Disseminating and Replicating an Effective Emerging Literacy Technology Curriculum: A Final Report

by

Patricia Hutinger, Carol Bell, Gary Daytner, and Joyce Johanson

Center for Best Practices in Early Childhood
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U.S. Office of Special Education Programs

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Executive Summary

Disseminating and Replicating an Effective Emerging Literacy Technology Curriculum: A Final Report

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The Emerging Literacy Technology (E2) study's technology-based curriculum and procedures combined effective computer applications and emergent literacy experiences and were based on the results of a 3-year research study of 255 children (E1). E2's target population was preschool children with a wide range of disabilities, those at risk, their families, teachers, and program staff. E2 goals included replication and validation of E1 research findings in a range of typical rural and urban educational settings; a study of implementation and maintenance of the model as demonstrated by replication sites; and dissemination.

E2 was based on the assumptions that emergent literacy forms the groundwork for attaining adult literacy; that gaining emergent literacy concepts is as important for children *with* disabilities as it is for children *without* disabilities; that technology provides access to literacy activities that benefit young children whether they have disabilities or not; and that an integrated curriculum approach offers meaningful context for learning. Three components, *Technical Assistance to Teachers, the ELiTeC Curriculum*, and *Assistance to Families*, provide the foundation for the ELiTeC model.

During the reporting period, the model was replicated in 17 classrooms. Eighteen replication teachers served 438 children over the 3 years. Developmental delays or speech and language labels made up the greatest number of disabilities demonstrated by children in the study. A greater number of children were at risk as compared to the number of children with disabilities. Four-year-olds outnumbered 3-year-olds.

Five groups were studied. Three Group 1 sites participated all 3 years. Two Group 2A sites were studied Years 2 and 3. Group 2B sites entered the study in Year 3. Group 3 teachers, who had previous experience with the model, participated all 3 years. Three comparison sites (Group 4) were added in Year 3. Teachers in comparison sites received no training or technical assistance.

Data were gathered to answer research questions related to the effectiveness of implementation, model fidelity, maintenance, training, and follow-up. Data sources included

observation and measures related to children, teachers, the classroom environment, and families. Both quantitative and qualitative data were collected.

Findings point to the effectiveness of the model in the 'real world' classroom context. Findings indicated that Group 3 teachers, who first participated in E1, had maintained the model for periods ranging from 1 to 4 years prior to beginning E2. Results supported the assertion, found throughout the literature, that implementing an innovation requires a great deal of time.

E2 results related to children generally reflected E1 child results, demonstrating technology *did* provide access to literacy activities that benefited young children, whether they had disabilities or were at risk. Across the 3-year period, children in treatment groups made gains in aspects of both literacy and technology use, as shown in both quantitative and qualitative data. In Year 3, across treatment groups, children's literacy gains and technology skills were greater than those of children in the comparison group.

Dissemination activities included 16 conference presentations attended by more than 635 early childhood educators, therapists, professionals, and family members. Presentations focused on promoting literacy through technology. Information was also disseminated through listserv postings and a website.

Products include a video, *Early Learning Standards: Supporting Language Arts with Technology,* and a Toolkit developed as a complete resource for sites implementing the model.

Future activities involve further analyses of E2 data, investigation of interesting questions arising from E2 findings, and continuing Center work on two related literacy and technology projects: LitTECH Outreach and ITLC (Interactive Technology Literacy Curriculum) Online.

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Emerging Literacy Technology Curriculum (ELiTeC 2, [referred to as E2 in this report]), housed at the Center for Best Practices in Early Childhood at Western Illinois University, was funded in 2000 by the U.S. Department of Education's Office of Special Education Programs (OSEP) as a 3-year Phase 3 Steppingstones of Technology Research on Implementation Project. E2's technology-based curriculum and procedures combined effective computer applications and emergent literacy experiences and were based on the results of a 3-year research study (referred to in this report as E1) of 255 children and their families from diverse cultures and socioeconomic groups; 8 teachers, and 16 half-day preschool classes in rural and urban central Illinois (Godt, Hutinger, Schneider, & Robinson, 1999; Hutinger, 1999; Hutinger. et al., 1998). E2's target population was preschool children with a wide range of disabilities, those at risk, their families, teachers, and program staff.

Goals and Objectives

E2 had three major goals: (1) replicate and validate E1 research findings in a range of typical rural and urban educational settings; (2) study implementation and maintenance of the model as demonstrated by replication sites; and (3) disseminate information related to the study. These goals were supported by five objectives and their tasks. Two objectives related to management and dissemination, while three related to such activities as conducting staff development activities, implementation, and follow-up in replication sites; studying the implementation of the E2 approach in multiple, complex settings; and revising, developing, and disseminating E2 products and materials.

Theoretical Framework

E2 was based on the assumptions that emergent literacy forms the groundwork for attaining adult literacy; that gaining emergent literacy concepts is as important for children *with* disabilities as it is for children *without* disabilities; that technology provides access to literacy activities that benefit young children whether they have disabilities or not; and that an integrated curriculum approach offers meaningful context for learning. These assumptions are supported by research and practice and are discussed in the following sections.

Emergent Literacy

An emergent literacy approach stresses that written and oral language develop concurrently and interrelatedly from birth. Both oral and written language are best learned when used in purposeful contexts and when children have opportunities to observe and interact with others who write and read (Casey, 1997; Clay, 1975; Gambrell, 1999; Harste, Woodward, & Burke, 1984; Sulzby, 1990) as opposed to rote learning of letters, words, or sounds out of context. According to Susan Neuman ("Early Learning," 2002, p.4), teachers should maintain "*an environment where children are motivated to learn…Drill and letter practice are boring*."

Literacy concepts emerge early in life. Young children begin to acquire building blocks for learning to read when their environment is language rich and they are given opportunities to hear and use language constantly ("Good Start," 2002). Children learn about print as they experience it in the environment of their daily lives, and they often recognize concepts of print prior to having any formal instruction (Clay, 1991; Neuman & Roskos, 1997; Yaden, Rowe, & MacGillivray, 2000). Among the concepts of print are understanding that letters are different from words and that letters are used to make words, that spoken words can be represented in print form, that there are spaces between words, that print carries meaning, that there is one-to-one correspondence between written and spoken words, and that words are read from left to right and from top to bottom on the page (Adams, 1990; Barclay, 1994; Clay, 1991).

Literacy concepts are also directly related to phonemic awareness (the ability to hear individual sounds in spoken words) and knowledge of alphabetic principles (the relationships between letters and their sounds). Research has shown that phonemic awareness and knowledge of alphabetic principles are important, not as stand alone practices, but when developed as part of authentic uses of reading and writing (Ehri et al., 2001; Peterson, Taylor, & Hansen, 2002; Snow, Burns, & Griffon, 1998; Stahl, 1998).

Barclay (1990) identifies seven stages of children's writing development as Scribbling, Mock Handwriting, Mock Letters, Conventional Letters, Invented Spelling, Approximated (Phonetic) Spellings, and Conventional Spellings. At all stages children need daily opportunities to see words and letters being written (Barclay et al., 1996).

Literacy is more than reciting the alphabet. Preschoolers demonstrate behaviors associated with emerging literacy when they point to pictures in a book or on a computer screen and pretend to ‘read’ the story; when pseudo-letters then recognizable letters and words emerge from their scribbles; or when they recognize the Hardees’ logo and ask for French fries. Unfortunately, when children have disabilities that make their world different from that of their peers without disabilities, literacy is not likely to be a part of their early intervention plan nor are their teachers aware of emergent literacy research (Erickson & Koppenhaver, 1995; Koppenhaver & Erickson, 1998). Initial literacy concepts are seldom addressed in programs for young children with special needs, a situation that highlights the need for widespread access to E2’s content.

Literacy and Children with Disabilities

The everyday experiences of early childhood are crucial to literacy acquisition (Casey, 1997; Mason & Allen, 1986; McGee & Lomax, 1990). Unfortunately, when children have disabilities that make their world different from that of their peers who are not disabled, their educational plan in not likely to include literacy and their teachers are often unaware of emergent literacy research (Erickson & Koppenhaver, 1995). Moreover, these children seldom enjoy a literacy environment at home where stories are read to them (Marvin, 1994).

Since much of what is known about emergent literacy results from research with typically developing children (Cousin, Weekley, & Gerard, 1993), even if teachers of youngsters with disabilities know about emergent literacy practices, they may question using such practices (Patzer & Pettigrew, 1996). Many children with oral language delays and impairments have significant literacy problems before they reach first grade (Scarborough & Dobrich, 1990). Although some suggest that children with mild to moderate disabilities develop literacy in ways similar to those of children without disabilities (Brazee & Haynes, 1989; Cutler & Stone, 1988; Erickson & Koppenhaver, 1995; Goodman, 1982; Katims, 1991; Pierce & Porter, 1996), typically these children do not have the opportunity to do so and are the ones who fall behind in kindergarten and primary grades. As children who are 'behind' in reading move into the upper grades, they stay 'behind' (Clay, 1979; Strickland, 1990).

Literacy and Technology

Incorporating computer applications provides a means for children to access literacy content and, at the same time, meet technology needs addressed by IDEA 97 and its reauthorization so *all* children can keep pace with technological and societal changes. Technology applications, including adaptive devices, switches, computer hardware, alternative input devices, interactive software, and related off-computer activities, give young children with disabilities a set of tools to equalize learning opportunities across developmental domains and curricular content—strategies that lead to access to the regular curriculum and pave the way to literacy.

Benefits of Technology for Children with Disabilities

Research and practical experience suggest that children with disabilities who have experiences with computers and other technologies are more likely to experience success than those without such access. Assistive technology equalizes learning opportunities for children with mild to severe disabilities. Intervening with computers and other technologies, including adaptive peripheral devices or specialized software, produces changes in young children (Derer, Polsgrove & Reith, 1996; Hutinger & Johanson, 2000; Hutinger, Johanson, & Stoneburner, 1996). Evidence clearly points to the effectiveness of computers as access technology for young children with disabilities (Behrmann & Lahm, 1994; Brett, 1997; Clements, Nastasi, & Swaminathan, 1993; Godt, Hutinger, Robinson, & Schneider, 1999; Hutinger, 1996; Hutinger & Clark, 2000; Hutinger & Johanson, 1998; Hutinger & Johanson, 2000; Spiegel-McGill, Zippiroli, & Mistrett, 1989). Computers and adaptive devices assist children with disabilities to participate in the activities of daily life and to do many of the same things other children do—draw pictures, play games, and communicate. Moreover, computers may help children learn in new ways.

Both literature and practice point to the important benefits of integrating technology into the preschool curriculum (Castellani & Jeffs, 2001; Gordon & Brown, 1996; Wright & Shade, 1994). Used appropriately, computers are valuable learning tools for preschool children (Haugland, 2000). Adding technology tool applications to an array of children's educational experiences enhances access, learning, attention, communication, and social skills (Casey, 1997; Hutinger et al., 1998; Pressman, 1999).

Although families and children benefit when access to effective technology applications is equitable, adults must learn to implement activities before wide-sweeping applications can assist children with disabilities. The success of technology integration in curriculum is limited by teachers' level of comfort and knowledge of technology (Merbler, Hadadin, & Ulman, 1999;

Schlosser, McGhie-Richmon, Blackstien-Adler, 2000; Smith & Jones, 1999). Too often early childhood teachers use computers to reward children or to reinforce isolated skills, but not to integrate software throughout the curriculum (Judge, 2001). Not only do staff and families need to learn how to use technology, but they also need to know how to determine what technology most effectively meets children's skills, abilities, and needs. To impact children's learning, teachers must be trained to use technologies and strategies for integrating those technologies into the curriculum (Judge, 2001; Maeers, Browne, & Cooper, 2000; Schlosser, McGhie-Richman, & Blackstien-Adler, 2000; Sianjina, 2000; Vannatta, 2000). Training families and staff in the use of these skills is essential. Teachers cite both lack of time and information about where to obtain training as primary reasons for their failure to use technology to its full extent (Judge, 2001). In fact, teachers reported that curriculum integration training has more impact on the use of software than basic technology skills training; however, more time is spent on basic skills training (Fatemi, 1999).

Educational reforms continue to emphasize computer-based instructional technologies. The Council for Educational Children (2000) and the President's Commission on Excellence in Special Education (2002) warn of a national crisis in special education teaching, arguing that students with disabilities receive less than adequate instruction.

