Developmentally Appropriate Technology for Young Children

COLLEEN FINEGAN AND NANCY JO AUSTIN
Wright State University
Dayton, Ohio USA
colleen.finegan@wright.edu

Is computer usage appropriate for young children? The manner in which the computer is used can benefit the child, have no effect whatsoever, or actually be detrimental to the child's academic and personal growth. Specific conditions can be instituted to assure that young children benefit from their exposure to or interaction with technology. How computers are used is dependent on several factors: the teacher, technical and curricular support, the software, the way the software is used, and the classroom environment.

The Future is Here

There are few who disagreed with the statement made back in 1996 by the National Association for the Education of Young Children (NAEYC) "Technology plays a significant role in all aspects of American life today and this role will only increase in the future" (1996b, p.11). Now, six years later, the future is here. As the world enters the twenty-first century, the relationship between society and technology is evident and the relationship between education and technology is even more obvious.

Many see computer technology as a key to the future. Downes (1998) studied children and parents' discourses on the use of computers in the home and in school. Downs reported that both children and adults link computer literacy with employment in the future. Parents feel that children need

to learn about computer technology now to prepare for their roles as adult workers.

The Milken Family Foundation (MFF) is an organization, which endeavors to improve the quality of life for individuals through education and medical research http://www.mff.org/index.taf. The Education Technology division of MFF (formally the Milken Exchange on Education Technology) "presents cutting-edge research on the effective integration of technology into America's schools" (http://www.mff.org/edtech/). According to a national poll collected by The Milken Exchange on Education Technology, 87% of parents rated technology as having a strong impact on learning that would make a significant difference in the quality of their children's education (Solmon, 1999, available at http://www.mff.org/publications/publications.taf?page=277)

In addition, both adults and children believed that the home and school should work together to teach the child about technology, viewing it as a skill that would advantageous in the academic world. Parents want children to be successful in school and this goal translates into an increase in home-ownership of computers.

The National Telecommunications and Information Administration (NTIA, 2000) (http://www.ntia.doc.gov/) reported that between December 1998 and August 2000, the share of households with computers rose from 42.1% to 51.0% and households with Internet access soared by 58%, from 26.2% to 41.5%. As of September 2001, 174 million people or 65.6% of the U.S. population were computer users. One hundred forty three million people or 53.9% of the population used the Internet (NTIA, 2002).

Having children in the household significantly increases the chances that there will be a computer in the home. *A Nation On-line: How Americans Are Expanding Their Use of the Internet* (http://www.ntia.doc.gov/ntiahome/dn/index.html), a report by the National Telecommunications and Information Administration (NTIA, 2002) concluded that "Families with children under age 18 are far more likely to have computers than families without children: 70.1%, compared to 58.8%. They are also more likely to have Internet subscriptions: 62.2% versus 53.2%. The presence of children is also associated with modestly higher rates of broadband connectivity through DSL or cable modem: 18.4% for families with children, compared to 16.9% for those without children" (p. 42). In looking at the use of computers among specific age groups of children, NTIA reports:

● Children and teenagers use computers and the Internet more than any other age group.

- Ninety percent of children between the ages of 5 and 17 (or 48 million) now use computers.
- Seventy-five percent of 14-17-year-olds and 65% of 10-13-year-olds use the Internet.
- Households with children under the age of 18 are more likely to access the Internet (62%) than households with no children (53%) (NTIA, 2002, p. 1).

TECHNOLOGY AT THE ELEMENTARY AND SECONDARY LEVEL

In most school systems, computers were first available at the secondary level, then became more commonplace in the upper elementary grades and finally found their way into the primary level. Home usage of computer technology by students follows a similar trend. The use of computer technology, specifically use of the Internet by middle and high schoolers outranks that of elementary students. This difference may be accounted for by the nature of school assignments and the greater freedom accorded to older children to explore the Internet on their own.

USE OF COMPUTERS IN THE SCHOOLS

NTIA reported that "almost every young adult (95.9%) between ages 18 and 24, who attends school or college, uses a computer: 86.1% in school (20.8% only at school and 65.3% both at home and school), and 74.5% at home (9.2% only at home and 66.3% both at home and school). Even among 5 to 9-year-olds, a large portion (84.3%) are using computers at home, at school, or both" (NTIA, 2002, p. 45).

