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# Integrating Computer Technology in Early Childhood Education Environments: Issues Raised by Early Childhood Educators

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## Integrating Computer Technology in Early Childhood Education Environments: Issues Raised by Early Childhood Educators

*The purpose of this study was to assess the educators' perspectives on the introduction of computer technology in the early childhood education environment. Fifty early childhood educators completed a survey and participated in focus groups. Parallels existed between the individually completed survey data and the focus group discussions. The qualitative data provided a richer understanding of the issues faced by these educators. Thematic analyses of the focus group discussions revealed that many of the educators' concerns involved the effect of technology on the educators themselves, with secondary emphasis on how computers affected the students and parents. Although educators generally supported the integration of computers, they also identified critical concerns and limitations.*

*L'objectif de cette étude était d'évaluer les points de vue des éducatrices relatifs à l'introduction de la technologie informatique dans un milieu d'éducation des jeunes enfants. Cinquante éducatrices de la petite enfance ont complété une enquête et ont participé aux sessions de groupes de discussion. La recherche a trouvé des correspondances entre les données des enquêtes individuelles et les discussions de groupe. Les données*

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*qualitatives ont permis une meilleure connaissance des enjeux auxquels sont confrontés ces éducateurs. Des analyses thématiques des discussions de groupe ont révélé que plusieurs des préoccupations des éducateurs portaient sur l'effet de la technologie sur les éducateurs eux-mêmes et, en deuxième lieu, sur l'influence des ordinateurs sur les élèves et les parents. Tout en indiquant qu'ils appuyaient globalement l'intégration des ordinateurs, les éducateurs ont également identifié des préoccupations et des limites importantes.*

Computer technology has become a prevalent feature in the elementary school system in North America (Collis et al., 1996; Statistics Canada, 1999). Recent policy decisions, along with research pointing to the critical role that the first five years of life play in the development of neural pathways (McCain & Mustard, 1999; Siegler, 1998), has resulted in the desire to move skill training down to the preschool level. It is no surprise, then, that computer technology has become more common in early childhood education environments where our youngest learners would reap the benefits from early exposure to this technology (Ko, 2002; Schofield, 1995; Shade & Watson, 1990; Wood, 2001). Along with the promise of increased learning opportunities for the students, however, the presence of computer technology brings additional burdens and responsibilities for educators (Becker & Ravitz, 2001; Rosen & Weil, 1995; Specht, Wood, & Willoughby, 2002). The present study examines the integration of computer technology in the early childhood education context by exploring potential barriers and supports from the perspective of the educator.

Most research exploring the implications of integrating computers in the classroom targets elementary and secondary schools (Becker, 1994; Rosen & Weil, 1995; Ross, Hogabaum-Gray & Hannay, 2001; Sandholtz, Ringstaff, & Dwyer, 1997). Little parallel research examines this effect from the perspective of early childhood educators, that is, those involved in child care environments prior to the elementary school system (Specht et al., 2002; Tsitouridou & Vryzas, 2003; Wood, Willoughby, Specht, Stern-Cavalcante, & Child, 2002). Because educators serve a pivotal role in determining just how much advantage can be gained from using computers, it is critical that we understand their perspective. The present study examines issues facing early childhood educators as they consider integrating technology in their curriculum.

The introduction of computer technology for very young learners has met with both support (Shade & Watson, 1990) and concern (Barnes & Hill, 1983; Elkind, 1996). Initially, there were fears that using computers with preschoolers would result in poorer social skills, less active learning opportunities, and fewer age-appropriate play activities (Barnes & Hill; Kaden, 1990; Zajonc, 1994). More recent research suggests that computers can facilitate social, cognitive, and play development among very young learners when handled appropriately (Kelly & Schorger, 2001; Ko, 2002; Muller & Perlmutter, 1985; Narroll, 1997; Podmore, 1991; Sandberg, 2002; Schofield, 1995). However, debates about the value and desirability of computers for young learners continue (Plowman & Stephen, 2003). Given the debates in the literature, it is important to investigate the perceptions of the early childhood educators who experience the effects of computers directly.