Integrated Curriculum

An integrated curricular approach integrates people, concepts, skills, and oral and written language in meaningful context. Children with special needs can participate in the integrated curriculum of the regular program, even when the services of special education teachers and therapists are needed. Through many and varied experiences relating to a common theme, young children with and without disabilities experience growth in conceptual understandings and process skills (Barclay, Benelli, & Wolf, 1996; Barclay & Walwer, 1992; Manzo, 2001). When teachers target specific knowledge and skills to develop or enhance theme-driven activities, participating children show increased capacities for risk-taking, problem-solving, cooperative learning, sharing, and decision-making (Clements, 2001; Katz & Chard, 2000).

Guidelines for both *special* and *regular* education support the concept of an *integrated curriculum* (DEC, 1993; NAEYC, 1996; Sandall, McLean, & Smith, 2000). An integrated curriculum has also been shown to be an effective teaching method for children with disabilities (Gurganus, Janas, & Schmitt, 1995; Kataoka & Lock, 1995; Patton, 1995).

At least two approaches to curriculum can be identified. One, the *thematic, project, or unit approach,* emerges from children's interests, experiences, and teacher-selected materials. By drawing upon young children's natural curiosity about the world around them, teachers and families can provide learning experiences that allow children to construct meaning, confirm predictions, generate new questions, synthesize ideas, and make connections. Both the Project Approach (Helm & Beneke, 2003; Katz & Chard, 2000) and Reggio Emilia (Gandini, 1993) foster children's sustained involvement in hands-on projects related to the area of interest.

A second, often dominant, approach in special needs classrooms is to *plan activities for each discrete traditional curricular area*, such as language arts, science, math, and art, typically without a unifying theme or considering the children's interests. For example, one day's activities may consist of work with the color 'purple,' the 'oval' shape, a book about friendship, and making thumbprint ladybugs. IEP goals and objectives are translated into discrete activities, rather than connected to authentic and meaningful experiences.

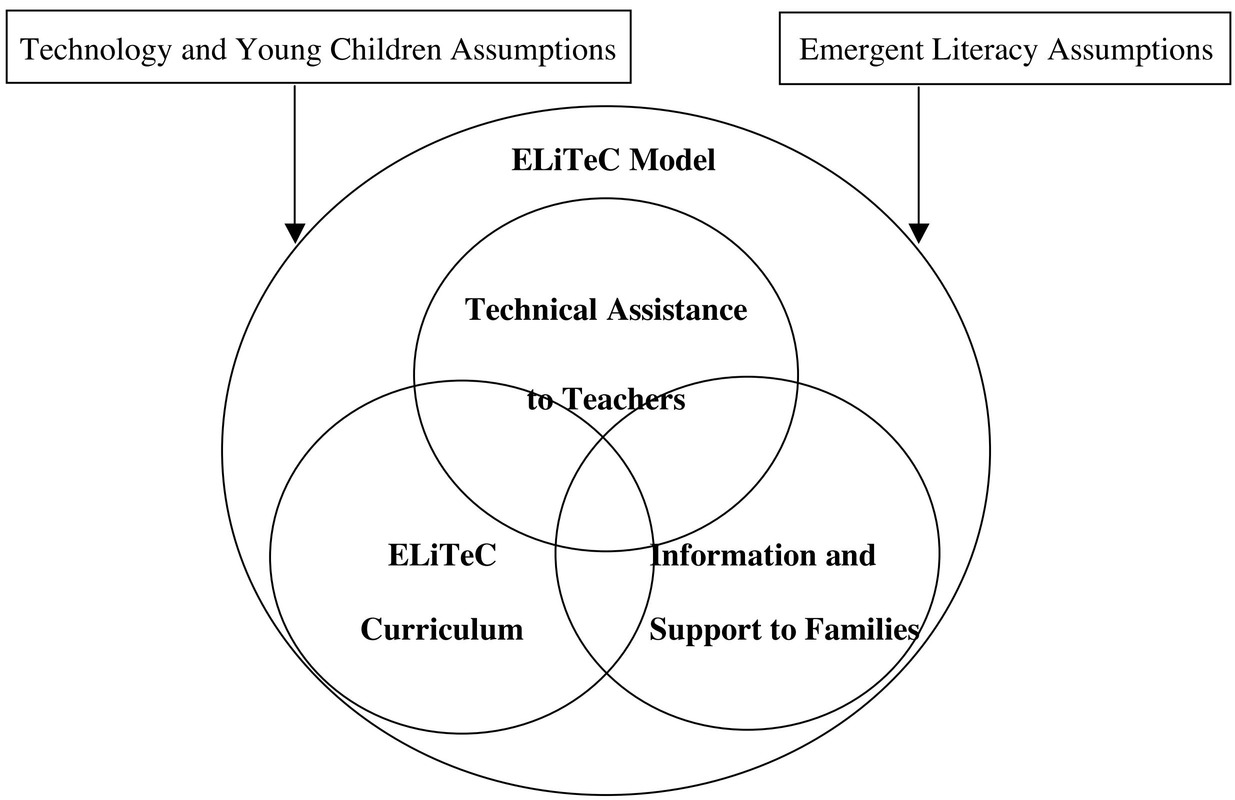
Description of the Model

ELiTeC Model Components

Three components, *Technical Assistance to Teachers, the ELiTeC Curriculum*, and *Assistance to Families*, provide the foundation for the model design, shown in Figure 1. The model was based on the Early Childhood Emergent Literacy Technology Research Project (E1) (Hutinger et al., 1998) procedures and materials, the theoretical formulations discussed in literature, and the Center's ongoing work with young children and technology.

The model's first component, *Technical Assistance to Teachers*, involved training on aspects of emergent literacy, technology applications, and the ELiTeC curriculum—skills necessary to provide children and families with ELiTeC literacy experiences. This component provided teacher consultation and follow-up support through a variety of methods, including phone, E-mail, the E2 web site, and in person.

Figure 1. ELiTeC Model



The second component, *The ELiTeC Curriculum*, integrated computer technology and emergent literacy experiences for children, using activities from *eMERGing Literacy and Technology: Working Together* (Hutinger et al., 2001). This component included emergent literacy theory, assumptions, and practices; information about integrating technology into the preschool curriculum, selecting software, developing related activities, and adapting literacy materials; computer access; and peripheral operation.

Component three, *Information and Support to Families*, focused on the home literacy environment. Awareness and training activities were designed to increase families' knowledge, capacity, and participation to support their children's emergent literacy development.

The Curriculum

The model's curriculum guide, *eMERGing Literacy and Technology: Working Together* (Hutinger et al., 2001), builds upon uses of literacy and language through existing home experiences, family participation, and differing cultures. Activities and adaptations were designed to promote literacy development in the computer center, using literature-based and tool software, and in other curricula areas in the classroom, as well as at home and in environments outside of school. Each curricular activity begins with an explanation of the relationships between the software theme and children's learning. Each activity contains curriculum integration ideas that can be incorporated into art, construction, blocks and manipulatives, cooking and snacks, dramatic play, music and movement, outdoor play, science, and math activities. Literacy links, extension activities beyond the classroom, and related websites, software, books, poems, and stories are also included. For example, activities based on content of *Just Grandma and Me* could include stocking the reading center with intergenerational books, inviting grandparents to class, authoring a memory book about family members, developing a classroom book about grandmothers, furnishing beach items in the dramatic play area, and sorting shells by color, shape, texture, and size in the science and math center. Techniques to customize literacy activities through low-tech adaptations (e.g., page turners for books), high-tech adaptive devices (e.g., switches, touch screens, IntelliKeys), and specialized software are included.

Content includes home and classroom management techniques targeting methods to integrate literacy activities during group time and free choice at school and everyday experiences at home. Critical factors include placement of the technology center, facilitating children's management of the technology center, and supporting groups of computer users to promote communication, turn taking, and social skills (Center for Best Practices, 2001; Godt, Hutinger, Robinson & Schneider, 1999). Suggestions for home use include setting up equipment and adapting the environment to provide access.

Software selected to enhance literacy and classroom curriculum is used to support activities in the reading center, in other areas of the classroom, and at home. Three types of software are used: (1) interactive literature-based software (e.g., *Just Grandma and Me, I Spy Junior, Arthur's Camping Adventure)* to extend literacy concepts and behaviors; (2) graphics and story-making software, such as *Kid Pix Studio 3* and *Crayola Make a Masterpiece*; and (3) authoring programs, such as *IntelliPics Studio* or *HyperStudio*, used by teachers or parents and children to develop their own software based on meaningful experiences (e.g., a class field trip or a child's family experiences and culture). Software is organized according to five levels of interactivity based on the degree of choice and control the child has over input, software paths, and events (Hutinger & Johanson, 1998).

Interactive software provides another medium, another learning experience, and a way to do new things, not just the same thing in another way. Use of interactive story software, often based on excellent children’s literature (e.g., *Stellaluna*), results in high interest and increasing time on task for many children. Such software incorporates colorful graphics, movement (one thing a book cannot do), sound (including voice and music), and the potential for children to control timing and repetition of words, pages, or parts of the story. Children compare the story on screen with the story in the accompanying book, discuss characters and action, and describe favorite parts to a teacher, a family member, or peers. Young children use language to discuss and compare, draw pictures about the story, write words and letters as part of their pictures, and make their own books.

Description of Participants

Classrooms

During the reporting period, ELiTeC was replicated in 17 classrooms that included 438 children served by 18 teachers. Of the 17 classrooms, seven were early childhood special education, seven were pre-kindergarten at risk, and three were inclusive programs. During Year 3, an additional four classrooms were studied as a comparison group. Table 1 on page 14 provides information about the 21 classrooms involved in the 3-year E2 study, including name and location; type of classroom; number of classrooms, teachers, and children; and number of children with disabilities. Descriptions of each site are in the Appendix.

Five groups of simple and multiple-complex sites, both rural and urban, were studied. Three **Group 1** sites, located within 26 miles of Macomb, participated Years 1 through 3. As a result, Group 1 teachers received more training and follow-up services than teachers in the other groups. Two **Group 2A** sites, located within 167 miles Macomb, were studied Years 2 and 3. The **Group 2B** site, 233 miles from Macomb, entered the study in Year 3. **Group 3** consisted of three teachers who participated in E1, two teachers who adopted the model during the demonstration phase, and two who adopted it during the outreach phase. Three comparison sites (**Group 4**) were added in Year 3. Located in both rural and urban areas of Illinois, the comparison sites were from 22 to 233 miles from Macomb. Teachers in each comparison site agreed to receive no training, technical assistance, or materials until the end of the study.

Table 1. Information about the *E2* Group 1, 2A, 2B, 3, and 4 Sites

	Number of Classrooms	Type of Classroom	Number of Teachers	Number of Children Served (by year)				Number of Children With Disabilities (by year)			
				Year 1	Year 2	Year 3	Total	Year 1	Year 2	Year 3	Total
Group 1											
CUSD #180 - Colchester, IL	1	At Risk	1	16	-	-	16	6	-	-	6
CUSD #338 - Carthage, IL	1	At Risk	1	22	20	20	62	-	-	-	0
CUSD #175 - Good Hope, IL	1	ECE	1	8	11	10	29	8	11	10	29
Group 1 Totals, All Years	3		3	46	31	30	107	14	11	10	35
Group 2A											
Rural Champaign County – Rantoul, IL	3	Inclusion	4	-	40	34	74	-	27	13	40
Black Hawk Area Special Education District - Moline, IL	2	ECE/Spec Needs	2	-	12	11	23	-	12	11	23
Group 2A Totals, All Years	5		6	-	52	45	97	-	39	24	63
Group 2B											
SD #109 - Bridgeview, IL	2	At Risk	2	-	-	38	38	-	-	14	14
Group 2B Totals, All Years	2		2	-	-	38	38	-	-	14	14
Group 3											
CUSD #180 - Colchester, IL	1	ECE	1	15	13	12	40	15	13	12	40
CUSD #175 - Good Hope	1	At Risk	1	13	14	14	41	-	-	-	0
CUSD #213 - Cantrall, IL	1	At Risk	1	20	20	19	59	-	-	-	0
CUSD #186 - Springfield, IL	1	ECE	1	10	8	-	18	10	8	-	18
SD #66 - Canton, IL	2	ECE/ At Risk	2	28	35	29	92	10	8	10	28
CUSD #335 - LaHarpe, IL	1	ECE	1	8	-	-	8	6	-	-	6
Group 3 Totals, All Years	7		7	94	90	74	258	41	29	22	92
Treatment Group Totals Years 1 - 3	17		18	140	173	187	500	55	79	70	204
Group 4											
Black Hawk Area Special Education District - Moline, IL	1	ECE/Spec Needs	1	-	-	8	8	-	-	8	8
CUSD #335 - LaHarpe, IL	2	ECE/ At Risk	2	-	-	25	25	-	-	5	5
SD #109 - Bridgeview, IL	1	ECE/ At Risk	1	-	-	13	13	-	-	-	0
Group 4 Totals, All Years	4		4			46	46			13	13
TOTAL All Groups Years 1-3	**21**		**22**	**140**	**173**	**233**	***546**	**55**	**79**	**83**	**217**

*** Of the 546 children listed by year, 62 were repeat children. Fifty-nine treatment group children attended for 2 years and three attended for 3 years. Therefore, a total of 484 different children participated from October 2000 to September 2003; 438 of those were treatment group children.**

Teachers divided the school day into a variety of activities. A typical schedule for the E2 sites involved children spending time in large groups, small groups, center time, and gross motor activities. Additional time was used for music, snack, lunch, nap, bathroom, and transition activities. Table 2 compares the amounts of time (in minutes each day) in their first year and final year with E2 that teachers reported children being involved in center activities.