As a result of increased technology in the home and schools, the educational process has not been the same; many more teachers are integrating technology into their classrooms at every level (Haugland, 1997b). National and state standards for teacher preparation by colleges and universities require coursework not only in the basic use of technology but also in the integration of technology into the elementary and secondary curriculum. However, according to a 1999 study called, "Will New Teachers Be Prepared To Teach In A Digital Age?" commissioned by the Milken Exchange and conducted by the International Society for Technology in Education (ISTE, 2002) (http://www.iste.org/index.html), many teacher preparation programs are not providing the kind of training and exposure teachers need

if they are to be proficient and comfortable integrating technology with their teaching. Some teacher education programs teach only the basics of computer usage and leave the teachers to fend for themselves as far as how to integrate technology into the curriculum. If preservice teachers do not have the opportunity to integrate computers into the curriculum while still in college, it is unlikely they'll have the time to do so in their first few years of teaching (Milken Exchange on Education Technology and Peter D. Hart Research Associates, 1998). (http://www.mff.org/publications/publications.taf?page=154).

Trotter (1999) pointed out that even with appropriate software, the technology is useless unless the 3 million teachers holding the software know how to use it effectively. The International Society for Technology in Education (http://www.iste.org/about/index.html), has as its mission: To adequately prepare our students for adult citizenship in the Information Age, computer-related technology must become a tool that students and teachers use routinely. ISTE has developed technology standards not only for preservice and inservice teachers, but also for what students at various ages and stages should know regarding technology (http://www.iste.org/standards/ncate/index.html). The inclusion of these ISTE standards are now required by the National Council for Accreditation of Teacher Education (NCATE, 2002) as an integrated component in teacher preparation programs (http://www.ncate.org/).

Technological Resources

Since the 1980s as the technology developed, electronic educational tools designed for students at the elementary and secondary level has become more plentiful. For example, in the early to mid 1990s, when educators attempted to locate and review educational software of educational value for young children, the results of their searches were minimal. However, as parents and teachers began to demand more software and as the industry realized the money to be made, relevant software for younger children proliferated, and as a result, "children's use of technology becomes more widespread" (NAEYC, 1996b, p. 11). Locating appropriate software continues to be problematic. A survey commissioned by The Milken Exchange on Education Technology, reported that although more educators had computer access in their classrooms, 57% of the teachers who use software for instruction admit that it is "somewhat" or "very" difficult to locate software to compliment their curriculum (Fatemi, 1999).

Computers at the Early Childhood Level

Although it is clear that technology has become a fundamental force in the educational field, when should children be introduced to computers as an education medium? Is technology, and learning through technological means appropriate for everyone? In particular, is it a safe and effective way for our young learners to learn? What might they NOT learn as a result of acquiring skills in computer technology?

Haugland (2000) advocated computer use in early childhood classrooms and suggested that "to become productive adults in an increasingly computer-oriented society, children should have the opportunity to become comfortable with computers early in their lives" (p. 12). However, she is in agreement with other educational experts who feel that computers should not be used by children under three years of age—when most youngsters are in the sensori-motor stage of development, learning through the senses and by movement (Haugland, 1999). More recent emphasis on accountability, measuring achievement, and high stakes testing, according to Vail (2001) has many school systems relying on computers in the classroom to provide additional focus on academics.

The homepage of the Alliance for Childhood (2001) states that it is "a partnership of individuals and organizations committed to fostering and respecting each child's inherent right to a healthy, developmentally appropriate childhood" (http://www.allianceforchildhood.net/index.htm). Those belonging to this organization, including early childhood educators, other teachers, and researchers are concerned about the ways in which the computer is affecting children at home and in school. The Alliance's position statement "Children and Computers: A Call for Action" implores others to consider the potential harm as well as the potential benefits of the computer age. "Computers pose serious health hazards to children. The risks include repetitive stress injuries, eyestrain, obesity, social isolation, and, for some, long-term damage to physical, emotional, or intellectual development." A follow-up report *Fool's Gold: A Critical Look at Computers in Childhood*, examined what the Alliance terms "the real cost of computers; billions of dollars at the expense of key educational programs and the pressing needs of low-income children, as well as serious risks to children's physical, emotional and intellectual development" (Alliance for Childhood, 2000).

