehensive Assessment Test) Explorer; Other test prep

tools; Integrated Learning Systems; Content-specific skills practice/tutorials; Content-specific simulation; Other content-specific resources; and General Reference tools.

The midpoint percentage of each option selected was used to create a continuous variable. The composite variable for each software type was created by finding the mean of all options selected. If no option was selected for a type of software, it was assumed that the school did not have any student computers with that software, and zero was used in the analysis. Cronbach's alpha for the group of survey items used to measure the composite variables for all software availability was .78 in 2003-04, 2004-05, and 2005-06.

How Often Students Use Curriculum-based and Tool-based Software. To examine the trends for how often students use software for delivery of the curriculum versus software that is used as a tool, a composite score was created from the options to the following item: *How often do students at your school use the following types of software?* Responses to the following software were used to represent software for delivery of curriculum: Drill and practice software; Integrated Learning Systems (ILS); and Simulation software. Responses to the following software were used to represent software that is used as a tool: Multimedia development (e.g., paint/draw, desktop video, sound-editing); and Tool-based software (e.g. graphic organizers, word processors, spreadsheets, databases). The mean of all the ranked response options selected for each type of software was used to represent the degree of student use. If no option was selected for an amount of time, it was assumed that the school did not have any students using that type of software, and zero was used in the analysis. Cronbach's alpha measure of the reliability of the scores on the group of survey items used to measure these student composite variables was .39 in 2003-04, .57 in 2004-05, and .63 in 2005-06.

Procedures

Multi-level modeling for repeated measures analysis using SAS 9.13 statistical software was used to compare models for predicting trends of technology integrators and SES. Multi-level modeling allows the relative impact of school demographic variables, such as SES and school levels (elementary, middle/ junior, and high school), on the trends of technology integrators within schools to be examined. Multi-level modeling was also chosen because it allows the analysis of nested data when there are missing data points, thus using more of the collected data in the data analysis. To determine if trends were significant, restricted maximum likelihood method was used with alpha set at .05 for all statistical tests to control the type I error rate. The ICC values ranged from 0 to .099, which confirms that there was some degree of nesting among the data and supports the choice of using multi-level modeling. Time was added to the model and centered on the 2003-04 school year. Since the focus of this study was on the differences in trends for the different levels of school and levels of SES, multi-level models with time as a categorical variable and with contrasts for each point in time, each school level, and each socio-economic level were run to determine if there were significant differences between each year (between 2003-04 and 2004-05, 2004-05 and 2005-06, and 2003-04 and 2005-06) for each school level (elementary, middle, and high) at High and Low SES levels.

Results

Interpretation of the results must be viewed within the limitations of this study. This study has been conducted using secondary data that were collected by the Florida Department of Education. The state of technology hardware has undergone rapid change over the last three years. As a result, the design of the STAR survey has also been revised to collect relevant information needed for decision-making by school districts. Requirements for who answers the

surveys as well as clarification and movement of the items within the survey may have impacted the responses. Thus, the constructs used in the analysis may have changed over time. In addition, combining responses from survey items to make composite variables may not adequately measure the constructs used in this analysis, and the internal consistency reliability for the measures of student use of software are less than acceptable (e.g., $\alpha < .70$). Finally, using the proportion of eligible students for free or reduced lunch status as the only proxy for SES may not accurately represent this population.

Access to Software

The successful integration of technology in schools is dependent upon student access to relevant software. Both tool-based software and curriculum-based software play important roles in the classroom and computer labs.

Tool-based Software. Figure 1 and Table 1 show student accessibility to tool-based software by SES and school level over time, as well as the contrasts between High SES and Low SES schools over time.