Table 2. Comparison of Time Spent in ELiTeC 2 Classrooms on Center and Technology Activities in First Year with Study and Final Year with Study

Site	Year 1 or Year 2	Year 3	Difference
Group 1 (Years 1 – 3)			
Carthage	60	**	
Colchester	45	45	0
Good Hope 1	90	80	-10
Group 2A (Years 2 and 3)			
Sidney	40	55	+15
Rantoul 1	45	45	0
Rantoul 2	70	45	-25
Moline 1	45	45	0
Moline 2	60	60	0
Group 2B (Year 3 only			
Bridgeview1	**	50	
Bridgeview2	**	60	
Group 3 (Years 1 – 3)			
Canton 1	50	60	+10
Canton 2	50	55	+5
Cantrall	45	60	+15
Good Hope 2	60	90	+30
Colchester	90	120	+30
Springfield	50	60	+10
LaHarpe 1	*	*	
Group 4 (Year 3 only)			
Bridgeview 3	**	55	
Moline 3	**	45-75	
LaHarpe 2	**	60	
LaHarpe 3	**	60	

* teacher did not provide information
**site did not participate during this reporting period

Technology was available in all classrooms during center time. The technology literacy activities took place during these times. Forty-three percent (*n*=6) of the 14 teachers spent at least an hour each day for center and technology literacy activities at the beginning of their involvement with E2, while 58% (*n*=11) of the 19 teachers who reported in Year 3 indicated an hour or more each day spent on center and technology literacy activities. Of the 13 teachers who reported both at the beginning and end, 85% (*n*=11) either increased their center and technology time or remained the same.

ELiTeC Training and Follow-up Activities

Module Content

Five modules comprised the formal ELiTeC training. Module titles and brief descriptions of content follow.

(1) *Using the Computer for Everyday Activities* (Note: This module was not used during ELiTeC training because all participating teachers were computer users and did not need the computer basics module.)

(2) *Building A Firm Foundation for Emergent Literacy*—Topics included the philosophy of emergent literacy, practices supporting emergent literacy, practices supporting oral language development, practices supporting early writing development, assessing early writing development, practices supporting emergent reading development, creating a literacy-rich environment, and assessing emergent literacy behaviors.

(3) *The Computer Environment*—Issues related to classroom technology included designing the computer environment with emergent literacy in mind, managing technology to promote literacy development, and facilitating emergent literacy behaviors using Edmark's *KidDesk*.

(4) *Using Children's Software to Promote Emergent Literacy Behaviors*—Discussions and demonstrations for this module focused on selecting software to support emergent literacy, levels of interactivity, evaluating software, integrating technology into the curriculum, and creating computer-generated materials to support emerging literacy.

(5) *Using* HyperStudio *to Enrich the Emergent Literacy Curriculum*—Content of the *HyperStudio* module included an overview of *HyperStudio*, demonstrations of *HyperStudio*

stacks made by other teachers, information on how to develop and evaluate a *HyperStudio* stack, and hands-on opportunities to create a *HyperStudio* stack.

Training

Teachers and, if applicable, paraprofessionals working in the site classrooms, received training prior to model implementation. Site and participant needs assessments were distributed before training, and training content was based on participant needs. Staff development activities took place at each site and were scheduled according to site staff availability.

Group 1. Teachers in Group 1 received training at different times to fit their schedule. The Good Hope 1 teacher received Modules 2-4 in January 2001, with follow-up in the classroom, and Module 5 training in October 2001. The Colchester teacher received Module 2-4 in 1-hour increments February 12-16, 2001, with follow-up in the classroom. The Carthage teacher received training on Module 2 on December 13, 2000, and Module 3 on January 5, 2001, with follow-up in the classroom. She received Module 5 training in October 2001 and January 2002. E2 trainers provided follow-up to each teacher in her classroom upon request through the end of the study.

Group 2A. Modules 2-5 were offered in Rantoul on September 12, 2001; September 28, 2001; October 5, 2001; January 16, 2002, February 13, 2002. Modules 2-5 were offered on September 17, 2001; November 9, 2001; January 18, 2002; January 25, 2002; March 8, 2002; and September 15, 2003. Follow-up was provided in each classroom as requested.

Group 2B. Modules 2-5 were offered in Bridgeview on August19-22, 2002, and December 13, 2002. Follow-up was provided via E-mail and the toll-free phone line.

Group 3. Group 3 teachers received training prior to this study through previous Center literacy projects. In Year 1, they received no additional training or technical assistance. However, Group 3 teachers received follow-up assistance during the summer after the first year. At the beginning of Year 2, E2 trainers followed up with Group 3 teachers on model implementation, making recommendations and discussing areas that E2 trainers perceived as weak or missing. During Years 2 and 3, E2 trainers provided follow-up and feedback during observations in the classroom. Follow-up was also provided through E-mail and the toll-free phone line.

Follow-up. In collaboration with the Center's other federally funded projects, E2 offered Project Summer Camp each June. The 2-day camp offered workshops tailored to teachers' needs as they related to the model, and teachers chose from a variety of topics, including adaptive peripherals, environment, software review, *iMovies*, and *HyperStudio*. Teachers from each treatment group attended summer camp. Attendance at summer camp had a later impact on model implementation. In addition to Project Summer Camp, teachers were offered the option of individual workshops during the summer months. Only two teachers, one from Group 1 and one from Group 3, took advantage of the additional training.

During the 3-years, E2 staff made 455 follow-up contacts with site teachers. These included 181 by E-mail, 94 by mail, 87 by phone, 90 face-to-face, and 3 by fax. Technical assistance ranged from answering simple requests about saving files and importing them into *HyperStudio* to more complex questions about dealing with system compatibility issues.

Method

Participants and Data Collection

Sites, classrooms, teachers, and children who participated in ELiTeC are described on pages 13 to 15, pages 33 to 34, and in the Appendix. This report contains three sets of participant (P) numbers. Because all children in treatment classrooms participated in technology activities, the number of children in the first set (P1, N=438) includes all who participated from the time their teachers were first trained until the end of the study. The second set (P2, N=424) is comprised of children in all Groups for whom we had consent forms and on whom we collected qualitative (QUAL) data over the 3 years. The third set of numbers (P3, *N*=361), a subset of P2, represents the children on whom quantitative (QUAN) data (*Individual Literacy Assessment* and *Behavior Interaction Tool*) were collected over the 3 years but does not necessarily reflect the number of children for whom there are complete data sets for each measure.

E2 staff planned to collect QUAN data on all children in classrooms having fewer than 10 children (self-contained) and on 10 children from classrooms having more than 10 children (inclusive). Teachers sent permission forms to parents or guardians of all children in their classrooms. In the self-contained classrooms, all children who had a signed permission form were selected for data collection. In classrooms with more than 10 children, teachers were asked to choose 10 children from among those whose parents or guardians signed and returned permission forms. Ideally, they would choose five children with disabilities and five children at risk. However, that was not always possible. If teachers did not have at least five children with disabilities returning signed permission forms, teachers chose as many children with disabilities as they had permission forms for and selected more children at risk until they had 10 children for data collection.

Data Sources

Data were gathered to answer research questions related to the effectiveness of implementation, model fidelity, maintenance, training, and follow-up. Data sources included observation and measures related to children, teachers, the classroom environment, and families. Figure 2 on page 20 shows the measures used and their data targets. Measures are discussed in the sections following Figure 2.

Figure 2. Measures and Data Targets

Measures	Child	Teacher	Family	Classroom Environment	Training
Behavior Interaction Tool (BIT)	•				
Informal Literacy Assessment (ILA)	•				
"What I Like Best About the Computer"	•		•		
Teaching Learning Styles Checklist		•			
Participant Profile and Needs Assessment		•		•	
Action Plans		•			
Participant Evaluation		•		•	
Model Fidelity Profile		•	•	•	•
Participant Feedback		•			•
Teacher Interviews	•	•			
Site Descriptions				•	
Field Notes	•	•		•	
Memos	•	•			
Training Evaluation					•
Family Survey			•		
Family Satisfaction Survey			•		
Family Interviews			•		

Child Data Sources

Both QUAN and QUAL data were gathered to measure child progress. QUAN measures included the *Behavior Interaction Tool, (BIT)* and the *Informal Literacy Assessment (ILA).* QUAL measures included E2 researchers' observations, field notes, and memos; comments made during teacher interviews about child progress; and the "*What I Like Best…*" form.

Behavior Interaction Tool (BIT). The *BIT*, developed by Hutinger, Harshbarger, and Struck in 1983, was used to collect data on children as they engage in computer activities. The Universal BIT, a 1998 revision of the original, contains subtests, determined by factor analysis, that include (1) Child attends to computer and demonstrates technical proficiency; (2) Child makes independent computer-related choices and expresses enthusiasm in several ways; (3) Child collaborates with peers at the computer; (4) Child interacts with adult at the computer; (5) Child demonstrates unfriendly behavior toward an adult in the computer area; and (6) Child monopolizes the computer.

Informal Literacy Assessment (ILA). The 29-item *ILA* was developed and first used in the *E1* study (Hutinger, et al., 1998) when we needed to measure emergent literacy behaviors in young children with disabilities. At that time, available early literacy measures were intended for children of kindergarten age, rather than 3- and 4-year-olds with disabilities. Since its development, the *ILA* has been used to assess 1,056 children. During E2, *ILA* administration was carried out in the classroom during center time so children's literacy behaviors could be observed within the context of the daily environment.

The seven *ILA* factors are (1) Child demonstrates understanding of story; (2) Child orients book appropriately for reading; (3) Child demonstrates literacy behaviors in response to pictures; (4) Child demonstrates literacy behaviors in response to print; (5) Child demonstrates early writing behaviors; (6) Child attempts to communicate using letters; and (7) Child uses inventive and conventional spellings. *ILA* content was derived from emergent literacy literature and preschool literacy measures by Dyson (1982), Katims (1991), Strickland (1990), Sulzby (1986, 1988), Teale and Sulzby (1986), and Toomey (1991), thereby ensuring content validity. Its internal consistency, based on average inter-item correlations, demonstrates it to be reliable and dependable with an alpha of (.8677). Nunnally and Bernstein (1994), as well as Shadish and colleagues (2002), indicate a coefficient alpha of at least .6 is acceptable for a measure in a new field. The *ILA* exceeds the .6 requirement.

"***What I Liked Best…***" Using a paper headed, "What I Liked Best about the Computer…," children drew pictures, wrote, or dictated to an adult what they liked best about the computer.

Teacher interviews. Part of the annual teacher interview consisted of questions about the impact and benefits of the ELiTeC model on children. Some teachers responded in general terms, while others targeted specific children and their responses to technology literacy activities.

Field notes and memos. E2 data collectors took field notes and wrote memos during classroom observations. The majority of field notes focused on literacy behaviors while children were at the computer. Notes regarding literacy behaviors outside of the technology center were taken as time allowed.

Field notes contained the date of observation, classroom, teacher, number of children present that day, and intervals of time as observations were recorded. Interpretations were placed in parenthesis and in a memo section at the end of the field note. Field notes were coded based on a coding schema (see Appendix) set up in *FileMaker Pro*, a dimensional database that was used to categorize and link E2 data. E2 researchers reviewed data in each code, identified coded behaviors that occurred repeatedly across classrooms and across children at different times, discussed their findings, and arrived at a group consensus regarding trends and patterns.

Teacher Data Sources

Data collected from and about teachers ranged from ELiTeC model implementation and fidelity to teaching styles and classroom environment. A variety of measures listed in Figure 2 and explained below were used to collect teacher data.

