Technology Integration in Early Childhood and Primary Classrooms: Access, Use & Pedagogy Remain Critical Components to Success

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Abstract

Calls for increased use of technology in early childhood and primary classrooms has not gone unanswered. However, recent research findings report little technology integration with computers continuing to be unavailable. This descriptive study looked to explore to what extent and in what ways technology is integrated into early childhood and primary classrooms. Findings corroborate previous dated research that trivial technology is being used. Technology use, computer access and styles of pedagogy remain critical in the debate to whether teachers will integrate computers for teaching and learning.

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In a recent special edition of the *Early Education and Development* journal dedicated to technology integration, guest editors Wang and Hoot (2006) argued that

> Early childhood educators are now moving away from asking the simple question of whether technology is developmentally appropriate for young children. Rather, they are more concerned with how [information and communication technology] can be effectively used to facilitate children's learning and development. (p. 317)

It would seem the value of using technology to support teaching and learning for young children has been reconciled.

Over a decade ago, the National Association for the Education of Young Children (NAEYC) adopted a position statement regarding the use of technology in the education of young children. This statement has since not been modified or replaced (NAEYC, 1996). Their prescience highlighted the increasing ubiquity of computers and information and communication technologies. NAEYC's (1996) statement also cautioned that "computers supplement and ... not replace highly valued early childhood activities and materials" (p.1). The obvious concern and assumption was that computers would become so pervasive to supplant other meaningful instructional methods. The authors in fact warn educators to "weigh the costs of technology with the costs of other learning materials and program resources to arrive at an appropriate balance for their classrooms" (NAEYC, 1996, p.1). Again, the assumption was that computer technologies may overshadow tactile learning. But is the reverse also true? Has a balance been struck between traditional forms of learning and technology integrated instruction? Have computer technologies become integral to learning? The conclusions appear to be less clear.

Smeets (2005) called for technology-supported learning environments in early childhood and primary education that align with the tenets of NAEYC. He argues that for technology to be best used to support student learning, then the environments must (a) embed authenticity, (b) emphasize knowledge construction, (c) use open-ended learning, (d) include student cooperation and collaboration and (e) integrate mixed ability levels and differentiated instruction where appropriate and possible. Smeets criticized schools for emphasizing "traditional, skill-based [information and communication technology] use" (p. 345), reporting that teachers made little use of technology to advance learning. Few teachers, but particularly males, were most likely to implement constructivist environments, where technology could be used in the most meaningful ways.

Possibly the strongest advocate for technology integration in *all* classrooms has been the International Society for Technology in Education (ISTE). In 1998, ISTE launched the National Educational Technology Standards for Students (NETS-S). In 2007, a significant revision to these standards reflected changes in technologies, security and ethics, individuals' skills and contemporary teaching and learning. In parallel, the 2000 National Educational Technology Standards for Teachers (NETS-T) were approved. In 2008, a similar revision to the NETS-T resulted in a greater emphasis on learning and creativity, assessment, authentic work, and ethics. These calls for meaningful technology integration have not gone unanswered.

Examples of Technology Integration and Use

There are numerous contemporary examples of innovative uses of computers and other technologies in early childhood and primary classrooms, such as with language and writing development, problem solving and drawing. For example, Couse and Chen (2008) considered the appropriateness of tablet computers for three- to six year old children with drawing and technological independence. Ching, Wang, Shih and Kedem (2006) explored how kindergarten and first grade students created and reflected upon digital photograph journals. Integrated learning systems, like those investigated by Paterson, Henry, O'Quin, Ceprano and Blue (2003) and Bauserman, Cassady, Smith and Stroud (2005), continue to produce inconsistent and mixed results with regard to their utility, implementations and teacher facilitation. Voogt and McKenney (2007) researched a more constructivist system to support language and literacy development. Finally, comprehensive programs, such as the Key Instructional Design Strategies (KIDS) project (Knezek & Christensen, 2007), have incorporated extensive teacher professional development in addition to hardware, software and instructional modules.