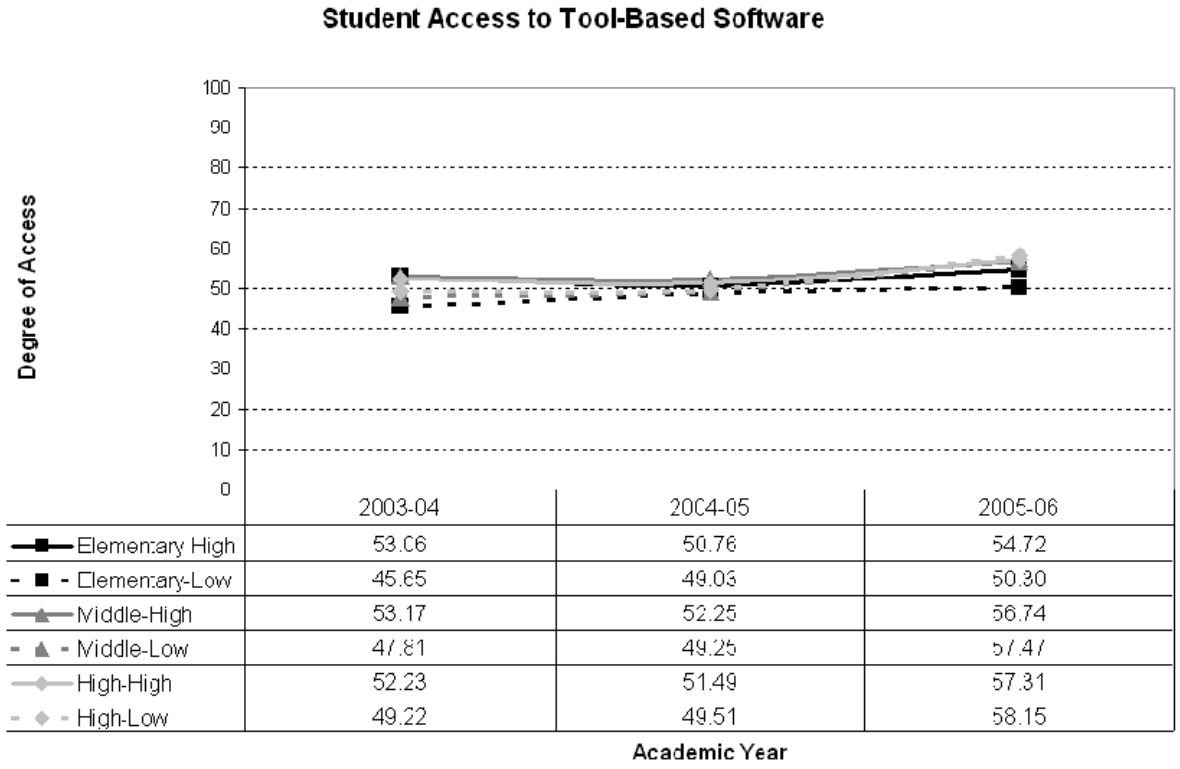


Figure 1. Student access to tool-based software.

In the 2003-04 school year, High SES middle and elementary schools had significantly more access to tool-based software than their Low SES counterparts. From the 2003-04 to the 2004-05 school years, High SES elementary schools had significantly less access, while Low SES had significantly more access. In middle schools between 2003-04 and 2004-05, the proportion of computers available with curriculum-based software followed a similar pattern, but the differences between years were not significant. Access to tool-based software stabilized in middle and elementary schools during the 2004-05 school year. In the 2005-06 school year, High SES elementary schools, again, had significantly more access to tool-based software as High SES elementary schools had significantly increased access from the 2004-05 school year, while Low SES school access remained relatively constant.

There were no significant relationships between SES and accessibility to tool-based software in high schools during any year under investigation. However, between the 2004-05 and 2005-06 school year, both High SES and Low SES high schools had significantly increased the proportion of computers available with tool-based software showing the greatest gain (more than 8%) in Low SES high schools. When examining the trends across years, it is evident that there has been a significant upward trend from the 2003-04 to 2005-06 school years for tool-based software on computers in Low SES schools (see Table 1). The pattern is similar for High SES high schools. Low SES schools made the greatest gains in the proportion of computers with tool-based software available. However, Low SES elementary schools still have significantly less access in the most recent school year (2005-06).