Teacher Learning Styles Checklist. The *Teacher Learning Styles Checklist* was used each year to record behaviors of teachers in the study. The checklist was adapted for E2 purposes from Missouri's *Standards and Procedures for Voluntary Accreditation of Early Childhood Education Programs*. The checklist contained 86 statements with *yes, no*, and *not observed* responses, along with space for remarks and examples. The instrument is designed to evaluate the teacher's and program staff member's interactions with children, developmentally appropriate curriculum practices, the physical elements of the classroom, and family involvement. Sample statements on the checklist include:

- Learning objectives or expectations are modified to accommodate children's individual abilities, learning styles and needs;

- Daily plans include individual experiences; all children are helped to acquire and use language to communicate information, thoughts and feelings, and to talk and listen with understanding.
- Books are available to children for use during free choice during each day;
- Staff relate to children in positive ways by evidencing pleasure and enjoyment in working with children;
- Staff refrain from corporal punishment or other humiliating or frightening discipline techniques;
- Family members have opportunities to be involved in the ongoing program with their children in some of the following ways (celebrations, field trips, sharing expertise, skills, interests, and family customs, sharing a meal or snack, assisting in the classroom, special projects).

Scores recorded on the checklist were triangulated with classroom observations, field notes, reports during staff meetings, and results from other measures.

Participant Profile and Needs Assessment. Teachers completed the *Profile and Needs Assessment*, a 16-item questionnaire, prior to E2 training. Components of the assessment included: facilitating children's computer use; recommending software; using problem-solving strategies; using peripheral devices; communicating with families; and supporting literacy behaviors. Some questions on the pre-assessment were taken out after the first year when *KidDesk* was eliminated from training because of its limited commercial availability.

Action Plans. Teacher's Action Plans consisted of specific model implementation strategies mapped out by each participant at the end of training on each module. Teachers made written plans to integrate the module content into their existing curriculum and gave a timeline for completion. Progress toward meeting Action Plans was noted in memos and field notes during classroom observations. Teachers submitted reports following completion of their Action Plans.

Participant Evaluation. The *Participant Evaluation* is a post-assessment to the *Participant Profile and Needs Assessment*. Ten questions were the same on the pre and post assessments. However, the post assessment included seven additional questions regarding changes in the environment, comments about the integration of the model, and literacy behaviors observed as teachers used the ELiTeC Curriculum.

Teacher interviews. During the annual teacher interviews, teachers were asked to provide input regarding the implementation and effects of the ELiTeC model in their classrooms. Responses addressed their training, concerns or success with model implementation, changes they made or wanted to make in their classrooms, and benefits of using technology to impact literacy behaviors.

Model Fidelity Profile. The *Model Fidelity Profile* was used to assess how closely the classroom teacher conformed to the ELiTeC model. The checklist was divided into four sub-sections that requested information on the set-up of the classroom (Facilities), family participation (Family Involvement), the specific materials and equipment used in the classroom (Materials and Equipment), and how the ELiTeC Curriculum was implemented in the classroom (ELiTeC Curriculum Implementation). The *Profile* was administered each spring, at the end of the school year.

Participant Feedback. One section of the *Participant Feedback* assessed the teacher's comfort level with technology. Statements ranged from, "I sat down in front of a computer for the first time yesterday" to "I have all of the answers." A second part of the assessment focused on participants' use of technical assistance provided by E2 personnel via E-mail, phone, and mail, and on participants' interactions with other E2 participants.

Field notes, memos, and site descriptions. E2 researchers took notes and wrote memos during classroom observations. Notes focused on classroom environment, teaching styles, model implementation, software and other technologies in use, numbers of teachers and support staff present, and other items of interest to the study.

Family Data Sources

Family Survey. The *Family Survey*, designed to evaluate the home literacy environment and literacy activities of both parents and children, was distributed to families at the beginning of each school year. Each survey contained an introductory paragraph explaining the relationship of the survey to the purposes of the study and asking each family to assist by providing information about their child's literacy behaviors. Adapted from work by Meyer (1990) and Toomey (1992), the survey was used during E1 and revised prior to E2's beginning to reflect work from the *Reading Checkup Guide* by Reading is Fundamental, Inc. (1996). Sample items include:

- How often does a family member read aloud to your child?
- Does your child retell a story by looking at the pictures?
- Does your child ask questions about the story by memorizing the words?
- Can your child predict what will happen next in a story?

Additional information collected in the survey included demographic information related to education and employment.

Family Satisfaction Survey. The *Family Satisfaction Survey* was used as a post to the *Family Survey*. It included the same questions as the pre-survey without the demographic information on education and employment. The post survey included three additional questions relating to satisfaction and involvement in the model.

Family interviews. Interviews were conducted with two families from each classroom each year. Families were selected based on input from teachers, who provided names of families who would not mind participating in a telephone interview. An E2 staff member then mailed an interview request to each family. A postage-paid envelope and card on which the family member could mark a date and time convenient for the interview and a phone number were included. Families were provided a toll-free number for calling the interviewer at a mutually-agreed upon time in the event that the family did not wish to give E2 researchers its phone number. Interview times varied; some were done in the late evening to accommodate family schedules. The study's evaluator and other E2 researchers conducted the interviews. Each family was asked the same questions. At their discretion, researchers could ask additional questions to elicit greater detail from a response.

Data Collection

E2 researchers collected both QUAL and QUAN data from children, teachers, and families. Data collection followed the schedule shown in Figure 3 on the next page.

Children

BIT* and *ILA. Prior to data collection in Years 1 – 3, for Groups 1, 2A, 2B, and 3, E2 researchers visited the classroom for 3 days to observe the classroom culture and learn students' names. At the end of the observation period, an E2 researcher assessed children using the *BIT* and the *ILA* over a period of 3-5 days. The same person post-tested children in the classroom at the end of the program. E2 researchers continued to visit each participating classroom for data collection at scheduled intervals, as often as allowed by the E2 budget. Observations were scheduled on a rotating basis, allowing for differences in observations and bias to be addressed during meetings when full reports of observations by E2 researchers were discussed. In Year 1, E2 pre and post tested children in the Group 3 classroom. In Years 2 and 3, the Group 3 teachers tested their own children. Group 3 teachers were given an individual consultation and follow-up technical assistance on using the instruments and a videotape demonstrating scoring and examples. G3 teachers were experienced in objective classroom assessment. All participate in Illinois Work Sampling, know their children's behavior well, and are trained to provide unbiased assessment.

Figure 3. Instruments and Data Collection Schedule

Research Instrument	Schedule
Behavior Interaction Tool (BIT)	Pre and Post – Years 1, 2, and 3
Informal Literacy Assessment (ILA)	Pre and Post – Years 1, 2, and 3
"What I Liked Best…"	End of Years 1, 2, and 3
Teacher Learning Styles Checklist	End of Years 1, 2, and 3
Participant Profile and Needs Assessment	Beginning of Participation in Study
Teacher Action Plans	Determined by the individual
Participant Evaluation	End of Participation in Study
Model Fidelity Profile	End of Years 1, 2, and 3
Participant Feedback	End of Participation in Study
Teacher Interviews	End of year
Family Survey	End of Years 1, 2, and 3
Family Satisfaction Survey	End of Years 1, 2, and 3
Family Interviews	Middle of year
Field Notes	Each observation, Years 1, 2, and 3

Field notes. In Year 1, Group 1 classrooms were visited three times a month, November through May. In Year 1, Group 3 was visited twice a month, November through May, to collect baseline data and to determine how well the model was being maintained.

Visits the second year (and third year for Group 1) of participation decreased so E2 researchers could accommodate the increasing numbers of classrooms in the study and resulting data collection activities, yet still remain within the travel budget. In Year 2, Group 1 was visited twice a month October through March. Group 2A was visited three times a month from October through March, and Group 3 was visited once a month.

In Year 3, Group 1 was visited once a month, October through May. Group 2A was visited twice a month October through March. Group 2B was visited once during the year with video taken twice a month and submitted to the research staff. Group 3 was visited every other month November through May. Group 4 was visited once a month from November through April.

At each visit, E2 researchers took field notes in each classroom and later entered segments of the field notes into a database created in *FileMaker Pro 4*. Videotape from Group 2B was transcribed, coded, and entered into the database. Data were entered by the following fields: entry date, date of observation, teacher, location of school, group, code, source of data, and data reference. Field notes were coded using the E1 coding system which was divided into behaviors occurring in five categories: (1) Literature-based Software; (2) *HyperStudio*; (3) Graphics and Story-making Software; (4) Outside of ELiTeC observable behaviors; and (5) Teachers, staff, and families. Across the five categories, there are 172 codes. A total of 17,779 behaviors were documented and coded from field note content. Table 3 reflects the number of coded behaviors according to each category over the 3 years.

Table 3. Number of Coded Behaviors across Five Categories over a 3-Year Period

Categories	Group 1	Group 2A	Group 2B	Group 3	Group 4	Total
Literature-based Software	2,481	1,784	446	5,584	352	9,849
Multimedia and Authoring Software	1	52	0	28	0	81
Graphic and Story-making Software	363	40	2	1,258	2	1,661
Outside of ELiTeC Observable Behaviors	1,016	721	140	1,333	260	3,070
Teachers, Staff, and Families	635	760	62	1,743	21	3,138
Total	**4,496**	**3,357**	**650**	**9,946**	**633**	**17,799**

"***What I Liked Best…***" The "*What I Liked Best about Computers*" form was distributed at the end of each school year. Initially, teachers were asked to send the form home with the family survey. However, due to the often-disappointing return rate and necessity to repeatedly ask families to return the form, most teachers preferred to have children complete the form in the classroom.

Teachers

Teacher Learning Styles Checklist. E2 researchers gathered data for the *Teacher Learning Styles Checklist* during observations throughout the year. At the end of the school year, all E2 researchers gathered to complete a checklist for each teacher. Following an item-by-item discussion based on observations made during the year, one person recorded the group's response for a particular item. If any person disagreed, she was required to present examples supporting her position. An agreement of 100% was needed to finalize and record a response for each item.

Participant Profile and Needs Assessment. The *Participant Profile and Needs Assessment* was administered to teachers prior to the first training module. The information gathered from the *Needs Assessment* was used to tailor training to meet site needs.

Participant Evaluation* and *Participant Feedback. The *Participant Evaluation* and *Participant Feedback* were sent to teachers at the end of the school year as part of a packet of evaluation materials. Teachers were asked to complete and return the forms by a specified date. If forms were not returned, researchers followed up with phone calls and E-mail.

Teacher Action Plans. Since the ELiTeC model is based on a constructivist approach, as teachers completed each training module, they were asked to write Action Plans for integrating what they had learned into their classroom curricula. Participants wrote descriptions of their plans following each training module and carried them out during the school year. When E2 researchers visited classrooms, they made note of the teachers' progress toward their Action Plan goals and provided any necessary technical assistance.

Teacher interviews. Teachers were interviewed annually, toward the end of each school year. The interviews took place by phone or in person, depending on the teacher's preference. E2 researchers conducted the interviews.

Model Fidelity Profile. The *Model Fidelity Profile* was completed based on notes taken during classroom observations. E2 researchers then completed the *Model Fidelity Profile* for each teacher at the end of each school year. As a group, researchers discussed each item, and one member recorded the group's response. An agreement of 100% was needed before a response was recorded for an item. Results were used to divide participants into "High" or "Low" in demonstrating model fidelity in their classrooms.

Family

Family Survey. Families received the *Family Survey* at the beginning of each year. Families were asked to return the completed surveys to the teacher within a 2-week period. The teacher gathered the surveys and mailed or gave them to E2 researchers during an observation visit.

Family Satisfaction Survey. Families received the *Family Satisfaction Survey* at the end of the school year and returned them to the teachers who then submitted the surveys to E2 staff. When families returned a survey, they received a children's storybook provided by ELiTeC and distributed by the teachers. A nameplate on the inside cover of each book thanked the family for its participation and included the child’s name.

Family interviews. Selected families were interviewed in the middle of each school year. If an interview was taped, families were told prior to the interview and given the opportunity to decline. Families were also advised that their answers were being recorded as they responded.