Outside of schools and formal learning institutions, the uses of technology are quite staggering. Specific to using the Internet, the Corporation for Public Broadcasting's ([CPB], 2002) report "Connected to the Future: A Report on Children's Internet Use" finds that the largest group of new Internet users from 2000-2002 were children aged two to five. Second was children aged six to eight. In 2000, 6% of two- to five-year-olds were online. In 2002, the number jumped to 35%. Similarly, in 2000, 27% of six- to eight-year-olds were using the Internet, while in 2002, the proportion was 60%. The amount of time children are spending online is not inconsequential. CPB went on to report that six- to eight-year-olds were on the average spending 2.7 hours per week using the Internet for exploration (e.g., surfing, searching), education (e.g., learning, homework, research) and games.

Challenges Describing the Technology Integration Landscape

Few large scale studies have examined technology integration in early childhood and primary classrooms. Moreover, few studies provide the generalizability and corroboration necessary to fully depict technology integration in general. Norris, Sullivan, Poirot and

Soloway (2003) reported survey data from approximately 3,700 teachers across four geographically diverse states. In general, they report that teachers' uses of computers and the Internet were "disappointingly spare," (p. 22) and access to technology was equally bleak. Teachers in middle and high schools were much more likely to use computer technology in their classrooms than elementary schools. Poignantly, Norris et al. report "by far the most significant predictor of technology use is the number of classroom computers" (p. 22). This was echoed in Smeets (2005) results, where "the availability of a sufficient number of computers contributed most to the probability of" integrating technology for higher order thinking.

Similarly, O'Dwyer, Russell and Bebell (2004) analyzed survey data from approximately 1,500 elementary teachers in kindergarten through sixth grade in Massachusetts. When technology was used, it was most often used by teachers to prepare for class. Student uses of technology to create products were the lowest. So, the type of instructional methods called for by Smeets (2005) above occurred least often. However, O'Dwyer et al. report that the more constructivist the teacher's beliefs, the more technology use was reported. Finally, they report "the strongest positive predictor of whether a teacher will use technology to deliver instruction, have their students use technology during class and have their students create products is a teacher's belief about the positive impacts of technology integration" (p.15).

Becker's (2006) study included data from 40 states and over 70,000 students from a 2000 National Assessment of Educational Progress mathematics database of fourth graders and a 1998 survey from the Miliken Exchange on Educational Technology. Almost 60% of the students reported never or hardly ever using a computer with math. In addition, Becker found that 80% of the variance of whether computers were used was attributable to differences within a school. He went on to suggest that these differences were most attributable to teacher characteristics and whether teachers may employ more constructivist strategies, which echoes O'Dwyer et al.'s (2004) findings. Moreover, Becker found that computers in classrooms did increase the probability for use, which corroborates Norris et al.'s (2003) results as well.

Using data from the Early Childhood Longitudinal Study sponsored by the U.S. Department of Education, Judge, Puckett and Bell (2006) considered longitudinal data from over 8,000 children in third grade. They report that access to computers is improving, but there are still too few computers to meet a five to one student-to-computer ratio in classrooms. They also report that low-achieving readers from all economic groups did not receive gains from increased computer times. This may connect with findings from Paterson et al. (2003) regarding ineffective use of integrated learning systems. So, these longitudinal results are providing a clearer picture of technology access and use, but we are still left with little data about the types of instructional activities with computers that are taking place inside classrooms and computer labs.

Research Question

The purpose of this research was to examine the current state of technology integration and describe access, instructional activities and use. The primary research question was to what degree and in what ways have teachers integrated technology with instruction in early childhood and primary grades? Some of the strongest, most sophisticated and largest investigations of technology integration (e.g., Becker, 2006; Norris, Sullivan, Poroit & Soloway, 2003; O'Dwyer, Russell & Bebell, 2004) have used data sets restricted by discipline (e.g, mathematics), state (e.g., Massachusetts) or currency (e.g., 1998-2002). In addition, these studies relied on self-report data from teachers, students and administrators. More robustly, Judge, Puckett and Bell's (2006) longitudinal data offered a broader perspective, collecting frequency data from parent interviews and administrator questionnaires. As noted above, however, we are unable to examine the instructional methods and subject areas to determine whether technology integration is or is not occurring. As a whole, these data provide indications of technology integration, but they are insufficient in providing a complete picture. The current research was an attempt to corroborate or refute the existing findings with observational data.