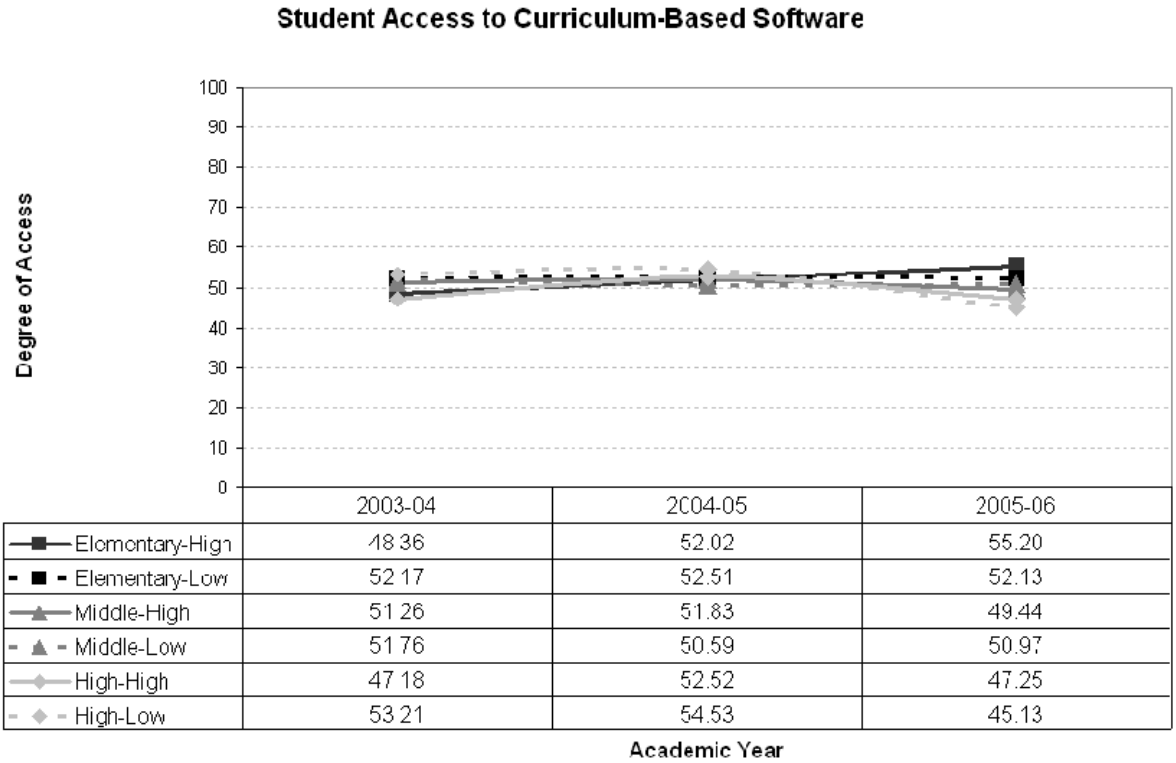
Table 1.
Differences and trends in access to tool-based software.

Contrasts		Hi vs. Low		
School Type	Year	F	Sig.	d
Elementary	2003-04	53.27	**	-0.46
Elementary	2004-05	2.57		-0.11
Elementary	2005-06	16.89	**	-0.27
Middle	2003-04	7.95	**	-0.32
Middle	2004-05	2.24		-0.18
Middle	2005-06	0.13		0.05
High	2003-04	1.67		-0.22
High	2004-05	0.7		-0.12
High	2005-06	0.13		0.07

Contrasts		03-04 vs. 04-05			04-05 vs. 05-06			03-04 vs. 05-06		
School Type	SES	F	Sig.	d	F	Sig.	d	F	Sig.	d
Elementary	High	4.9	*	-4.92	13.09	**	4.86	2.56		0.11
Elementary	Low	10.21	**	-3.78	1.45		4.18	19.5	**	0.27
Middle	High	0.23		-4.5	5.06	*	6.2	3.52		0.24
Middle	Low	0.53		-4.09	16.89	**	5.77	23.7	**	0.63
High	High	0.12		-5.52	6.97	**	6.78	5.65	*	0.4
High	Low	0.01		-4.87	11.85	**	6.66	12.6	**	0.67

* $p<.05$; ** $p<.01$; $F(1, 4224)$

Curriculum-based Software: Accessibility to curriculum-based software took a different form and is shown in Figure 2 and Table 2. There were very few significant differences related to the access to curriculum-based software between Low and High SES schools. As illustrated in Table 2, the only significant differences in access to curriculum-based software were in elementary schools in 2003-04 (where Low SES had more access) and 2005-06 (where High SES had more access). Significant differences related to SES resulted in medium effect sizes in every case. Socio-economic status did not have a significant relationship with accessibility in either middle or high schools.