Research with elementary and secondary school educators points to a number of potential variables that can affect the integration of computers in the higher grades, and some of these variables may be important in early

childhood education environments as well. Both barriers and supports for integrating computer technology in the classroom have been identified. For example, barriers include equipment-related issues such as limited access, technical problems, and malfunctions (Hadley & Sheingold, 1993; Rocheleau, 1995; Sandholtz et al., 1997); skill-related concerns such as lack of educator training and limited knowledge (Becker, 1994; Becker & Ravitz, 2001); and attitudinal issues such as educator anxiety and concerns about the change to the social structure in classrooms (Anderson, 1996; Demetriadis et al., 2003; Rosen & Weil, 1995; Schofield, 1995). Supports include access to in-house specialists, technical support, administrative support, and opportunities for training (Sandholtz et al., 1997; Tsitouridou & Vryzas, 2003).

Intuitively, it would appear that many of these barriers and supports also would apply in an early childhood education setting. The relevance and the relative importance of each of these factors, however, is not yet known. In addition, the early childhood education environment has features that make it distinct from higher-grade contexts (e.g., level of independence and basic skills in young children), and these unique elements may require supports and produce barriers that are not found in higher-grade environments. Clearly more work is needed to understand the effect of computer technology in the early childhood education setting.

In order to gauge the perceptions of the early childhood educators accurately and comprehensively, the present study incorporates both survey and focus group methodologies. The survey methodology addresses specific issues identified in research and allows for comparison across participants. Focus groups are an effective method for gathering a wealth of information through an organized, open-ended, and flexible discussion (Marshall & Rossman, 1989). The combination of these two methods allows for specific questions to be addressed and quantified while also providing a context-rich qualitative understanding of issues identified by the educators themselves (Clark, Carlson, & Polkingholme, 1997). In summary, the present study captures early childhood educators' perceptions regarding the integration of computer technology in their centers and explores the potential advantages, disadvantages, barriers, and supports to the integration of computer technology in this setting.

### *Method*

#### *Participants*

The 50 early childhood educators (all women) who participated in the study ranged in age from 21 to 50 years ( $M=33.90$ ,  $SD=8.04$ ) and had between one and 29 years of experience in an early childhood education setting ( $M=11.16$ ,  $SD=6.65$ ). All participants were currently involved in programs working with children from 2 to 5 years of age. Sixty percent of the participants had completed a college program, 28% had completed a university undergraduate degree, and 10% had graduate degrees. When asked to indicate the age groups of children that they had worked with previously, 68% reported working with 0-2 year olds, 90% with children ages 2-4, 66% with 4-6 year-olds, and 16% with children aged 7 and over (the reported numbers add up to more than 100% as most had worked with children in more than one age group).

Administrators from 10 early childhood centers agreed to permit their staff to participate in a focus group discussion about the use of computer technology

in their early childhood center. These administrators were targeted because they directed a diverse array of possible early childhood settings including large and small, public and private daycare centers (that provided both full-time and/or part-time care for children) and university laboratory preschool centers. All requests for participation were granted. The 10 centers in this study represented the full range of settings listed above. The number of participants in each focus group varied across centers (generally reflecting the size of the center) from groups of three to 10 individuals (average group size was five participants). In all smaller centers all child care staff participated. In larger centers participants were selected to represent the varied ages of the children in the center. Participants were all volunteers, and a token cash donation of \$100 dollars was provided to each participating center.

#### *Materials and Procedure*

Participants in each center were asked to attend one focus group meeting. There were two facilitators for each focus group. The sessions were audiotaped and videotaped. The focus groups took place after regular work hours and lasted approximately 90 minutes.

At the beginning of each session, each participant was asked to complete individually a short, two-page survey. The survey contained two sections. The first asked for demographic information (age, sex, years of experience in early childhood education, age groups worked with, and level of highest educational training). The remaining six questions asked participants to identify and describe theoretical and pedagogical models used at their center (if any), identify whether they as individuals or whether the center supported the introduction of computers (i.e., "Do you support the introduction of computer technology in early childhood education environments?" and "Does your center support the introduction of computer technology?"), and describe whether the use of computers fitted with their own and/or the center's theoretical, pedagogical, or educational objectives (i.e., "Does the introduction of computer technology 'fit' in the theoretical framework(s), approaches or orientations of your center?"). Below each question participants were provided with space to explain and elaborate their responses. These questions were open-ended. All surveys were completed anonymously. Participants were given approximately 20 minutes to complete the survey.