Method

Design and Data

This was a descriptive study reporting classroom observational data collected by external trained observers. We aggregated an extant set of data from the Center for Research in Educational Policy (CREP) at The University of Memphis. The data were collected during Fall 2005 through Spring 2007, aggregating two years of classroom observations (i.e., 2005-2006 & 2006-2007) for kindergarten through fifth grades. Data were originally collected as part of formative evaluations conducted by CREP for individual schools and school districts.

Across the two years of data, five states are represented, encompassing 81 individual schools and 316 summaries of school classroom observations. Each summary report represents approximately 10-12 individual classrooms within a school, totaling approximately 3,100 classroom visits. The schools represented were diverse in their population densities (e.g., urban, suburban, rural) and populations served (e.g., high proportions of free and reduced lunches, low proportions of free and reduced lunches). All of the schools, however, were interested in change and school reform hence the desire for an external formative evaluation. Also, all of the schools were interested in documenting technology integration, which included an observation instrument to do so. A table of the data collection distribution is listed below.

Table 1. Distribution of Classroom Observations			
2005 - 2006			
	States	Number of Schools	Number of Observations
	Kentucky	40	116
	Michigan	7	7
	Tennessee	19	94
	Texas	3	12
2006-2007			
	Kentucky	23	61
	Florida	9	26
Totals	5	81*	316

* Note: 20 of the Kentucky schools reported in 2006-2007 were duplicates from 2005-2006. As a result the total number of schools is 81.

Instrumentation

Data from two instruments were used: (1) the Survey of Computer Use and (2) the School Observation Measure. Descriptions of the instruments are explicated in the following sections.

Survey of Computer Use

The Survey of Computer Use (SCU©) examined the availability of and student use of technology and software applications (Lowther & Ross, 1999). The SCU was completed as part of the 15-minute observation with each SOM. Four primary types of data were recorded: (a) computer capacity and currency, (b) configuration, (c) student computer ability and (b) student activities while using computers. Computer capacity and currency was defined as the age and type of computers available for student use and whether or not Internet access was available. Configuration referred to the number of students working at each computer (e.g., alone, in pairs, in small groups). Student computer ability was assessed by recording the number of students who were computer literate (e.g., easily used software features/menus, saved or printed documents) and the number of students who easily used the keyboard to enter text or numerical information. Student use of computers was focused on the types of computer-mediated activities, subject areas of activities, and software being used. The computer activities were divided into three categories based on the type of software tool (a) production tools (word processing, databases, spreadsheets, draw/paint/graphics, presentation authoring, concept mapping, planning), (b) Internet/research tools (Internet browser, CD reference materials, communications) and (c) educational software (drill-practice/tutorial, problem solving, process tools). This section ends by identifying the content subject area of each computer activity (i.e., language arts, mathematics, social studies, science, other). Like the SOM, the computer activities and software being used are summarized and recorded using a five-point rubric that ranges from (0) Not Observed to (5) Extensively Observed. The final section of the SCU was an "overall rubric" designed to assess the degree in four levels to which the activity reflects "meaningful use" of computers as a tool to enhance learning (1=low-level use of computers, 2=somewhat meaningful, 3=meaningful, 4=very meaningful).

The reliability of the SCU was determined in a study involving pairs of trained observers conducting SCU observations in 42 targeted visits to classrooms that were schedule to have students using technology. Results from the study revealed that overall the paired observers selected the identical SCU response on 86% of the items with all other responses being only one rating apart. When looking at subcategories of the SCU, the percentage of times that paired observers selected the same responses was as follows: (a) computer capacity and currency, 83%; (b) configuration, 95%; (c) student computer ability, 70%; (d) student activities while using computers, 92%; (e) subject areas of computer activities, 88%; and (f) overall rubric rating meaningfulness of computer activities, 88% (Lowther & Ross, 1999).