Setzer and Monke (2001) shared a similar view. They believed that children are being introduced to the computer at too early an age and that this is detrimental to a child's development. They based their opinion on Mortimer Adler's views of child development, recognizing that children

grow into their ability to handle abstract and complicated systems. Consequently, Setzer and Monke recommended that students should not begin the formal study of computers until they are in high school.

Many critics of the computer in elementary and early childhood warn of over-reliance on the computer. It is well recognized that unbridled computer usage, just as unregulated use of other multi-media tools, is not an educationally sound practice. Various aspects of using technology need to be taken into consideration, which are correlated with the wise use of technology as a learning tool.

The way that the computer is used can benefit the child, have no effect whatsoever, or actually be detrimental to the child's academic and personal growth (NAEYC, 1996b; Shade & Watson, 1990). "Like crayons, blocks, or any other learning resource we provide young children, computers are neither good nor bad. The effect of computers depends upon how they are utilized; it depends upon the wisdom of adults to make wise choices regarding appropriate experiences for young children" (Haugland, 1992, p.28).

The debate whether or not young children should use computers will continue, but Haugland (2000) joined others who suggested that the manner in which computers are used with young children is more important than whether or not they are used. How computers are used is dependent on several factors: the knowledge and computer expertise of the teacher, technical and curricular support, the software and the way it is used, and the classroom environment.

DEVELOPMENTALLY APPROPRIATE AND INDIVIDUALLY APPROPRIATE PRACTICES

Developmentally Appropriate Practice (DAP) is an educational philosophy which demands that educators and parents consider the individual's stage of development when making curricular decisions. Individually Appropriate Practices (IAP) is a similar philosophy that reminds educators that children of the same age cannot be automatically grouped into the same developmental level. Each child should be viewed as an individual with different skills and needs, and the goal for one child is not necessarily appropriate for another child.

It is recognized that children are active learners and expert in constructing their own knowledge; they learn through the senses and through their own movement as well as of objects in the world. It is also well known that children are individual and unique in the way they learn. Very young children are working on perfecting their motor skills as they master crawling,

walking, and running. Their worlds expand from their immediate families to a larger world as they make their needs and wants known through babbling and talking. They learn best through first hand experiences and manipulation of objects from the real world. Children begin to learn about a symbolic world through play. For example, young children can be seen using a block for a phone and babbling in it as they have seen adults do. As they get older, they learn that certain symbols stand for sounds and sounds joined together become words and that words placed in various arrangements convey meaning. Children need to interact with other children and adults to learn, model and practice their language skills.

Although recognizing technology as a useful and powerful educational tool, many critics voice concern that technology may lead early childhood educators away from discovery learning and learning by doing. Henniger (1994) feared that early childhood educators will abandon the "hands-on" approach, or the use of concrete materials in the learning process, and resort to a less interactive, and therefore, more passive approach.

Perry (1999) observed that many modern technologies, including computers are quite passive in nature and therefore "do not provide children with the quality and quantity of crucial emotional, social, cognitive, or physical experiences they require when they are young" (p. 37). Technology is not the only classroom tool or resource that can be abused by inappropriate usage. Teachers must be well prepared to make professional choices regarding how technology is utilized in the classroom.

EARLY CHILDHOOD PROFESSIONALS AND THE USE OF COMPUTERS

The success of technology in educational settings does not rely totally on having the latest hardware, graphic software, multiple peripherals, and a color laser printer. All the gizmos and gadgets in the world operating in tandem can't work miracles by themselves. "It is people who make technology powerful" (The Alliance for Technology Access, 1996, p. 8). It is well recognized that the teacher is central to the successful integration of computer usage into the early childhood classroom (Badgett & Snider, 1995; Haugland, 1999, 2000; Kersh, 1999; Liu, 1996; Wright, 1998).

In any early childhood environment, the teacher's role is critical. "The purpose (of computers) is not to convince (teachers) to give up all the traditional developmental activities (they) provide, but to help (them) begin to think of and use computers as (they) would any other material" (Shade,

1992, p. 43). Teachers need to see technology as another manipulative opportunity offered to their students and not as a separate entity in the classroom.