Once the surveys were completed, participants were invited to participate in the focus group discussion. At the outset it was made clear that there were no right or wrong answers and that all the comments provided would be helpful toward increasing our understanding of the use of computers with young learners. Specifically, we identified the focus groups as an opportunity to determine if and how computers are being used in early childhood education environments, and how the use of computers might or might not fit within existing pedagogical beliefs or other constraints in the early childhood education environment. Further, we clarified the need to explore barriers or reasons for opting not to use computer technology, especially in those centers where computers were not available. After this brief introduction, the tape-recorder and video-camera were turned on, and one of the two facilitators began the session by asking for three specific pieces of information, that is, the ages of children attending the center, the number of children in the center, and

whether computers were available in the center. Participants were then invited to talk about how they felt about having computers for their classrooms. The role of the facilitators was to encourage all members of the focus group to have a turn to express their views and to redirect discussion to the topic of computers when discussion went off-task. Few prompts from facilitators were required.

### *Results*

Two sets of data were analyzed. The first set involved the survey responses. The second set involved the thematic analysis of the focus group data. We employed a textual or content analysis approach, which involves coding statements based on their key concepts, clustering these coded concepts into themes, and revisiting themes several times to delineate and refine them (Fiese & Bickman, 1998).

#### *Survey Data*

*Theoretical orientations/pedagogies of the centers.* Participants were asked to identify the major theoretical and pedagogical models used to design and implement the programs at their preschool. In general, most participants at the same center provided similar answers on this question. Seven of the 10 centers indicated that their program adopted a child-centered or child-initiated approach where children selected activities that were organized, supervised, and prepared by educators. Most of these seven centers identified a particular model such as Piagetian, Eriksonian, Discovery Learning, and High Scope orientations. The remaining three programs identified learning through play and learning in a loving, caring, and nurturing environment as the key principles guiding the center.

*Questions on computer technology.* Participants were asked to respond to three open-ended questions about computer technology. Responses were coded quantitatively (percentages) and qualitatively.

For the first question, "Do you support the introduction of computer technology in early childhood education environments?" most (80%) indicated support, with 6% of these participants indicating enthusiastic support. Another 18% indicated qualified support, and 2% did not answer. Only 24% of the sample provided an elaboration to support their response. Among the elaborations, age of the child, the need for monitoring computer access and use, and unspecified situational limitations were identified by multiple participants as important concerns. For example, age constraints are reflected in the following statements:

I think it really depends how the computer is used and in which programs.  
E.g., would not use with toddlers and young preschoolers.  
Only for older children (4 years and up).

The need for monitoring/supervision is captured by the following:

I believe it needs to be monitored with regards to content and length of time.

The situational limitations are evident in the following:

In particular situations.  
With specific parameters.

Individual participants also elaborated on the need to integrate computer technology into the curriculum, on the potential to assist children with special needs, and the need to expose children to computer technology that will be part of their everyday life.

For the second question, "Does your center support the introduction of computer technology?" most (89%) of the participants indicated support in the center (89%), but 35% qualified their response (see below). Only 6% of the participants indicated a lack of support at their center, and (2%) did not answer. One of the key constraints for centers supporting computers was funding. For example, participants indicated,

We would (support) if the funding to purchase a computer was available.  
We support but no cash to introduce.

Another important constraint was the age of the target population, with most participants indicating support for computers, but only for older children. For example,

Yes for older age groups. We do not have computers in our toddler or preschool programs.  
More computers would be an asset, especially for the "senior kindergarten like" class we run.

A third constraint was the challenge that educators found in translating their support for computers into a practical curriculum opportunity. For example,

We all seem to support the idea but it's actually doing that's the difficult part.  
We have spent a number of years figuring out how to use them appropriately.

Individual participants also acknowledged the importance of limiting computer use to appropriate "time(s) and context(s)" and only for "certain parts of the curriculum."

For the third question, "Does the introduction of computer technology 'fit' within the theoretical framework(s), approaches or orientations of your center?" two thirds (66%) responded positively, and 20% answered both Yes and No, 4% indicated a lack of fit, and 10% did not answer.