Data Analysis

Quantitative Data

All quantitative child data were entered into *SPSS* for the purpose of data analysis. Demographics such as age (younger or older than 4 years on September 1 of the start of the school year), gender, disability status (disabled vs. at risk), type of disability, the specific year(s) of participation, and group (1, 2A, 2B, 3, or 4) were entered. *BIT* and *ILA* data were also entered. Pre scores and differences scores for each of the six *BIT* and seven *ILA* factors were calculated. Family surveys as well as teacher *Model Fidelity Profiles* were also entered into *SPSS*. *Model Fidelity Profiles* were used to identify two groups of teachers, High fidelity and Low fidelity to the model, with criteria based on extent and quality of model implementation.

Qualitative Data

Child, teacher, and family data were coded and entered into the E2 database, which was used to organize, analyze, and compare coded data across groups. Child data included field notes from observations and transcription of videotape. The "What I Liked Best about Computers" form was subjected to a content analysis categorizing drawing stages according to scribbles or recognizable drawings, stages of writing as described on page 5, and messages from drawing and writing. Teacher data included observations and reports by site staff, responses from teacher interviews, and portions of the *Participant Evaluation.* Family data included observations and reports shared by families.

Qualitative data were coded by categories established in the original literacy research (E1) study (Hutinger, et al., 1998) and entered into the database. The database was sorted by categories listed in the Appendix. If a category showed 14 or more entries, it was analyzed for patterns of behavior. The coding system used to identify behaviors, developed in the original study, included observable child behaviors related to emergent literacy, communication, social interaction, and related developmental behaviors. Examples include ‘identifying environmental print,’ ‘labeling items,’ ‘dictating stories,’ ‘recognizing letters,’ ‘articulating key concepts of story,’ and ‘predicting story sequence of outcome.’ Categories were organized and coded according to the types of software being used, as explained on pages 28.

Using procedures delineated in the literature (Guba & Lincoln, 1991; Patton, 2002;

Tashakkori & Teddlie 2003), categories were examined to find common themes across classrooms in each group and across groups. After analyzing the categories, data were examined for patterns. Four E2 staff members (two of whom worked on the original literacy study) reviewed data contained in each code and determined trends. Staff identified coded behaviors that occurred repeatedly across classrooms and across groups, discussed their findings, and came to a consensus. Procedures in the present report were similar to procedures from the Center's literacy research study that preceded this study.

Results and Discussion

The study took place in multiple rural and urban Illinois sites across a 3-year period and was subject to a number of problems faced by real world research, whether experimental, naturalistic, or a combination of methods. Problems included administrative decisions on teachers' tenure or dismissal, retirement, a teacher's decision to discontinue participation, holidays, snow days and related bad weather, days when school schedules were disrupted, ill children, and families agreeing or not to their children's participation. In addition, budget restrictions for both schools and E2 had an effect on the progress of the study in various ways, including availability of software, hardware, and personnel. Across teachers and groups, E2's staff dealt with varying personal issues ranging from children's crises, professional demands, and deaths in immediate families.

Characteristics of Groups and Teachers

Teachers. Treatment (G1, G2A, G2B, G3) and comparison groups (G4) varied according to the number of years they participated as well as in degrees of treatment received. Research staff reduced the time spent in each group yearly over the 3-year period. An explanation is contained on page 27. Group 1 participated 3 years; however, one teacher dropped out after the first year, another was Low on model fidelity (discussed below), and the third teacher admitted that she was just beginning to 'get it' in Year 3. Group 2A participated 2 years, while Group 2B participated the third year and was the only group where videotaped observations were used. Group 3 teachers were those who participated in the Center's previous literacy and technology projects (E1, model demonstration, or outreach) and continued to use the model. Their experience using the model, described on pages 17-18, ranged from 1 year to 4 years.

Children with disabilities and children at risk. Over the study's 3-year period across groups the number of children with disabilities within each of the classes tended to decline while the number of children at risk within classes increased, as shown in Table 4.

Table 4. Declining Number of Children with Disabilities in Each Group by Year

Year 1			Year 2			Year 3		
Total	At Risk	Disability	Total	At Risk	Disability	Total	At Risk	Disability
G1 46	32 (70%)	14 (30%)	G1 31	20 (65%)	11 (35%)	G1 30	20 (67%)	10 (33%)
			G2A 52	13 (25%)	39 (75%)	G2A 45	21 (47%)	24 (53%)
						G2B 38	24 (63%)	14 (37%)
G3 94	53 (56%)	41 (44%)	G3 90	61 (68%)	29 (32%)	G3 74	52 (70%)	22 (30%)
						G4 120	107 (89%)	13 (11%)

During Year 1, G1 classes included 14 children with disabilities and 32 children at risk, while G3 had 41 children with disabilities and 53 children at risk. In Year 2, the number of children with disabilities in G1 fell to 11 while 20 were at risk. In Year 2, G2A had 39 children with disabilities and 13 at risk, while the number of children with disabilities in G3 fell from 41 to 29, and the number at risk increased from 53 to 61. In Year 3, G1 had 10 children with disabilities and 20 at risk; G2A had 24 with disabilities and 21 at risk; G2B had 14 with disabilities and 24 at risk; G3 had 22 with disabilities and 52 at risk; and G4 had 13 with disabilities and 107 at risk.

Disabilities varied. Parental or guardian consent was given for 424 of the 484 children who participated during the 3 years. Of those, disability data are available on 419 children. Across groups and years, the bulk of identified categories for the 419 children were developmental delays (*n*=62) and speech and language (*n*=48). From one to nine children were in each of the 11 other category labels, including but not limited to, autism, cerebral palsy, Down syndrome, learning disabilities, and social emotional conditions. Sixty-six percent of the children (*n*=275) were at risk.

Ages of children. Analysis of ages of 350 children indicated that across groups the greatest number, 249 (71%), of children were age 4. One hundred and one (29%) were 3. A decrease in the number of 3 year olds with an accompanying increase in 4 year olds was evidenced in Year 2 and continued into Year 3, although the number of classes increased. One would expect that if Child Find programs were operating effectively, numbers of 3 year olds and numbers of children with disabilities would not decrease during E2's 3-years.

In Years 1 and 2, G1 had the largest number of 3's, but dropped substantially in Year 3. September 1st of the school year was used as a cutoff date, so a child was coded as 3 if he or she was not yet 4 on this date. Everyone else was coded as a 4.

Model Fidelity Profile

Comparisons of model fidelity and implementation in Years 1 and 2 across groups 1, 2A, and 3, according to the *Model Fidelity Profile*, were accomplished by breaking the classroom teachers into High and Low implementation categories based on the extent to which the ELiTeC Curriculum was implemented. Teachers scoring .9 or greater were placed into the High implementation group and teachers scoring below .9 were placed into the Low implementation group. Comparisons were made of High and Low teachers across the *BIT* and *ILA* factors defined on pages 39 and 43. No significant differences were found in Year 1 between six Low teachers and four High teachers. Three of the four Highs were in G3. In Year 2, with nine Low teachers and three High teachers (all three in G3), the High group outscored the Low group on three factors: ILA Factor 3 (p=.041), ILA Factor 5 (p=.013), and ILA Factor 6 (p=.000). Year 3 classrooms were also divided into High and Low groups. Five teachers scoring .9 or greater were placed into the High implementation group and eight teachers scoring below .9 were placed into the Low implementation group. Groups were compared on each of the *BIT* and *ILA* factors. Results favored the High implementation group on all factors. When the preferred outcome was an increase in factor scores, the High implementation group outscored the Low implementation group. When the preferred outcome was a decrease in factor scores, the High implementation group showed decreases on all three factors while the Low implementation group showed a slight decrease in *ILA* Factor 5 focusing on early writing skills, stability in *BIT* Factor 5 focusing on unfriendly behavior in the computer area, and even a slight increase in *BIT* Factor 6 focusing on the child monopolizing the computer. Due to the small sample size used, statistical significance was not found for any of the comparisons. Figures 4 and 5 illustrate comparisons between High and Low model fidelity group performance on the *BIT* and *ILA* in Year 3.

Figure 4. Year 3 Comparison of *BIT* Factors by High and Low Implementation Groups

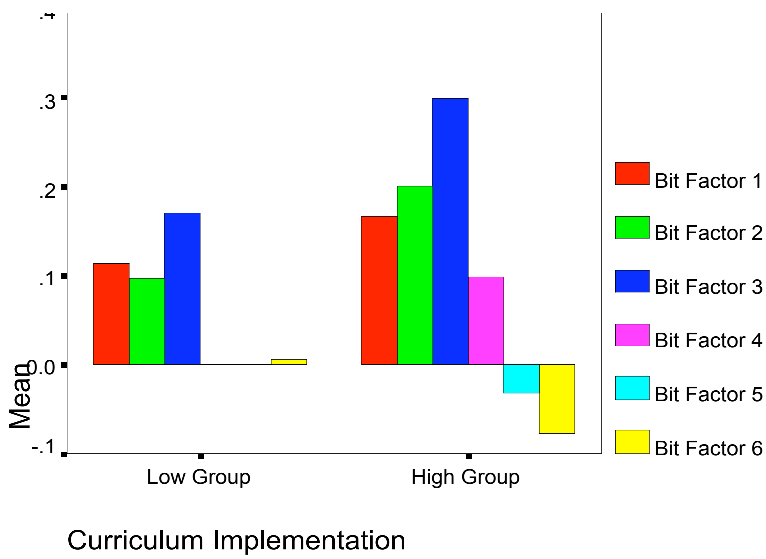
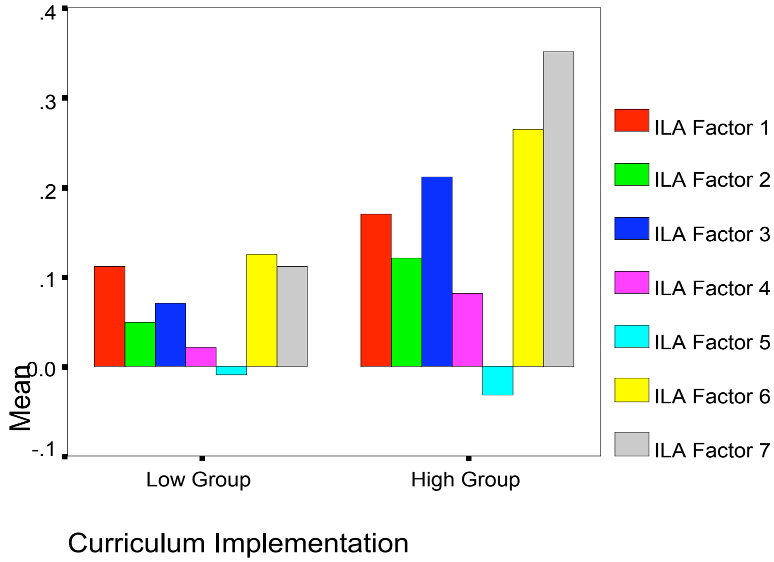


Figure 5. Year 3 Comparison of *ILA* Factors by High and Low Implementation Groups



Four of the High fidelity teachers were in G3; one was in G2B. Two of the Lows were in G1, four in G2A, one in G2B, and one in G3. Teachers' total teaching experience in the High group ranged from 10 to 25 years, while those rated Low ranged from 4 to 22 years, and included one teacher who retired. The teaching experience of G4 ranged from 4 years to 14 years, with two teachers at 4 years, one at 13 years, and one at 14 years.

When origination of the teachers' agreement to participate was examined, seven of the eight Lows were in the study because of an administrative decision. Two of the Highs made the decision to participate themselves, while the remaining three participated because of a decision made jointly by both the teacher and her administrator. One teacher in G4 was required to be in the study, while three others agreed to participate. The former told research staff that she preferred being in the comparison group since she did not believe in using technology in the classroom.

Teachers' Action Plans. Action plans that related to environment included rearranging the computer environment to make it more accessible, implementing a sign-up method for using the computer, adding literacy related materials to the computer center, and adding a choice board to the computer center. Action plans that related to integration named a software title and the unit or project with sample activities that would be used to support the curriculum and language arts standards. One teacher placed the child-developed images on a wall outside of the classroom with related language arts standards to educate families on how technology impacts literacy. Action plans that related to *HyperStudio* described the type of stack that would be developed. Examples included stacks titled "All About Me", stacks related to IEP goals with images and sounds that were personalized for individual children, and stacks relating to literature used in the classroom. Information about the Action Plans' implementation and follow-up was entered into the E2 database.

E2 Classrooms' Environment

The results discussed below are based on *Model Fidelity Profile* results, Year 3, for 13 classrooms in the four E2 treatment groups and in G4. The measure's section on Facilities included 16 items, while Materials and Equipment included 11 items.