The teacher needs to be very computer literate and to possess "effective knowledge of how to make technology developmentally appropriate for young children" (Badgett & Snider, 1995, p. 101). Recognizing teachers as integral to successful technology use in the classroom, Anderson, Foertsh, Hawkes, McNabb, Raack, and Valdez advocate for "new kinds of professional development assistance" (1999, p. 18), as well as "shifts in both curricular and instructional goals (p. 9). They recommended that, "Computers should be used less for drill and practice and more as open-ended thinking tools and content resources. Teachers need to buy in to this teaching style and then learn how to use the technology to support it" (p. 9).

TECHNOLOGICAL SUPPORT AND TIME TO PLAY AND SHARE

Technology is still very new to some educators and the management of hardware and software can often feel quite overwhelming. Administration and staff need to develop a support system and provide technical and informational assistance. Often an enthusiastic educator will begin to lose their interest in and commitment to technology when computers and multi-media devices do not operate efficiently and as they should.

In addition to preservice and inservice training, and technology that works, teachers need to be provided the time to experiment with the technology on their own. Time restraints and scheduling conflicts have often left teachers with very little time to investigate the possibilities offered their students. It is probable that many educators have not reviewed the software installed or read the accompanying manual before students begin to use the programs. But once a teacher has used a specific program, "it is much easier to begin to think and plan how it can be used effectively to enhance a particular interest, theme, or activity" (Kneas, 1999, p. 39). By truly understanding the capabilities of the programs offered, teachers will see technology as more than just another toy in the classroom, and will begin to integrate computers more fully into the curriculum.

Teachers also profit from networking with other educators. "Sharing experiences and ideas about using software can create a feeling of confidence and enthusiasm" (Kneas, 1999, p. 39). Educators can no longer take a passive role in the realm of technology, but share in the collective accountability of using technology in a developmentally appropriate capacity with young children. As stated in the NAEYC Position Statement, "The teacher's

role is critical in making certain that good decisions are made about which technology to use and in supporting children in their use of technology to ensure that potential benefits are achieved" (1996b, p. 11).

DEVELOPMENTALLY APPROPRIATE AND INDIVIDUALLY APPROPRIATE CURRICULUM

Another concern about computer use in early childhood is focused on the purpose for which computers are being used. In addition, teachers need to learn specific strategies to make the use of the computer relevant for *all* students. Jones and Selby (1997) found that in elementary schools the majority of computer time that students are allocated is focused on fostering academic or cognitive skills. But, in early childhood education, to focus solely on cognitive skills is not only to ignore the mandate for development appropriate curriculum, but also to deny some of the computer's greatest benefits, creativity, open-ended problem-solving, and social and linguistic development.

SOCIAL AND LINGUISTIC DEVELOPMENT

In 1996, NAEYC published *Guidelines for Preparation of Early Childhood Professionals* which stated that "the acquisition of language skills is an essential developmental task of childhood" (1996a, p. 75) and of the early childhood curriculum. Unfortunately, some teachers view computer usage as a solitary and passive activity, comparable to a child's educational videotape. Many critics of early childhood computer use are concerned over the potential for solitary interaction with the computer and the lack of social interaction. Young children need many opportunities for social interaction and some computers can be utilized to aid children in development of these areas. Furger (1999) advocated strongly for the use of technology with young children, but cautions that it "shouldn't come at the expense of more critical activities, such as talking and playing with friends."

Early childhood educators are required to establish specific language and social goals for their students, and some are unsure how to integrate these goals with computer usage. But, computers can be used to benefit young children in the areas of language and social development. With the creative and dynamic use of computers in the classroom, researchers have consistently observed high levels of spoken communication and cooperation as young children interact on the computer (Clements, Nastasi, & Swaminathan, 1993).

DEVELOPMENTALLY APPROPRIATE SOFTWARE

Another key element in the beneficial use of technology is the availability of software that is developmentally appropriate. The use of such software will compliment the early childhood curriculum and the educational goals of the individual instructor (Kneas, 1999). Teachers may erroneously make the assumption that a colorful program with "cute" characters is educationally valuable for young children. These programs are often constructed to attract adult buyers, not to provide a rich learning experience for children. Haugland (1992) warned that the characteristics of the software may significantly impact children's development in specific areas. Interaction with interesting and motivating stories on the computer allow students to use closure and problem-solving skills and may encourage children to read more and read more often. Quigley (1996) noted that the use of some computer software programs will raise IQ levels, others, particularly drill and skill programs, may slow development and even stifle creativity in children.