Those educators who indicated a good fit between computers and the ongoing theoretical/pedagogical approaches at their centers were further asked to outline how computer technology would ideally be used to achieve their goals. The major contributions from computers were represented by three themes: skill development, accessibility, and engagement/exploration. With respect to skill development, most respondents indicated that use of computers could help children to acquire skills in specific subject areas. For example,

Computer play helps to enhance language skills, reading skills, math, as well as social skills.  
We would be able to allow children to become aware of the computer and how it works. It could be incorporated into themes, letter-matching, color-matching, problem-solving games and techniques.

When discussing accessibility, participants indicated that access to computers would help to promote the goals of the program. In most cases participants indicated that greater access than is currently available would be useful. For example,



Right now we have only 1 computer. It's the first thing in the children's mind when they arrive in the morning and the last thing before they leave. I would like to see 2 in every room. I know how much I have learned, just imagine what they are going to learn.

We already have a computer available for children's use. In my opinion, we should have one in each room. This would allow each child a chance on it daily. It would be great to have a printer hooked up so that each child would have the opportunity to "create" something occasionally.

A number of participants focused on the possibilities for encouraging exploration and knowledge acquisition in the children when using computers. For example,

Allows children to explore using a different medium.

As a positive way, learning new items from different cultures. Computer is very informative.

A smaller number of participants indicated that children liked to use the computer and that children found the computer engaging (e.g., "fun and creative").

Participants who indicated a lack of fit between computers and the goals of their center were asked to identify specific problems, concerns, and shortcomings. Participants identified social development as an important concern. Use of computer technology was seen as inhibiting opportunities for social development by limiting social interaction (particularly among children with less developed social skills) and by having too much interaction with an inanimate object. For example,

Evidence that the availability of computers in a classroom can curtail (at best ... diminish at worst) social interaction amongst and between children, regardless of teacher modeling of social behavior while at the computer.

Often children with social problems would gravitate to the computers so they wouldn't have to interact.

A second concern was the restricted ability to implement computer technology as part of an array of available centers for the children. The inability to incorporate computers effectively was attributed both to limited numbers of computers and hence accessibility problems and to high demands on teachers. For example,

Initially we had the computers as an independent center. This did not work because it did not encourage independence, a lot of children needed one on one support.

The biggest problem I see is not enough time for each child to use it daily unless computers were in each room or it was a planned weekly event.

Participants were also concerned that children would be limited in the amount of direction they would be able to exert as a result of programs being too restrictive and computer activities being teacher- rather than child-initiated and directed. For example,

Some programs have too much direction.

May be very teacher-directed for the youngest preschoolers.



Participants were also concerned that their own skill level and the ability to maintain computer equipment and upgrade software could prevent them from using computers. For example,

Staff training (some of us are still “dummies”). How can we educate the children?

The only problem I see is breakdowns, lack of upgrading due to financial problems and proper upkeep of the computer.

#### *Focus Group Data*

The audiotapes for each focus group were transcribed verbatim. The videotapes were used to clarify any unclear portions. Thematic analysis (Boyatzis, 1998) was used to code the transcripts. See Figure 1 for a summary of themes. Two coders independently coded 20% of the transcripts using open-coding techniques to identify significant overarching themes. Participants' language was used as much as possible to produce a data-driven coding scheme (Lincoln & Guba, 1985). Both coders identified the same three overarching themes: one identified issues related to the children in the center, a second related to the children's parents, and the third and largest theme referred to the early childhood educators. The coders then reexamined the transcripts to extract subthemes in each of these major groupings, again using open-coding techniques and independently coding 20% of the transcripts. The coders identified identical subthemes for the child and parent themes. The coders differed slightly in the number of subthemes generated for the early childhood educator grouping. Discrepancies were resolved through discussion between the two coders (Boyatzis). Once the coding scheme was established, an additional 20% of the transcripts were coded independently and checked for reliability. The remaining transcripts were coded simultaneously by the two coders.

#### *Issues related to children*

Three subthemes captured the discussion of issues related to children. The first identified by all the centers related to children's experience and access to technology, particularly in the home. For the most part, educators perceived that computer technology was a common part of most children's lives, and as a result, children who had a computer at home were comfortable with the technology and able to use it.