Facilities. Similarities were found across Groups 1, 2A, 2B, and 3. Ten of the 13 teachers (77%) received a score for all 16 Facilities items. One teacher (7%) in Group 2A scored on only 12 of the 16 items. Her classroom was not organized into centers; the computer was not placed in a quiet low traffic area; the computer monitor was not placed at the children's eye level; and environmental print was not present in classroom. Two other teachers (15%) were missing scores on only one item each. A Group 1 teacher had no environmental print in her classroom while a Group 2A teacher did not use literacy-related materials at the computer center.

A number of differences in Facilities were found between G4 and the treatment groups. Two G4 teachers received a score of 13 on Facilities items. One teacher received a score of 7 while one teacher received a score of 3. None of the four G4 teachers had literacy-related items in the technology center, nor did they store materials nearby or allow children access to the software. The teachers receiving a score of 3 and 7 did not keep the hardware or keyboard accessible to children, did not allow access to an art center, and did not offer an assortment of art or book publishing materials. In addition, the teacher receiving a score of 3 did not have the classroom organized into centers; did not keep the computer in a quiet, well lit, low traffic area; did not have a large number of books accessible to children; and did not allow access to writing materials. The teacher with a score of 7 did not have environmental print present in her classroom.

Materials and equipment. Eleven items are included in the *Model Fidelity* measure for materials and equipment. More differences among treatment classes and teachers were found in this section. Only one teacher (Group 3) scored on all 11 items. Only one teacher (Group 2B) did not score on five items. The remaining teachers ranged between 1 and 4 items missing (2 teachers missed one item; three missed two, three missed three; and three missed four). All 13 teachers had five items in common: a computer with a color monitor; a CD-ROM drive; a color printer; a digital camera; and a variety of literature-based commercial software programs.

Only two teachers had scanners. Eleven (85%) teachers did not have a scanner; however, this did not have a negative effect on the model because all had digital cameras and used them to photograph items that might otherwise have been scanned. Access to the Internet was not available to five of the 13 (38%) teachers. This did impact implementation of the model.

The greatest impact on model implementation resulted from two types of software important to the model missing from some classrooms: the authoring program, *HyperStudio* and a variety of drawing and writing software. In spite of the fact that E2 bought authoring software for all the treatment classrooms and had graphic and writing software from the E2 software library available to loan to treatment teachers during the entire E2 study, seven of the 13 respondents

(54%) reported that they did not have authoring software, and four of the 13 (31%) reported not using drawing and writing software.

Analysis of equipment items in the comparison classrooms (G4) indicated that two teachers scored 7 out of the 11 items in this section; one teacher scored 6, and one teacher scored 4. All four teachers had a computer with a color monitor, a CD-ROM drive, a color printer, and child-sized tables and chairs. Two teachers had a digital camera and a microphone, but none of the teachers had a scanner. Three of the teachers had a variety of commercial software programs. None of the comparison teachers had a variety of drawing and writing programs, used *HyperStudio*, or had access to the Internet.

Results of Child Quantitative Measures

The child quantitative measures of interest to the study include the *Behavior Interaction Tool (BIT)* and the *Individual Literacy Assessment (ILA)*. Results are reported by year across a 3-year period.

***Behavior Interaction Tool* results.** The six factors of the *BIT* are (1) Child attends to computer and demonstrates technical proficiency; (2) Child makes independent computer-related choices and expresses enthusiasm in several ways; (3) Child collaborates with peers at the computer; (4) Child interacts with adult at the computer; (5) Child demonstrates unfriendly behavior toward an adult in the computer area; and (6) Child monopolizes the computer.

Analysis of Variance (ANOVA) was used to determine group differences in Pretest scores on each of the BIT factors. Year 1 showed that G1 scored higher than G3 on Factors 2 (p=.011) and 3 (p=.000). In Year 2, Pretest scores demonstrated differences on 5 of the 6 factors: G1 and G3 scored higher than G2A. Note that G2A had the highest percentage of children with disabilities (See Table 4 on page 33) of the three Year 2 groups. For Factors 2 (p=.000) and 3 (p=.000), G1 and G3 scored higher than 2A. For Factors 4 (p=.000) and 6 (p=.000), G3 scored higher than G1 and 2A. For Factor 5, G3 scored higher than 2A. In Year 3, there were differences on four of the factors. For Factor 1 (p=.008), Groups 1, 2B, and 3 scored higher than G4 and G1 and G3 scored higher than 2A. For Factor 2 (p=.000), G1 and G3 scored higher than G2B and G4. For Factor 4 (p=.000), G3 scored higher than 1, 2A, 2B, and 4 while G1 and G2B scored higher than 2A and G4. G3 scored higher than G1, G2A, G2B, and G4.

Analysis of Variance (ANOVA) was used to determine Year 3 group differences on each of the six *BIT* factors. Follow-up tests were run on factors yielding statistically significant group differences. Factor 1 was the only factor that did not show statistically significant differences. For Factor 2, Group 2B scored higher than both Group 2A and Group 3. For Factor 3, Group 4 scored lower than all four groups. For Factor 4, Group 3 scored higher than all other groups. For Factor 5, Groups 1 and 3 showed greater decreases than Group 2A. For Factor 6, Group 3 showed greater decreases than Groups 2A, 2B, and Group 4.

In Year 1, quantitative data were gathered for 94 children. Of these, 49 had a disability and 45 were 'at risk'. Thirty-three (33) were female and 61 were male. Pre and post data for the *Behavior Interaction Tool (BIT)* were gathered for 79 of the 94 children. Results are shown in Table 5.

T-tests were conducted to determine pre and post differences for all Year 1 participants. Statistical significance was obtained for two of the six factors. T-tests were conducted to determine pre and post differences for participants categorized as disabled. Statistical significance was obtained for two of the six factors. T-tests were conducted to determine pre and post differences for participants who were categorized as at risk. Statistical significance was obtained for two of the six factors.

Table 5. Year 1 *BIT* Results

BIT Factor	Pre		Post		*t*	*p*
	M	SD	M	SD		
All Participants (*N*=79)						
1. Child attends to computer and demonstrates technical proficiency.	.785	.127	.820	.137	1.69	.094
2. Child makes independent computer related choices and expresses enthusiasm in several ways.	.529	.233	.676	.242	4.54	.000
3. Child collaborates with peers at the computer.	.470	.338	.622	.339	3.24	.002
4. Child interacts with adult at the computer.	.380	.271	.441	.329	1.30	.199
5. Child demonstrates unfriendly behavior toward an adult in the computer area.	.004	.038	.004	.038	.00	1.00
6. Child monopolizes computer.	.029	.106	.029	.106	.00	1.00
At Risk (*N*=38)						
1. Child attends to computer and demonstrates technical proficiency.	.792	.086	.830	.126	1.51	.141
2. Child makes independent computer related choices and expresses enthusiasm in several ways.	.511	.212	.674	.215	3.77	.001
3. Child collaborates with peers at the computer.	.455	.356	.729	.295	4.68	.000
4. Child interacts with adult at the computer.	.379	.274	.374	.349	-.07	.945
5. Child demonstrates unfriendly behavior toward an adult in the computer area.	.009	.054	.009	.054	.00	1.00
6. Child monopolizes computer.	.013	.081	.020	.090	1.00	.324
Disabled (*N*=41)						
1. Child attends to computer and demonstrates technical proficiency.	.778	.157	.810	.148	.99	.327
2. Child makes independent computer related choices and expresses enthusiasm in several ways.	.546	.253	.678	.268	2.73	.009
3. Child collaborates with peers at the computer.	.484	.324	.523	.349	.56	.576
4. Child interacts with adult at the computer.	.381	.271	.502	.300	2.17	.036
5. Child demonstrates unfriendly behavior toward an adult in the computer area.	.000	.000	.000	.000	NA	NA
6. Child monopolizes computer.	.043	.124	.037	.119	-.24	.812

In Year 2, there were 149 participants of which 62 were female and 87 were male. Of the 149, 79 were 'at risk' and 68 had a disability (the status of 2 participants was not determined). Pre and post data for the *Behavior Interaction Tool (BIT)* were gathered for 93 of the 149 participants. Results are shown in Table 6.

T-tests were conducted to determine pre and post differences for all Year 2 participants. Statistical significance was obtained for four of the six factors. T-tests were conducted to determine pre and post differences for participants who were categorized as at risk. Statistical significance was obtained for three of the six factors. T-tests were conducted to determine pre and post differences for participants categorized as disabled. Statistical significance was obtained for two of the six factors.

Table 6. Year 2 *BIT* Results

BIT Factor	Pre		Post		*t*	*p*
	M	SD	M	SD		
All Participants (*N*=93)						
1. Child attends to computer and demonstrates technical proficiency.	.771	.154	.852	.135	5.71	.000
2. Child makes independent computer related choices and expresses enthusiasm in several ways.	.633	.291	.735	.280	3.25	.002
3. Child collaborates with peers at the computer.	.550	.341	.748	.320	7.41	.000
4. Child interacts with adult at the computer.	.512	.330	.622	.324	3.34	.001
5. Child demonstrates unfriendly behavior toward an adult in the computer area.	.032	.140	.039	.154	.58	.567
6. Child monopolizes computer.	.124	.252	.097	.242	-1.15	.254
At risk (*N*=38)						
1. Child attends to computer and demonstrates technical proficiency.	.807	.136	.906	.088	4.77	.000
2. Child makes independent computer related choices and expresses enthusiasm in several ways.	.647	.239	.842	.229	3.41	.002
3. Child collaborates with peers at the computer.	.707	.261	.929	.162	5.62	.000
4. Child interacts with adult at the computer.	.616	.343	.742	.308	2.34	.025
5. Child demonstrates unfriendly behavior toward an adult in the computer area.	.000	.000	.000	.000	NA	NA
6. Child monopolizes computer.	.112	.215	.112	.264	.000	1.00
Disabled (*N*=55)						
1. Child attends to computer and demonstrates technical proficiency.	.746	.161	.814	.150	3.57	.001
2. Child makes independent computer related choices and expresses enthusiasm in several ways.	.622	.324	.659	.290	1.12	.267
3. Child collaborates with peers at the computer.	.442	.349	.623	.343	5.02	.000
4. Child interacts with adult at the computer.	.440	.304	.538	.310	2.37	.022
5. Child demonstrates unfriendly behavior toward an adult in the computer area.	.055	.179	.067	.197	.574	.568
6. Child monopolizes computer.	.132	.276	.086	.227	-1.43	.159

In Year 3, there were 181 participants of which 75 were female and 106 were male. Of the 181, 114 were classified as 'at risk' while 67 had a disability. Pre and post data for the BIT were gathered for 145 of the 181 participants. Results are shown in Table 7.

T-tests were conducted to determine pre and post differences for all Year 3 participants. Statistical significance was obtained for five of the six factors. T-tests were conducted to determine pre and post differences for participants who were categorized as at risk. Statistical significance was obtained for four of the six factors. T-tests were conducted to determine pre and post differences for participants categorized as disabled. Statistical significance was obtained for four of the six factors.

Table 7. Year 3 *BIT* Results

***BIT* Factor**	Pre		Post			
	M	SD	M	SD	*t*	*p*
All Participants (*N*=145)						
1. Child attends to computer and demonstrates technical proficiency.	.785	.186	.897	.108	7.92	.000
2. Child makes independent computer related choices and expresses enthusiasm in several ways.	.600	.305	.765	.225	5.76	.000
3. Child collaborates with peers at the computer.	.566	.322	.735	.317	5.38	.000
4. Child interacts with adult at the computer.	.454	.324	.506	.356	2.07	.040
5. Child demonstrates unfriendly behavior toward an adult in the computer area.	.023	.116	.009	.078	-1.62	.109
6. Child monopolizes computer.	.069	.213	.036	.125	-2.08	.039
At risk (*N*=73)						
1. Child attends to computer and demonstrates technical proficiency.	.798	.185	.912	.104	5.39	.000
2. Child makes independent computer related choices and expresses enthusiasm in several ways.	.556	.308	.734	.197	4.36	.000
3. Child collaborates with peers at the computer.	.626	.306	.771	.290	3.01	.004
4. Child interacts with adult at the computer.	.477	.336	.521	.372	1.18	.241
5. Child demonstrates unfriendly behavior toward an adult in the computer area.	.019	.077	.000	.000	-2.04	.045
6. Child monopolizes computer.	.069	.188	.038	.108	-1.35	.182
Disabled (*N*=60)						
1. Child attends to computer and demonstrates technical proficiency.	.763	.192	.883	.117	6.14	.000
2. Child makes independent computer related choices and expresses enthusiasm in several ways.	.603	.291	.793	.260	4.35	.000
3. Child collaborates with peers at the computer.	.433	.300	.690	.365	6.05	.000
4. Child interacts with adult at the computer.	.461	.318	.546	.338	2.32	.024
5. Child demonstrates unfriendly behavior toward an adult in the computer area.	.033	.159	.022	.121	-.63	.532
6. Child monopolizes computer.	.083	.259	.042	.154	-1.60	.115

***Informal Literacy Assessment* results.** Seven *ILA* factors are (1) Child demonstrates understanding of story; (2) Child orients book appropriately for reading; (3) Child demonstrates literacy behaviors in response to pictures; (4) Child demonstrates literacy behaviors in response to print; (5) Child demonstrates early writing behaviors; (6) Child attempts to communicate using letters; and (7) Child uses inventive and conventional spellings. Year 1 post tests indicated that there were no significant differences between Group 1 and Group 3 on the seven *ILA* factors, indicating that the model was maintained by the teachers who acquired the knowledge and skills needed in prior projects and that differences among characteristics of the children in either group did not significantly affect results.