Early childhood educators must know how to evaluate software programs and their ability to stimulate interactional experiences as well as satisfy curricular goals. Haugland (2000) has developed the Haugland Developmental Software Scale to help parents and educators evaluate available software for young children. The child's ability on the computer itself must also be taken into consideration when choosing software. Some children have had interaction with a computer since they were very young. However, it is important not to overestimate a child's ability to comprehend the material contained in the program based on his or her ability to manipulate the mouse or click on icons (Elkind, 1996).

Developmental software must provide enough flexibility to " match the child's current level of understanding and skills, while growing with the child" (Haugland, 1997a, p. 133). The NAEYC (1996b) recommended the use of software that "engages children in creative play, mastery learning, problem solving, and conversation" (1996b, p. 12).

Badgett and Snider (1995) recommended software programs that are open-ended, providing children a sense of control over their environment, as well as a sense of pride of accomplishment. Programs in which the child drives the program, such as those that allow the child to draw or paint with various size and colors of brushes, can provide vast learning experiences for the child. The child is encouraged to freely and playfully explore lines, shapes, and colors with little emphasis on product (Shade, 1992).

AN ENVIRONMENT CONDUCIVE TO SUCCESSFUL
INTEGRATION OF TECHNOLOGY

Finally, it is essential that the early childhood teacher create an environment in which technology can be meaningful in the early childhood classroom. "Computers must be viewed as learning environments with multiple capabilities to support and enhance student learning as an important medium for instruction" (Anderson et al., 1999, p. 25). It is recommended that early childhood educators use materials that "support positive, cooperative interaction, opportunities to engage in social interaction, and adult guidance to prevent problems and support for cooperatively resolving problems that do occur" (Bronson, 1995, p. 101). The same guidelines should apply to technology within the early childhood curriculum. Teachers take great care in choosing appropriate play materials to use with their students to promote learning in the classroom. Such consideration should also be applied to computer use with young children.

In developmentally appropriate settings, educators often provide opportunities for children to make some choices regarding centers visited, when and how long they use the learning resources, and with whom they wish to play. Haugland (2000) believed that children should be provided those same choices in computer usage. She suggested that children be provided plenty of time to experiment and explore on the computer and that teachers should intervene only when children appear frustrated or to reach an impasse with the program or with each other (Haugland, 1999). As with any new learning situation or material, the children should not be forced to "play" on the computer, but should be allowed to gradually become familiar with it, as would be done with another machine or a classroom pet. It is also extremely important that the teacher provide equitable time for all students to experiment with the technology and not view the computer or a particular computer program as more suitable for one gender or the other.

Working at the computer should not be an isolated activity. As with most early childhood materials, computers should involve children working cooperatively and sharing ideas. Peer teaching and shared conversations at the computer fostered social development among young children (Barnett, Dublin, Pressman, & Woldman, 1994), and provide a collaborative learning environment in which children learn form the computer and each other (Liu, 1996). "The value of computer time diminishes if there is no discussion with the child about the new ideas and concepts that are being explored" (Furger, 1999, p. 105). "The activities and the environment that teachers create provide the children in their classrooms with a variety of

opportunities to use oral and written language to carry out, understand, and give meaning to activities and relationships" (NAEYC, 1996b, p. 75). In a recent study conducted on the use of computers for self expression and communication, researchers found that some computer programs were successful in allowing children to express their feelings and in helping them to develop better social relationships with peers and adults (Jones & Selby, 1997).

Teachers can use computers to foster this language development in the same way that they use traditional materials. Teachers may use the computer keyboard to type the children's language experience and encourage the children to illustrate the story with a draw or paint program or with "real" crayons or paint.

An important role of the early childhood educator is to facilitate the interactions between children during various classroom activities. This is as easy to do when children are working together on the computer as when they are playing a game or with other learning materials in the classroom.

> Effective use of technology in the education of all young learners is dependent on the manner in which it is used. In providing the support that young learners require in crossing the bridge from being dependent to more independent learners, technology offers a strong foundation (Badgett & Snider, 1995, p. 104).