Most have computers at home, majority, Common to kids' lives now.

A lot more kids have computers at home, have interest and knowledge behind them when they come.

Children who have it at home are comfortable with mouse, can shut down etc., compared to those who don't.

Educators, however, also were sensitive to the children with fewer resources at home and acknowledged the potential for a digital divide. They indicated that children who did not have computers at home were eager to use those in the center.

Some homes can't afford clothes, certainly not computers.

Some, who don't have it at home ... the first thing that they do is the computer.

A second subtheme involved the skills of the children. Some of the educators were surprised at the speed at which the children learned to use the

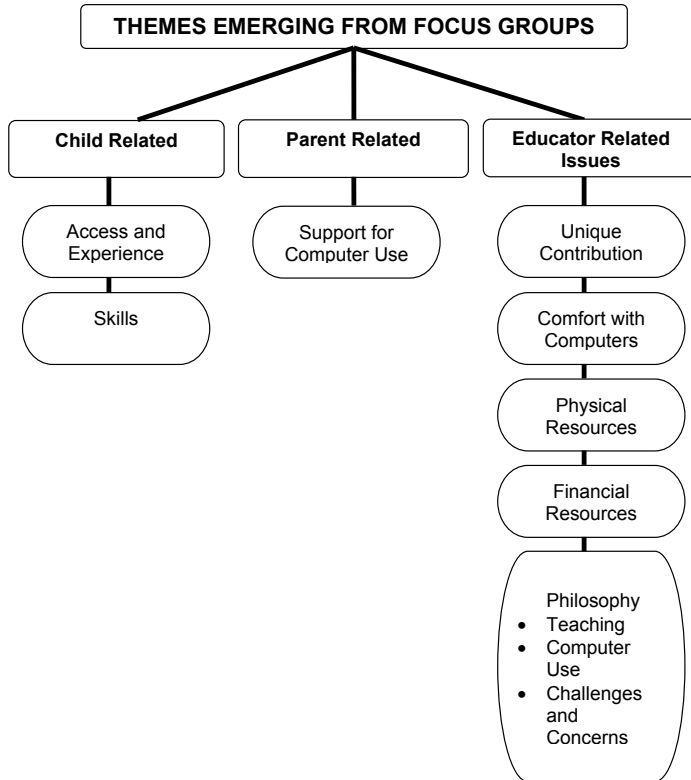


Figure 1. Themes and subthemes emerging from focus groups.

computer and their lack of worry or concern at active experimentation while navigating through the software. Specifically, educators highlighted the ability of the senior children to turn the computer on and off, use the CDs, and play games using the mouse and directional arrows for the most part independently. As was found in the survey responses, however, some educators (at two of the centers) were concerned that the younger children did not have the fine motor control necessary to use computers effectively and generally were more limited in their skills. Overall, skills were perceived as an important issue. There also was a perception among the educators that learning how to use a computer in early childhood would prepare children for subsequent schooling.

Surprised at how quickly kids caught on in a couple of days.

Kids will press buttons and try to fix things.

Child found way back after another child got lost when the teacher couldn't.

Learn beginning skills so that when they are older, they can work more independently.

Children need to start learning computers early; they are part of their world.

The third subtheme concerned the children's desire to use the computer. Some educators had the perception that the computer was a magnet, drawing all children in. Others noted that there was a discrepancy in that some children were drawn to the computer whereas others were not. The appeal of the computers was perceived as having direct consequences for programming.

Specifically, educators identified the challenge that they faced in persuading some children to leave the computer and to make other choices for their activities.

Children love them, become attached, and don't like when they are taken away.  
They don't all flock to it and they don't all ignore it.

*Issues related to parents*

Little discussion focused on issues related to parents. However, one theme that did recur (in all but one of the centers) was the perception that parents strongly endorsed computers as part of their children's program. Parental interest was evidenced through fundraising and donations of hardware and software to promote computer use.

Parents agree that computers are a priority.

Parents support computer use; sign their kids up even if they (children) are not interested.