School Observation Measure

The School Observation Measure (SOM©) examined the frequency of usage of 24 instructional strategies, including traditional practices (e.g., direct instruction and independent seatwork) and alternative, predominately student-centered methods associated with educational reforms (e.g., cooperative learning, project-based learning, inquiry, discussion, using technology as a learning tool) (Ross, Smith, & Alberg, 1999). The strategies were identified through surveys and discussions involving policy makers, researchers, administrators, and teachers, as those most useful in providing indicators of schools' instructional philosophies and implementations of commonly used reform designs (Ross, Smith, Alberg, & Lowther, 2001).

The observer examined classroom events and activities descriptively, not judgmentally. Notes were taken relative to the use or nonuse of 24 target strategies. Observation forms were completed every 15 minutes, then the observer changed classrooms. This process continued for approximately 3 hours, resulting in approximately 10-12 classroom observations. At the conclusion of the visit, the observer summarized the frequency with which each of the 24 strategies was observed across all classes in general on a data summary form. The frequency was recorded via a 5-point rubric that ranges from (0) Not observed to (4) Extensively. The same 5-point scale was used to summarize how frequently high academically focused class time and high student interest/attention were observed.

To ensure the reliability of data, observers received a manual providing operational definitions of terms, examples and explanations of the target strategies, and a description of procedures for completing the instrument. After receiving the manual and instruction in a group session, each observer participated in sufficient practice exercises to ensure that his or her data are comparable with those of experienced observers (i.e., the trainers). In a 2004 reliability study reported by Sterbinsky, Ross and Burk, observer ratings were within one category for 96% of the multi-class observations.

Findings

Data for both years of data were aggregated. Descriptive statistics were calculated for both instruments, where None=0 through Extensively=4. Results from each measure are detailed in the sections below.

SCU

Summary tables with all SCU results are below in Tables 2–6. Observations using the SCU documented that almost 70% (66.8%) of all classrooms had at least two computers. Surprisingly, over 30% (31.6%) had at least five computers or more. At least 50% (50.3%) of the computers were observed to up to date, and almost all (98.7%) of the computers were observed to be connected to the Internet. During the majority of the classroom visits (62.8%), on the average 50% or less of the class were using computers. When computers were used, overwhelmingly, students used computers alone (74.8%). In fact, just over 10% (12.1%) of the time, students were using the computer collaboratively. Computer literacy skills were consistently observed to be moderately or very good (73.2%), while keyboarding skills were observed to be moderately or very good almost 50% of the time (46.6%). The configurations of computers most often observed were desktop computers (80.1%). Laptop computers were observed about 30% (27.3%) of the time, while personal digital assistants and graphing calculators were almost never observed. Information processors, such as AlphaSmarts tablets, were observed about 7% (6.6%) of the time.

On the average, all production tools and Internet tools were rarely observed to the be used in classrooms ($M<=1$). When observed, combining rarely through extensively frequencies, word processors (37.9%) and Internet browser (41.1%) were observed most often. Drill and practice/tutorial software was observed on the average between rarely and occasionally (*M*=1.05), and it was observed 54% of the time. Individualized/tracked software was on the average rarely observed (*M*=0.76), but it was observed 40.2% of the time. Notably, in comparison to all software types, drill and practice/tutorial software was on the average observed most often in a school with a mean=1.05 (between Rarely and Occasionally) and in 54% of the observations as compared to the next three highest software uses of Internet browser (41.1%), individualized/tracked (40.2) and word processing (37.9). Internet browser and drill and practice software were observed 13.3% of the time. All categories of software were observed most often in language arts classrooms, while the largest category of software observed in mathematics class was educational software.

On the average, all levels of quality for computer uses were rarely seen (M<=1). Somewhat meaningful uses of computers were observed from rarely to extensively 51.6% of the time just surpassing low level uses of computers (50.2%) and meaningful uses of computers (48.1%). Very meaningful uses of computers were only observed one quarter (25.2%) of the time.