CONCLUSION

The integration of technology into the early childhood classroom is an exciting new media that can become a playful addition to the learning environment when several factors are considered. With comprehensive teacher knowledge about the technology, critical examination of software, and the creation of an environment in which computers are included in a developmentally appropriate manner, early childhood educators can begin to reap the potential benefits offered by the technology in all areas of child development.

The 1996 NAEYC Position Statement on Technology in the Classroom proposes seven guidelines related to technology use and young children to help educators integrate technology in the early childhood classroom appropriately:

1.   …NAEYC believes that in any given situation, a professional judgment by the teacher is required to determine if a specific use of technology is age appropriate, individually appropriate, and culturally appropriate.

2. Used appropriately, technology can enhance children's cognitive and social abilities.
3. Appropriate technology is integrated into the regular learning environment and used as one of many options to support children's learning.
4. Early childhood educators should promote equitable access to technology for all children and their families. Children with special needs should have increased access when this is helpful.
5. The power of technology to influence children's learning and development requires that attention be paid to eliminating stereotyping of any group and eliminating exposure to violence, especially as a problem-solving strategy.
6. Teachers, in collaboration with parents, should advocate for more appropriate technology applications for all children.
7. The appropriate use of technology has many implications for early childhood professional development (NAEYC, 1996b, available at http://www.naeyc.org/resources/position_statements/pstech98.htm).

A commitment to NAEYC's standards regarding technology is an excellent foundation that can jettison educators and their young students into the fascinating world of learning.

References

Alliance for Childhood (2000, Sept. 12). *Children and computers: A call for action*. Retrieved from the World Wide Web on March 28, 2002, from: http://www.allianceforchildhood.net/projects/computers/computers_articles_call_for_action.htm

Alliance for Childhood (2001, Sept. 12). *Fool's gold: A critical look at computers in childhood*. Retrieved from the World Wide Web on March 28, 2002, from: http://www.allianceforchildhood.net/projects/computers/computers_reports_fools_gold_contents.htm

The Alliance for Technology Access (1996). *Computer resources for people with disabilities* (2nd ed.). Salt Lake City, UT: Author.

Anderson, M., Foertsh, M., Hawkes, M., McNabb, M., Raack, L., & Valdez, G. (1999). *Computer-based technology and learning: Evolving uses and expectations*. Oak Brook, IL: North Central Regional Educational Library.

Badgett, T., & Snider, S. (1995). I have this computer, what do I do now? Using technology to enhance every child's learning. *Early Childhood Education Journal, 23*(2) 101-105.

Barnett, E., Dublin, P., Pressman, H., & Woldman, E. (1994). *Integrating computers in your classroom, early childhood*. New York: Harper Collins.

Bronson, M. (1995). *The right stuff for children birth to 8*. Washington, DC: National Association for the Education of Young Children.

Clements, D., Nastasi, B., & Swaminathan, S. (1993, January). Young children and computers: Crossroads and directions from research. *Young Children,* 56-63.

Downes, T. (1998). Children's and parents' discourses about computers in the home and school. *Australian Computers in Education Conference*. Retrieved from the World Wide Web on March 28, 2002, from: http://www.cegsa.sa.edu.au/acec98/papers/p_downes.html

Elkind, D. (1996, September). Young Children and Technology: A Cautionary Note. *Young Children,* 22-23.

Fatemi, E. (1999, Sept. 23). Building the digital curriculum: Summary. *Education Week on the Web*. Retrieved from the World Wide Web on March 28, 2002, from: http://www.edweek.org/sreports/tc99/articles/summary.htm

Furger, R. (1999, November). Screen time: Should you let your child play on the computer to his heart's content? *Child*, 103-105.

Haugland, S. (1992). The effect of computer software on preschool children's developmental gains. *Journal of Computing in Childhood Education, 3*(1), 15-30.

Haugland, S. (1997a). Children's home computer use: An opportunity for parent/teacher collaboration. *Early Childhood Education Journal, 25*(2), 133-135.

Haugland, S. (1997b). How teachers use computers in early childhood classrooms. *Journal of Computing in Childhood Education, 8*(1), 3-14.

Haugland, S. (1999, November). What role should technology play in young children's learning: Part I? *Young Children, 54*(6) 26-31.

Haugland, S. (2000). What role should technology play in young children's learning: Part II—Early childhood classrooms in the 21st century: Using computers to maximize learning. *Young Children, 55*(1) 12-18.