Concern was raised by one center that some parents questioned the use of computers when other more traditional tools were available:

When child told dad about building on Tonka program, he wondered what happened to sticks, sand, and bricks.

*Issues related to early childhood education educators*

By far the vast proportion of the discussions involved information specific to the early childhood educators and how computers affected their delivery of programs. Five subthemes were identified, one comprising three further subthemes. The themes reflected discussion related to unique contributions from computers, comfort with the computers, physical resources, financial resources, and philosophical issues related to the use of computer technology.

*Unique contribution of computers.* In terms of children's learning, educators view the computer as adding something unique to children's learning opportunities. The educators highlighted the immediate feedback as one important feature. They also identified the attractiveness of the visual and sound properties that are not available with other traditional tools.

Computer is colorful, moves quickly, pulls kid in that don't have attention span to sit at the table and do a puzzle.

The speed; instant visual back and forth.

Interestingly, some educators felt that having computers at their center and using computers as part of their curriculum afforded them an opportunity for improving their professional image and "legitimizing their curriculum."

Computers make teachers feel more professional; improve image as educators.

*Comfort with the technology.* The second theme reflected educators' perceived level of comfort working with computers as part of their interactions with the children. Much of the discussion on comfort was connected with experience with computers, training opportunities, and available maintenance support. Overall, educators felt that they needed more training and more opportunities to practice with the computer programs in order to feel more comfortable with

computers. They also felt the need to acquire this experience without the children present.

Need access in staff room to play around and do planning.

Almost a fear that I'm going to blow it up or something.

Biggest issue is lack of training, how to problem solve if something goes wrong.

In terms of training, they were specific. They wanted training that would allow them to become familiar with software that was specific to children and programming rather than for administration. They also felt the need to have on-site maintenance support for when there were problems.

Some staff are not comfortable at all, but at least one staff in each room is okay with it.

Training was not practical. *Excel* stuff you would not use with kids.

One staff member does a lot of the maintenance. Someone from the head center will come down if they have the time.

Potential conflicts about access to the computers between the educators and the children were mentioned as a comfort issue, especially when availability of equipment was limited.

Don't want the computer to become a babysitter—gets you into battles.

*Physical requirements.* The issue of physical requirements involved discussion related to the physical set-up or location considerations associated with computer technology.

All the centers with computers had more than one chair in front of the computer; in most cases two or three chairs were available to encourage access by more than one child. For the most part, the computer was set up as another activity center, much like the drama center or the crafts center. In addition, the actual placement of computers was dictated by physical constraints such as available plugs and space. Some consideration of noise level also was made regarding the location of the computers.

Two of the centers had one or more computers in a separate room, "to keep more vulnerable system(s) closely supervised" and to eliminate "noise and conflict." One educator suggested that keeping the computer in a separate room indicated that it required more responsibility and that it was not a toy. Having the computers in a separate room brought with it additional considerations. Specifically, rotating children through a separate room presented difficulties with supervision ratios, created frustration for children who had to wait in another room, and made scheduling difficult. Some educators suggested that having computers in a separate room was more appropriate for older school-aged children. Educators indicated that the atmosphere was intended to be "homey" and that the computer set-up was meant to be relaxing and that perhaps "low tables with kids sitting on the floor would be more appropriate."

*Financial resources.* Financial resources were an important concern for most of the centers. Funding for computers, upgrading, and particularly software were the most important issues. Most centers reported that fundraising was necessary to obtain computer hardware and software. An important concern was that fundraising money was targeted to other competing priorities (e.g.,

large-ticket items such as playground equipment, dishwashers, toys, and in one case staff wages were considered as competing with computer acquisition).

It is expensive to update software; need money for playground first.

*Philosophy and computers.* This theme included discussion of the philosophy in the center and the match or mismatches that introducing computers posed. Three subthemes were identified under this general theme.

The first subtheme dealt with the philosophy of teaching. Two centers identified their approaches as High Scope and Piagetian-based. All of the centers spoke about offering children a variety of learning experiences. Their philosophies were child-centered, allowing children to choose their activities based on their interests. However, teachers also ensured that all children experienced varied activities throughout the day.

With older kids it becomes consuming, focus on it even when they are to be doing something else, have to move them away.