Pretest comparisons on the *ILA* factors among treatment and comparison groups were done for all 3 years. With the exception of Factor 5 (*p*=.016) where G1 outscored G3, there were no significant differences on the pre *BIT* or *ILA* factors between G1 and G3 in Year 1. For Year 2, there were significant differences on five of the factors. Since these are ANOVAs, the significance is overall (not pair wise comparisons). On Factor 1 (*p*=.036), G3 scored higher than G2A. For Factor 2 (*p*=.012), G2A scored lower than G1 and G3. For Factor 3 (*p*=.000), G3 scored higher than G1 and G2A. For Factor 5 (*p*=.001), G3 scored higher than G2A. For Factor 6 (*p*=.000), G3 scored higher than G1 and G2A. G3 started higher on some factors and further outpaced the other groups during the study. In Year 3, there were significant differences on three of the factors (Factors 3 [*p*=.002], 5 [*p*=.012], and 6 [*p*=000]). For all three factors, G3 outscored all other groups (1, 2A, 2B, and 4). Again, G3 is starting higher and experiencing more gains.

In Year 1 there were no significant difference in post test ILA factors between G1 and G3, a very good indication that G3 teachers maintained the model over time periods ranging from 1 to 4 years. During Year 1, E2 staff observed in G3 classes, but did not offer training since the intent was to determine the extent of G3 teachers' maintenance of the model. In Year 2, when E2 staff began offering technical assistance and support to G3 teachers, G3 outperformed G1 and G2A on Factors 2, 3, 4, 5, 6, and 7.

ANOVA and follow-up tests for the seven *ILA* factors were also run in Year 3. Again, Factor 1 was the only factor that yielded no statistically significant results. For Factor 2, G3 scored higher than G2A and G4 (the comparison group). For Factors 3 and 4, G3 scored higher than all other groups. For Factor 5, G2A and G3 scored higher than both G1 and G4. For Factor 6, G2A and G3 scored higher than G4. For Factor 7, G2B and G3 scored higher than G1, G2A and G4.

***BIT* and *ILA* comparisons between children with disabilities and children at risk.** When results on the *BIT* and the *ILA* were compared according to whether children had disabilities or were at risk, pre scores for the six *BIT* factors showed no differences. The pre scores for the seven *ILA* factors resulted in two differences: the at risk children scored higher on Factors 4 (p=.006) and 7 (p=.001). When differences between pre and post scores were analyzed, there were no significant differences on any of the *BIT* factors. On the *ILA*, there was only a difference for Factor 5 (p=.02) which showed a gain by the at risk group and no change by the group with disabilities.

Qualitative Results

Children's behaviors, recorded in field notes and notes taken from G2B videotapes, were sorted according to three types of software, (1) literature based, (2) graphic, and (3) authoring/multimedia, across Groups 1, 2A, 2B, 3, and 4. Behaviors and patterns identified in all groups when children interacted with literacy-based software in Year 3 follow. While similarities and differences in the *numbers* of recorded behaviors in coding categories were found, *numbers* alone did not necessarily reflect important patterns of behaviors. Patterns of behaviors included use of appropriate vocabulary, carrying on conversations, solving problems, making judgments, listening, attending, predicting sequence and outcomes, and interacting socially with peers when children used storybook and activity programs. As expected, the majority of significant literacy behaviors occurred when children used literacy software. When teachers were not assisted by the E2 staff, multimedia software and graphic software were seldom used, with some exceptions in Groups 2A and 3.

Patterns noted as children used literature-based software. The following section addresses a variety of behaviors as children used literature-based software. These include, but are not limited to, behaviors related to vocabulary, problem solving, prediction, and communication.

Uses appropriate vocabulary. Percentages of the number of behaviors observed as children used vocabulary reflecting E2 activities, from least to greatest ranged from 3% (G2A), 4% (G4), 9% (G1), 10% (G3), to 11% G2B. Children in the treatment groups demonstrated patterns showing use of appropriate vocabulary related to E2 activities when discussing signing up for computer time and taking turns. Their vocabulary also indicated a pattern of appropriate use of terms such as menu items (*file, save, print*) and technology related terms (*mouse, click, computer, frozen, restart*) while conversing with peers about the content of a program or navigation through a program. No discernible patterns were found in the comparison group (G4).

Carries on a conversation. Percentages of the number of behaviors observed when children carried on conversations included 9% of G2B and G3, 10% of G2A, 12% of G4, and 14% of G1. Children in all groups conversed with peers about the programs' content; however, the identified patterns indicated that the quality and content of their discussions differed. In the treatment groups, children discussed what happened in the program, how to navigate through a software activity, taking turns, and signing up for a turn at the computer.

Similar discussions about the software took place with adults across the treatment classrooms, but did not occur in G4, comparison group. G4 children's conversations occurred more often with adults and were generally adult directed. Children's discussions with adults focused on *how to use* the program.

Observations point to differences in teachers' behaviors related to computers in their classrooms. In G4 classrooms, teachers often sat at or hovered nearby the computer, directing children as to what to do with the technology. However, teachers in treatment classrooms functioned as facilitators. Teachers in Groups 1, 2A, 2B, and 3 treated the technology as another center, offering assistance when requested and occasionally offering supporting comments to extend learning opportunities. Teachers in treatment groups did not demonstrate as much 'fear' of the technology as was found in the comparison group.

Solves problems. A number of observed behaviors involved children solving problems. Percentages range from 4% (G2A and G4), to 7% (G 2B, G3) to 9% (G1). No similarities were found across all treatment and comparison groups. No identifiable behavior patterns were found in G4. In Groups 1, 2B, and 3, patterns of problem-solving included asking for assistance from peers or adults, navigating through the program, and taking turns. In Groups 2A, 2B, and 3, children solved problems presented in the software application (e.g., balancing objects in *Dr. Seuss's Cat in the Hat*).

Makes judgments. Percentages of the number of behaviors observed when children made judgments ranged from 15% (G2A), 16% (G1), and 18% (G3) to 21% (G4) and 23% (G2B). Across both treatment and comparison groups, the pattern indicated that children made judgments while completing activities *within* software programs. In G4, no other patterns of behavior were found related to making judgments, yet all treatment groups demonstrated differences in several categories. Across all four treatment groups, the difference in making judgments related to individual children deciding what software to use in the technology center from the choices offered by the teacher. Groups 1, 2A, and 3 also made judgments related to navigating in the program and taking turns. Children in Groups 2B and 3 made judgments in requesting help from a peer and assisting a peer with help, asking adults for assistance, and using a sign-up sheet for a turn on the classroom computer.

Listens. Percentages of the number of listening behaviors observed ranged from 11% (G1 and G3), 14% (G2B), 17% (G 2A), to 19% (G4). In order for a behavior to be coded as *listening*, a child had to respond verbally or non-verbally to an adult, another child, or a computer verbalization. In both treatment and comparison groups, patterns indicated that children listened to adult direction and to directions on software programs. However, in the treatment groups, children also listened to peer suggestion and comments. This behavior pattern was *not* evidenced in the comparison group.

Attends. Attending behaviors accounted for the largest number of observed behaviors across groups. Percentages ranged from 18% (G3) to 24% (G1, G 2B), 26% (G 2A), and 32% (G4). *Attending* was defined in terms of eye gaze (i.e., the child's eyes were focused on the monitor screen or what they were doing). Across all five groups, children attended to the software application and to peers' suggestions and comments, as well as adult comments. In addition, children in Groups 2A, 2B, and 3 attended to signing up, taking turns, and to the processes involved in choosing software and loading programs.

Predicts sequences and outcomes. Percentages of the number of observed behaviors indicating that children predicted sequence and outcomes follow: 9% (G2B), 10% (G2A), 11% (G1), 13% (G3), and 15% (G4). Across treatment and comparison groups, children predicted sequences and outcomes in software activities. However, among the groups the character of the sequence and outcomes predicted differed. In treatment groups, but *not* in the comparison group, children predicted sequences as they navigated through the programs, while in Groups 2B and 3, children predicted sequence and outcome as they chose, inserted, started, and ran an application in the computer. Although children in Groups 1 and 2A were allowed to select applications, their teachers were concerned about the children handling classroom software. This may be explained as school policy, or a monetary or training issue. Groups 2B and 3 teachers did not demonstrate similar constraints. Group 2B teachers purchased inexpensive software and appeared to have a larger income base. Through ongoing model implementation, Group 3 teachers observed the ease with which children handled software and noticed positive results over time. As a result, they were not apprehensive about children handling software.

Uses related literacy materials. Percentages and numbers of coded observations showing children used related literacy materials represents the smallest numbers reported here: 1% (G1), 3% (G4), 6% (G 2B), 7% (G 2A), and 8% (G 3). No similarities were found across all groups. Not a single pattern of behavior related to literacy material use with technology was shown in G4, the comparison group. This is quite surprising since the Early Childhood DOE division, as well as federal initiatives, have promoted literacy and curriculum integration for several years through technical assistance, video, conferences, and other training. Groups 1, 2B and 3 were all observed using a computer sign-up method, which over time demonstrates changes in children's emerging writing. Group 2B used name cards and models for sign up. Group 3 was the only group where a pattern of reading hard copies of software related books, making books, and printing books was observed.

Shares and takes turns. Of the behaviors observed 6% (G2B, G4), 8% (G2A, G3), and 9% (G1) related to children sharing and/or taking turns. Across Groups 1, 2A, 3, and 4, children took turns, but not in Group 2B. No observable patterns of sharing and turn taking were found in G4, nor were patterns found in the field notes taken from G2B video observations. However, when E2 staff reviewed observations for the *BIT* and *ILA*, they noted that children *did* take turns in G2B. Perhaps this behavior was not recorded due to the limitations of video data collection**.** Background noises in the classrooms made the tapes difficult to hear. In addition, many times E2 researchers were unable to see children's behaviors in their entirety on the videotaped observations. Across the remaining three treatment groups, children demonstrated their ability to share as they took turns at the computers. In Groups 1, 2A, and 3 children were observed sharing knowledge as they exchanged ideas and participated in cooperative interactions. Discussions centered around what was taking place in the software or suggestions on what action to take next.

Social interaction among children. Of the behaviors observed, 13% (G4), 14% (G3), 16% (G 2A), and 17% (G1 and G2B) involved children interacting socially. Similarities were *not* found across all groups. However, patterns across the four treatment groups indicated that children made suggestions to peers, observed peers using the computer, and assisted peers.

Social interactions among children and adults. Percentages of the number of behaviors observed involved children interacting with adults ranged from 10% (G3) to 15% (G1, G2B G3), 17% (G4), and 18% (G2A). Across the treatment groups, children had conversations with adults about the software. Patterns were not discerned in G4, the comparison group. In the treatment groups, adults facilitated children's technology use *on request* by providing verbal assistance. Children and adults had conversations about taking turns and signing up for a turn. In Groups 1, 2A, and 3, adults initiated assistance. In Groups 1 and 3, children were documented asking for assistance.

Graphic and authoring software. In Year 3 observations across the treatment and comparison groups, children most often interacted with literature-based software. Occurrences of children using graphic and writing software or multimedia authoring software were scarce. Children in Group 1 classrooms were observed using graphic programs to draw, but the observations and field notes did not document that children engaged in other literacy behaviors when using drawing programs. Major differences were found in G3 classrooms where children used more graphic programs. Documentation of G3 child behaviors included using appropriate vocabulary, carrying on conversations, drawing, using emergent keyboarding, keyboarding, solving problems, making judgments, listening, attending, using related literacy materials, predicting sequence and outcomes, recognizing letters, identifying environmental print, sharing and taking turns, socially interacting with peers and interacting socially with adults. Across groups, observations of children using authoring/multimedia software were rare, and patterns could not be identified and documented.