	2003-04	2004-05	2005-06
Elementary-High	48.36	52.02	55.20
Elementary-Low	52.17	52.51	52.13
Middle-High	51.26	51.83	49.44
Middle-Low	51.76	50.59	50.97
High-High	47.18	52.52	47.25
High-Low	53.21	54.53	45.13

Figure 2. Student access to curriculum-based software.

When looking at the trends across the years, it is apparent that High SES elementary schools made significant increases in access to curriculum-based software every year (see Table

2). Meanwhile, Low SES high schools had a significant decrease in the proportion of computers with curriculum-based software installed from the 2003-04 to 2005-06 school years and between the 2003-04 and 2004-05 school years. Analogous to access to tool-based software, only elementary schools show a disparity between High and Low SES in favor of High SES schools.

Table 2.
Differences and trends in access to curriculum-based software.

Contrasts		Hi vs. Low		
School Type	Year	F	Sig.	d
Elementary	2003-04	7	**	0.16
Elementary	2004-05	0.1		0.02
Elementary	2005-06	4.1	*	-0.16
Middle	2003-04	0		0.02
Middle	2004-05	0.2		-0.05
Middle	2005-06	0.3		0.08
High	2003-04	3.3		0.26
High	2004-05	0.4		0.08
High	2005-06	0.4		-0.12

Contrasts		03-04 vs. 04-05			04-05 vs. 05-06			03-04 vs. 05-06		
School Type	SES	F	Sig.	d	F	Sig.	d	F	Sig.	d
Elementary	High	6.2	*	-2.91	4.2	*	4.12	21.5	**	0.32
Elementary	Low	0.1		-3.05	0.1		3.8	0		0
Middle	High	0		-3.03	0.7		3.61	0.45		-0.08
Middle	Low	0.2		-3.01	0		3.6	0.08		-0.04
High	High	3.2		-2.71	2.9		3.78	0		0
High	Low	0.1		-3.37	7	**	3.37	5.1	*	-0.39

* $p<.05$; ** $p<.01$; $F(1, 4224)$

Student Use of Software

Although having access to the software is crucial for the integration of technology into the fabric of the educational enterprise, how frequently the software is being used by students is even more important.

Student Use of Tool-Based Software: Table 3 and Figure 3 show student use of tool-based software by SES and school level over time.