International Society for Technology in Education (ISTE) (2002). Retrieved from the World Wide Web on March 28, 2002, from: http://www.iste.org/standards/index.html

Henniger, M. (1994). Computers and preschool children's play: Are they compatible? *Journal of Computing in Childhood Education, 5*(3/4), 231-239.

Jones, A., & Selby, C. (1997). The use of computers for self-expression and communication. *Journal of Computing in Childhood Education, 8*(2/3), 199-214.

Kersh, P.H. (1999). Tech matters: How computers impact Head Start children, teachers and parents. *Children and Families, 18*(3), 24-26, 28.

Kneas, K.M. (1999). Finding a place for computers. *Early Childhood Today, 13*(6), 39-40.

Liu, M. (1996). An exploratory study of how pre-kindergarten children use the interactive multi-media technology: Implications for multi-media software design. *Journal of Computing in Childhood Education, 7*(1/2), 71-92.

The Milken Exchange and the International Society for Technology in Education (1999). *Will new teachers be prepared to teach in a Digital Age? A national survey on information teachnology in teacher education.* Retrieved from the World Wide Web on March 28, 2002, from: http://www.mff.org/publications/publications.taf?page=154

Milken Exchange on Education Technology and Peter D. Hart Research Associates (1998). Public opinion poll - 1998. Retrieved from the World Wide Web on March 28, 2002, from: http://www.mff.org/publications/publications.taf?page=162

National Association for the Education of Young Children (NAEYC) (1996a). *Guidelines for preparation of early childhood professionals.* Washington, DC: Author.

National Association for the Education of Young Children (NAEYC) (1996b, September). NAEYC position statement: Technology and young children - ages three through eight. *Young Children*, 11-16. Retrieved from the World Wide Web on March 28, 2002, from: http://www.naeyc.org/resources/position_statements/pstech98.htm

National Council for the Accreditation of Teacher Education (NCATE) (2002). Website retrieved from the World Wide Web on March 28, 2002, from: www.ncate.org

National Telecommunications and Information Administration (NTIA) (2000, October). *Toward digital inclusion: A report on Americans' access to technology tools.* U.S. Department of Commerce Economics and Statistics Administration. Retrieved from the World Wide Web on March 28, 2002, from: http://www.ntia.doc.gov/ntiahome/fttn00/Falling.htm#2

National Telecommunications and Information Administration (NTIA) (2002, February). *A nation online: How Americans are expanding their use of the Internet.* U.S. Department Of Commerce Economics and Statistics Administration. Retrieved from the World Wide Web on March 28, 2002, from: http://www.ntia.doc.gov/ntiahome/dn/index.html

Perry, B. (1999, March). Technology on the brain. *Early Childhood Today, 13*(6), 37-38.

Quigley, M. (1996, March). Computer programs that do (and don't) teach kids. *Good Housekeeping, 222*(3) 117-118.

Setzer, V.W., & Monke, L. (2001). *An alternative view on why, when and how computers should be used in education.* Retrieved from the World Wide Web on March 28, 2002, from: http://www.ime.usp.br/~vwsetzer/comp-in-educ.html

Shade, D.D. (1992, Spring). Software with the appeal of blocks. *Day Care and Early Education*, *19*(3), 41-43.

Shade, D.D., & Watson, J.A. (1990). Computers in early education: Issues put to rest, theoretical links to sound practice, and the potential contribution of microworlds. *Journal of Educational Computing Research, 6*(4), 375–392.

Solmon, L. (1999). *Results from a study of 27 states' district technology coordinators*. Retrieved from the World Wide Web on March 28, 2002, from: http://www.mff.org/publications/publications.taf?page=277

Trotter, A (1999, September 23). Preparing teachers for the Digital Age. *Education Week on the Web*. Retrieved from the World Wide Web on March 28, 2002, from: http://www.edweek.org/sreports/tc99/articles/teach.htm

Vail, K. (2001, June). How young is too young? *Electronic school: The school technology authority.* Retrieved from the World Wide Web on March 28, 2002, from: http://www.electronic-school.com/2001/06/0601f1.html

Wright, J. (1998). A new look at integrating technology into the curriculum. *Early Childhood Education Journal, 2*(2), 107-109.