The second subtheme involved the philosophy of computer use in the classroom. In general, the educators indicated that the computer served as an alternative center during free play rather than as an instructional tool during teacher-directed activities. The computer was perceived as a learning tool for the children when working independently or with peers. Examples of use ranged from keyboarding skills to math and language skills. In addition, educators acknowledged the computer as a tool to individualize instruction for the children.

Reinforce numbers and letters.

Had computer as a separate center, then evolved to be part of the program, more individualized, geared to skills of the child.

The third subtheme identified challenges and concerns. Especially, educators acknowledged difficulties in trying to schedule computers into the curriculum given the many competing activities that were available.

There isn't time in the schedule to fit computers in; so many other things.

Most centers indicated that they did not find computers appropriate for children under 3, either because of immaturity in using equipment or for concerns about social development. However, they did perceive computers as useful for older children because computers allow children to share information and to share their common interests.

Haven't introduced them to the younger kids yet, equipment was getting abused, things shoved in.

Frustrating for those who don't have the mouse skills.

Social development goes on; chit-chat; cooperation, a lot of dialogue.

Social aspect, playing together on the computer.

### *Discussion*

Overall, there was a high degree of correspondence between the opinions expressed by individuals completing the survey and the group responses contained in the focus group discussions. The issues identified in the surveys and group discussions focused primarily on the effect of technology from the perspective of the educator, with additional comments addressing the perspec-

tives of the children and parents. The focus group discussions permitted a more robust elaboration of issues identified in the survey responses.

With respect to overall impressions regarding the integration of technology, most of the educators in the present study concurred in the opinions of early childhood educators sampled in earlier studies on their support of computers as potentially positive additions to the early childhood education environment (Specht et al., 2002; Tsitouridou & Vryzas, 2003). In particular, computers were perceived as a highly motivating alternative means for providing instructional opportunities that satisfied the general constraints of a child-centered approach. Computers were generally depicted as providing an additional or alternative activity for children or as an independent learning tool. None of the educators identified the computer as a central means of instruction. This characterization of computers as an ancillary rather than a central feature of instruction echoes one of the ongoing debates in the elementary and secondary school literatures. Specifically, current discussion suggests that there are two ways of incorporating computers into the classroom: one way views computers as another add-on activity, and the other involves more extensive integration where the computer is used as a medium for instruction (Conlon & Simpson, 2003; Goos, Galbraith, Renshaw, & Geiger, 2003). This latter form of integration may not be possible given the present limitations in resources in the early childhood environment. For example, educators would not have enough computers to engage groups of children interactively on the computers, because on average only one computer was available in each center. In early childhood education settings it may be that limited computer resources rather than pedagogy are driving the instructional use of computers.

Alternatively, it may be that early childhood educators do not perceive the full integration of computers as appropriate for their young learners. Indeed some educators in the present study voiced concern that computers should be limited to specific programming goals or to contexts and identified potential risks to social development from the integration of technology, especially for the youngest children at their centers. Educators of children in the primary grades have raised similar concerns about the potential loss of valuable hands-on learning opportunities when computers replace traditional educational formats (Mueller, Wood, Willoughby, & Specht, 2003). Clearly the role of computers is an issue that requires further consideration by early childhood educators both from a pedagogical and a practical viewpoint.

Consistent with earlier research, educators were more comfortable with integrating technology for the older preschoolers and school-aged children at their centers (Haugland, 1999). One perceived benefit for older children was that early exposure and experience with computers would prepare children for future school and life demands. Specifically, early exposure to computer technology was perceived as providing the fundamental skills that would prepare them for school and for future use of computers. In addition, having computers available in the centers was perceived as “[evening] out the playing field for those who don’t have computers at home,” and hence as remedying some of the potential effects of the digital divide. This perception is consistent with the Milken Family Foundation’s (1999) report that 80% of households with a family income above \$75,000 had a computer compared with only 20% of families

with a household income of under \$30,000. Early childhood education centers, then, may be in the unique position to offer children fundamental learning opportunities that are not available at home.