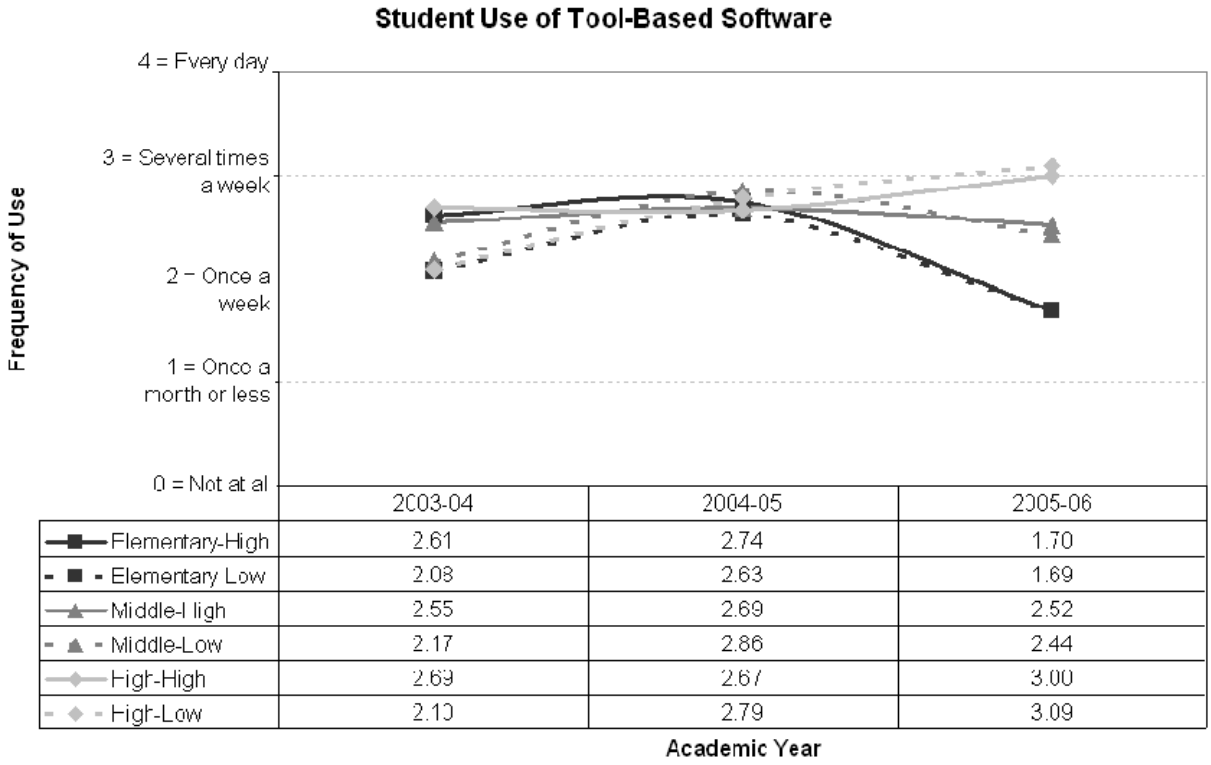


Figure 3. Student use tool-based software.

Interestingly, there were significant differences in SES related to student use of tool-based software at every school level during the initial school year, as shown in Table 3. During the 2003-04 school year, students in High SES high, middle, and elementary schools used tool-based software significantly more than students in Low SES schools. In the subsequent school years, the differences were not significant. Lows SES elementary, middle, and high schools had significantly increased the use of tool-based software from the 2003-04 to 2004-05 school years, while only High SES elementary schools had significant gains during that period. By the 2005-06 school year, all school levels were nearly consistent in student use by SES; however, when viewing the differences by school level, high schools and middle schools used the software more frequently than elementary schools (see Figure 3).

The trends across years showed significant increases for both High and Low SES elementary schools between 2003-04 and 2004-05 and then significant decreases between 2004-05 and 2005-06 (see Table 3). Low SES high schools experienced significant upward trends every year, while High SES high schools experienced significant increased trends for student use of tool-based software between 2004-05 and 2005-06, as well as between 2003-04 and 2005-06. Low SES middle schools experienced a significant increase in student use of tool-based software between 2003-04 and 2004-05 and then a significant decrease in student use of tool-based software between 2004-05 and 2005-06, although the overall trend was positive.

Table 3.
Differences and trends in student use of tool-based software.

Contrasts		Hi vs. Low		
School Type	Year	F	Sig.	d
Elementary	2003-04	75.5	**	-0.63
Elementary	2004-05	2.65		-0.11
Elementary	2005-06	0.05		-0.02
Middle	2003-04	11.4	**	-0.45
Middle	2004-05	2.05		0.18
Middle	2005-06	0.41		-0.08
High	2003-04	18.1	**	-0.72
High	2004-05	0.66		0.11
High	2005-06	0.48		0.1