For younger children, computers were perceived as physically challenging because of immature motor skills. Existing literature also highlights the motoric, cognitive, and spatial challenges inherent in various input devices for novice users (Scaife & Bond, 1991; Thomas & Milan, 1987). In some cases the physical requirements involved with more demanding devices such as the mouse can be reduced by using devices such as touch screens (Thomas & Milan; Wood et al., 2004). These alternative devices, however, entail additional expenses that may strain or exceed available resources.

Educators also suggested that computers may pose a threat to social development for very young children. Engagement with computers could limit social development in two ways. First, children would have less time to interact with peers, observe peer models, and engage in social problem-solving during these critical early years. Second, there was a concern that young children would be engaged with an inanimate object rather than with their peers. Concern about the potential social effect of computers is an ongoing issue in the literature, both for younger and older learners with both positive and negative outcomes being identified (Attewell, Suazo-Garcia, & Battle, 2003; Healy, 1998). Interestingly, the educators here targeted only social concerns for younger children. Among the older children, computers were perceived as promoting cooperative activity and also providing an outlet for individual quiet time. The social ramifications of computer use warrant further investigation; however, potential negative effects may be alleviated with careful planning such that the social context is maximized when computers are used. For example, the educators in the present study highlighted modifications to the classroom setting that could maximize social interaction when using computers, such as providing several chairs around the computer and providing access for more than one child on the computer at any given time. Modifications such as these encourage peer interaction while using the computer.

With respect to achieving educational goals, computers were seen as offering "variety to the curriculum" as well as being an available resource for information. Specific advantages for children included the motivational appeal of the computer; its speed, color, and dynamic presentation; opportunity for individualized instruction and independent learning; and the ability to do something and see an immediate effect. Together these qualities indicate the richness of computer technology and its unique potential to enhance the instructional environment.

A number of limitations and barriers to the integration of computer technology in the classroom were identified. Concerns included problems with managing children's access to the computers, as well as training and technical/financial issues. Specifically, educators highlighted challenges in moving and supervising children when equipment was restricted to one area, thus making its use impractical. In addition, children argued over their time on the computers, and some children seemed consumed by the computer. Thus there were definite concerns about maintaining a balance or setting limits on com-



puter time. There were also worries about the computer becoming a babysitter like the television. Anticipating management issues related to access, turn-taking, and supervision requirements would be an essential requirement to the successful integration of computer technology.

Consistent with earlier literature, the educators indicated a lack of comfort with the technology and a need for greater training and technical support (Specht et al., 2002; Wood et al., 2002). In particular, educators indicated that they would benefit from an on-site trained support staff member or direct access to support personnel. Maintenance and technical support was of particular concern for computers used with very young children as a result of the wear and tear that children cause to the equipment. For example, educators indicated that young children often destroyed the hardware when interacting with the computers (e.g., mouse buttons breaking and wear on the CD drive). In addition, with young children there were challenges in keeping the equipment clean. Technical challenges (e.g., computer breakdowns, software freezing, etc.) were perceived as frustrating and in some cases prohibitive.

Limited resources, both in the structure of the center (i.e., electrical outlets) and in the number of computers available, yielded additional concerns. Consistent with earlier research (Wood, Willoughby, & Specht, 1998), access to hardware, software, and funding to support ongoing renewal was seen as a distinct disadvantage for integrating computers in the classroom. As is the case with computer technology at any educational level, educators must be supported in order for computers to be integrated effectively. Supporting computer technology in the early childhood education environment may be a particular challenge because these programs are not government-funded, networked, or organized through a central administration unit, hence isolating each center and increasing the pressures on individual early childhood educators. Interestingly, using computers was described by a few participants as important for improving their image and making their job appear more professional, perhaps reflecting society's value of computer technology and those with technological skills.

In summary, educators have the motivation, the interest, and the desire to guide their students in using computer technology, and they perceive support for their interest in the parents of the children they supervise. The caveats, however, are that the computer technology must be age-appropriate to the learner, reflect the skills promoted through early childhood education environments, allow for ease of use without compromising safety and supervision of children, and be accompanied by sufficient training and support for the educator. The correspondence between survey and focus groups and across centers indicated cohesion in these perceptions. Allowing educators to elaborate on their perceptions through the focus groups provided a venue for educators to voice clearly the barriers and supports that they face when integrating computer technology in their centers and provides a foundation for interventions and policy development for these environments.

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