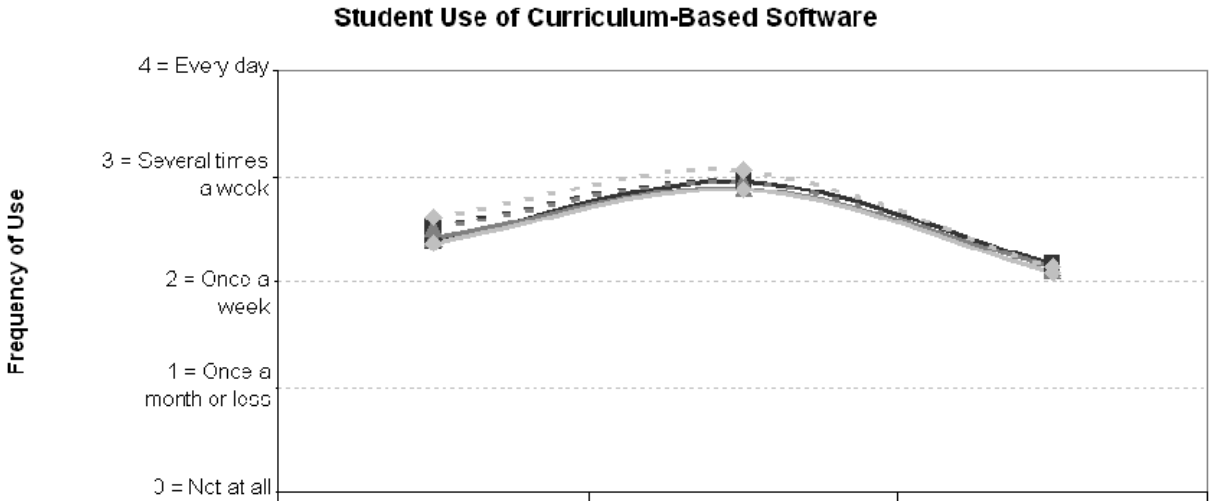
Contrasts		03-04 vs. 04-05			04-05 vs. 05-06			03-04 vs. 05-06		
School Type	SES	F	Sig.	d	F	Sig.	d	F	Sig.	d
Elementary	High	4.33	*	-4.15	249	**	2.4	212.2	**	-0.99
Elementary	Low	76.2	**	-3.52	221.9	**	2.46	38.81	**	-0.45
Middle	High	1.28		-4.17	1.91		3.39	0.09		-0.04
Middle	Low	33.6	**	-3.44	11.93	**	3.38	5.31	*	0.29
High	High	0.03		-4.3	5.91	*	4.03	5.45	*	0.31
High	Low	20.1	**	-3.71	4.03	*	4.19	42.88	**	1.09

* $p<.05$; ** $p<.01$; $F(1, 4224)$

Student Use of Curriculum-based Software: Student use of curriculum-based software showed different results (see Figure 4 and Table 4). In the initial school years, students in both Low SES elementary schools and Low SES high schools used curriculum-based software

significantly more than students in High SES schools, as shown in Figure 4. Again, this difference dissolved in the following school years as both High SES and Low SES schools used curriculum-based software less frequently (both High SES and Low SES fell to between one to several times a week).

The trends across years were significant for all levels. As illustrated in Figure 4 and Table 4, students in all school levels and SES groups were using curriculum-based software less frequently in the 2005-06 school year than in the initial 2003-04 school year. Moreover, the upward changes between 2003-04 and 2004-05, downward changes between 2004-05 and 2005-06 as well as the overall downward trend over all of the school years were significant for all levels of SES and all levels of school.



	2003-04	2004-05	2005-06
Elementary High	2.39	2.95	2.17
Elementary-Low	2.54	2.96	2.10
Middle-High	2.42	2.89	2.15
Middle-Low	2.51	2.96	2.12
High-High	2.36	2.88	2.09
High-Low	2.61	3.06	2.14

Figure 4. Student use of curriculum-based software.

Table 4.
Differences in student use of curriculum-based software.

Contrasts		Hi vs. Low		
School Type	Year	F	Sig.	d
Elementary	2003-04	8.39	**	0.21
Elementary	2004-05	0.03		0.01
Elementary	2005-06	1.46		-0.09
Middle	2003-04	0.82		0.12
Middle	2004-05	0.46		0.08
Middle	2005-06	0.12		-0.05
High	2003-04	4.46	*	0.35
High	2004-05	2.11		0.21
High	2005-06	0.19		0.06

Contrasts		03-04 vs. 04-05			04-05 vs. 05-06			03-04 vs. 05-06		
School Type	SES	F	Sig.	d	F	Sig.	d	F	Sig.	d
Elementary	High	112	**	-4.34	194.3	**	4.04	17	**	-0.3
Elementary	Low	60.86	**	-5.05	250.1	**	3.64	65.4	**	-0.59
High	High	23.2	**	-4.27	49.8	**	2.93	6.28	*	-0.32
High	Low	11.63	**	-5.31	51.08	**	3.04	13.4	**	-0.57
Middle	High	22.52	**	-4.24	51.35	**	3.59	7.32	**	-0.33
Middle	Low	19.73	**	-4.88	66.91	**	3.89	14.5	**	-0.54

** p<.05; **p<.01; F(1, 4224)*

Conclusions and Educational Importance

Important trends in the accessibility of software were found during this study. In high schools, access levels to both tool- and curriculum-based software were relatively comparable in both Low and High SES groups – no significant differences were identified across the three school years. High SES middle schools, during the 2003-04 school year, showed significantly more access to tool-based software than in Low SES schools; however, in the following years, Low SES advanced to comparable levels. In terms of software access, Florida's elementary schools had the largest differences. The 2005-06 school year showed significant differences on SES in elementary schools, in favor of High SES schools in both broad categories of software. This study, unlike previous studies, compared schools by SES at each school level (elementary, middle, and high). While previous studies found no significant difference in access to software in

schools by SES (Anderson & Becker, 2001; Benner et al., 2002; Wenglinsky, 1998, 2005), this study found significantly less access to both curriculum-based and tool-based software by Low SES elementary schools at the end of the study. This is an area, perhaps, that should be addressed by the Florida K-12 education system.

There are also significant differences among the starting points of elementary schools in terms of access to software when grouped by SES (and middle school access to tool-based software). Schools with higher proportions of economically disadvantaged students began with less student access to tool-based software. Meanwhile, the starting points for student access to curriculum-based software are consistently higher in Low SES schools. These trends have moderated over time, and levels of access to both types of software were comparable in 2005-06 with the exception of elementary schools.

Perhaps the most interesting finding is the apparent differences between High SES and Low SES schools related to student use of the two broad categories of software during the initial school year under investigation. In the 2003-04 school year, student use of tool-based software was significantly greater in High SES schools, confirming the research of Wayne et al. (2002) and Wenglinsky (1998, 2005). In the subsequent school years, this difference dissolved as Low SES schools increased student use of tool-based software. Conversely, Low SES elementary and high schools used curriculum-based software significantly more often than their High SES counterparts in 2003-04, again corroborating results of Wayne et al. (2002) and Wenglinsky (1998). Unlike tool-based software, curriculum-based software was less frequently used at all school and SES levels in the subsequent years. While access levels may have a relationship with SES, student use of the resources is relatively comparable in both High and Low SES schools in the latter years, indicating that economically disadvantaged students were using both tool- and

curriculum-based software at comparable levels. This suggests that the differences in the ways that students used software based on SES has changed since 1996, the time of Wenglinsky's (1998) study. However, differences continued when comparing school levels with high and middle schools, using tool-based software more frequently than elementary schools.

The digital divide reported by Anderson and Becker (2001) and Adelman et al. (2002) may not be as pervasive in Florida's K-12 schools. This research, as Benner et al. (2002) demonstrated, has found that Florida's Low SES middle schools and high schools have comparable levels of access to software. Though Florida's High SES elementary schools have better access to software than Low SES elementary schools, the use of software by students and teachers of High and Low SES is relatively comparable at each school level in 2005-06.

Results from this study have expanded our knowledge about the availability and use of technology in K-12 schools. These results can help inform policy makers, and state/district level administrators on how to plan for the integration of technology in all public schools, as well as provide a basis for the comparison of Florida's technology integration trends with other states. In addition, the results can provide guidance on professional development for teachers, partnerships with community members, and support systems for educators. Tracking the impact of technology on closing the digital divide is important to students, parents, and the community, as well as educators and researchers.

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