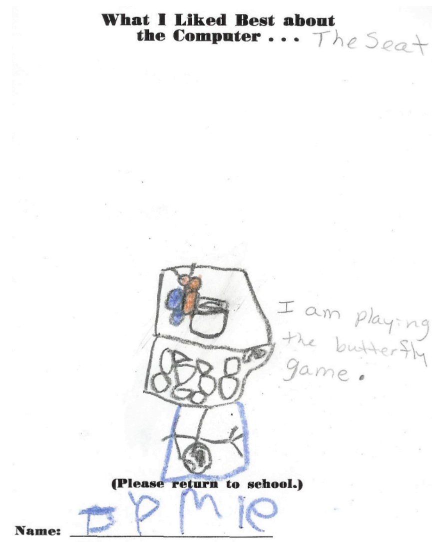
"***What I Liked Best…***" **results.** Children's responses to *"What I Liked Best about the Computer"* varied from scribbles on a page without dictated responses to drawings of children engaged in activities at the computer. Four hundred and seventy-nine forms were gathered from all groups over E2's three years. Not all completed forms contained pictures and print. Table 8 reports the types of drawings and children's dictated responses across all groups over the 3 years. Three hundred fourteen (314) forms contained different stages of child writing, ranging from scribbles to recognizable letters. Figure 6 on page 52 contains four examples of completed *"What I Liked Best…"* forms.

Table 8. Content of *What I Liked Best* Drawings across 3 Years

	G1 *N*=91	G2A *N*=72	G2B *N*=28	G3 *N*=234	G4 *N*=52
Content of Drawings					
Scribbles	25%	42%	7%	18%	23%
Illustrates software	25%	8%	21%	18%	8%
Draws what child liked to do	33%	15%	39%	31%	37%
Draws computer center	4%	19%	25%	16%	19%
One child at computer	1%	8%	0	13%	4%
More than one child at computer	1%	1%	0	4%	4%
Messages					
General	42%	19%	50%	47%	48%
Specific Software Title	45%	7%	50%	41%	6%
Stages of Writing					
Scribbles	2%	1%	0	1%	4%
Mock Handwriting	3%	6%	0	4%	8%
Mock Letters	12%	22%	0	17%	21%
Invented Spelling	7%	1%	1%	7%	6%
Approximated Spellings	8%	11%	1%	13%	10%
Conventional Spellings	21%	17%	10%	33%	18%

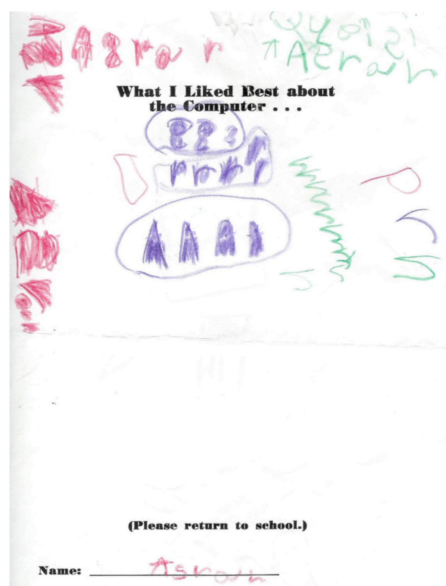
Figure 6. Examples of Completed "What I Liked Best about the Computer" Forms

Scribbling
No recognizable image or message



Recognizable Image, Invented spelling of name, Dictation of what the child is doing at the computer.

Recognizable Image, Conventional spelling of name, Dictation of program the child liked best, "Little Monster At School"



Recognizable Image, Conventional spelling of name, Invented spelling

Skills Teachers Need to Implement the Model

Results of E1, the Center's original literacy study, led to the conclusion that in order to implement E2 procedures, teachers and staff must possess knowledge and skills related to emerging literacy and create a technology environment that promotes emergent literacy in young children. Model training was designed so that teachers could acquire and use such knowledge and skills.

Training and follow-up are designed so teachers can use the computer and other technology tools without fear and acquire the skills and knowledge to troubleshoot basic technical problems, if necessary. Teachers using the model know how to evaluate software and can implement the software into the curriculum to impact learning in the classroom. Being able to facilitate children’s discussions and verbally assist with the technology when necessary is important.

Effective strategies to carry out the model include the adults in a classroom taking the role of a facilitator. Teachers offer software choices related to children's interests and learning styles, whether a child is at risk or demonstrates a disability. If a child is more interested in pursuing an activity program to learn about a particular topic, that choice is made available. On the other hand, if a child learns better through drawing and or writing about the topic, graphic software choices are available for the child.

The environment is set up with appropriate choices that integrate technology with other classroom activities. Using a sign-up book offers children a way to control their own turn taking at the computer and is a meaningful way to encourage emerging writing skills. Children know if their name is written down, they will have a turn. As they await their turn, children discuss what is happening in the software with a peer who is at the computer or become involved in a different classroom learning center, knowing someone will call them when it is their turn to use the computer.

During E2, acquisition of implementation skills and strategies resulted from workshops and ongoing support within the classroom from E2 staff. Teachers reported ongoing support as being particularly necessary for implementation of *HyperStudio*, the authoring software used in the study. A teacher from Group 2B indicated the necessity of being willing to try new teaching strategies in the classroom to implement the ELiTeC Curriculum. The model *does* ask teachers to rethink the potential of using technologies with young children and to try new techniques. Perhaps these techniques may already be used successfully in other areas of the classroom, but the teacher does not yet realize they can also be used in the technology center.

Training teachers to use adult productivity software not only benefited correspondence among families and the teacher in some classrooms but also increased the teachers' skills and comfort level with technology. Teachers used software to produce newsletters and write notes. Software also helped them with assessments. When teachers use computers themselves and when they see children successfully using computers, software, and other technologies as learning tools, their fear of or discomfort with technology is usually alleviated.

Based on observations and teacher interviews, Table 9 shows skills and strategies important to model implementation demonstrated by treatment teachers during Year 3. Group 1, 2A, and 2B teachers demonstrated about half of the 15 skills and strategies, while G3 teachers, who had been implementing the model longer, showed evidence of all 15.

Table 9. Teachers' Skills and Strategies Important to Model Implementation Across Treatment Groups

Skills and Strategies	**G1**	**G2A**	**G2B**	**G3**
Ability to troubleshoot	•		•	•
Allowing children to make choices about software	•	•	•	•
Allowing children to print	•			•
Facilitating through verbal instructions	•	•	•	•
Facilitating children's discussions and conversations with peers	•	•		•
Knowledgeable about software	•		•	•
Ability to integrate software across curriculum to support learning	•	•	•	•
Comfortable with technology	•			•
Allowing children to change from one software program to another		•	•	•
Facilitating children's turn taking		•		•
Using sign-up books for the computer center		•		•
Making technology accessible to children		•		•
Providing supporting curricular materials (e.g., books, markers, paper, props)			•	•
Sharing technology with families				•
Using a digital camera				•
Using technology as an assessment tool				•

Options for Model Implementation

Strategies used by different groups to implement the model were studied. Groups 2A, 2B and 3 used digital cameras as a means to integrate technology into curriculum activities. Children took pictures of activities and projects and made books that could be color-printed and bound to become part of the classroom library. Group 2A used various peripheral devices for input, and Groups 2A and 3 used multiple computers in their classrooms. Groups 2B and 3 provided name models for children to use when they signed up to use the computer.

In Year 2, *KidDesk* was eliminated from E2 training because the program's publisher discontinued it due to incompatibility issues with newer operating systems. *KidDesk* had been an important component of the model in the E1 study. Its desktop security features not only provided teachers peace of mind but also offered children autonomy as they used the computer. *KidDesk*'s desktop included literacy features such as mail, classroom E-mail, voicemail, note pad, and calendar. Because the ELiTeC training video contained information about *KidDesk* and because E2 teachers saw its potential for encouraging literacy development, they searched online auctions (e.g., half.com) to find the program. If they were able to find it and if the program was compatible with their system, E2 provided *KidDesk* training.

Problems Encountered by Classroom Teachers

E2 teachers encountered various problems when implementing the model. These problems were similar to problems encountered in the original research project. All classrooms had computers that crashed or froze, software and hardware compatibility issues, and software system problems. Teachers talked about being low on the list not only for receiving new classroom technology but also for getting their computers and printers repaired. School districts tend to buy the newest technology for upper grades and move the older technology into the lower grades, often leaving preschool programs with the oldest technology.

When E2 classrooms did receive newer operating systems, they experienced an issue not seen with E1: their software was not compatible with the newer systems. E2 teachers learned how to troubleshoot around this issue and were able to get a number of older software programs to work on newer systems. Group 1 and 2A indicated trouble using *HyperStudio* and requested more hands-on help in the classroom from E2 trainers.

Families

In Year 1, pre and post *Family Surveys* were completed for 33 children. Year 1 comparisons found gains in 13 of the 16 items with statistically significant gains on 6 of the items (asks questions about print, recognizes familiar print, identifies letters of the alphabet, sight-reads words in favorite book, makes marks that looks like letters, and prints letters of the alphabet). In Year 2, *Family Surveys* were completed for 14 children. Year 2 comparisons also found gains on 13 of the 16 items with statistically significant gains on 7 of the items (predicts what will happen next, tells stories that have a beginning, middle, and end, asks questions about print, recognizes familiar print, identifies letters of the alphabet, sight-reads words in favorite book, and makes marks that looks like letters). In Year 3, *Family Surveys* were completed for 78 children. Year 3 comparisons found gains on 14 of the 16 items with statistically significant gains on 7 of the items (retells story by pictures, follows story by pointing to text/pictures, requests an adults to create signs/symbols, predicts what will happen next, tells stories that have a beginning, middle, and end, asks questions about print, looks at book independently, recognizes familiar print, identifies letters of the alphabet, sight-reads words in favorite book, makes marks that looks like letters, and prints letters of the alphabet).

Comparison Between E1 and E2

E1 described and explained the effects of an Interactive Technology Literacy Curriculum (the ELiTeC Curriculum) treatment on emergent literacy knowledge and abilities of 3, 4, and 5 year-old children who demonstrated mild to moderate disabilities. Classrooms were the unit of measurement. Based on rigorous naturalistic inquiry, the study incorporated mixed methods, and completed case studies of 16 preschool classes in West Central Illinois rural and urban communities. Four different types of classrooms were studied in depth, categorized according to elements of teachers' technology use. The resulting effects were determined using QUAN and QUAL data from children, their families, the staff, and the settings of the participating classrooms. Use of ITLC resulted in positive effects on emergent literacy knowledge and skills of the children in the classrooms studied.

Differences from pre to post on the six *BIT* factors for E2 data was compared to data reported in E1's final report. E1 showed significant change on *BIT* Factors 1-5, while E1 shows changes on *BIT* Factors 1-4 and 6. The differences between pre and post for E1 and E2 groups basically look the same, showing good consistency across the two studies. The only significant difference is for Factor 4 (child interacts with adult at the computer), which shows that E1 children showed a much larger increase than did E2 children.

Differences from pre to post on the *ILA* items for E2 data were compared to data reported in E1's final report (Hutinger et al., 1998). E1 reported significant gains in Book Handling, Pictures, and Story but no significance for Text. Since there were changes made to the *ILA* from E1 (4 factors consisting of 12 items) to E2 (7 factors consisting of 29 items), nine individual items from E2 that were used as part of the E1 factors were identified. E2 gains were found across nine items with statistically significant gains for 5 of the items (following print, two items involving attending to pictures, points to text, and attending to print while reading some words). The four items that were not found to be significant included holds book right side up, points to pictures, attends to each picture while labeling objects, and attends to print and reads fluently.

Cross-referencing patterns of behavior in the original research (E1) findings with behaviors found in Year 3 of the present study (E2) demonstrated strong relationships in observed behavior patterns when a program implements the model. In all E1 treatment groups and in the E2 treatment groups, the following patterns of behaviors were found when research staff assisted in implementing the model:

- *Carries on a conversation*. When children in both E1 and E2 classrooms used literature-based software programs, they discussed what was happening in the program and what they would like to do. They talked to each other and helped navigate through software programs. Children discussed taking turns and using the sign-up book. Patterns of these types of oral communication were documented in both studies.
- *Makes judgments*. Children made judgments in both E1 and E2 classrooms when discussing what was happening in the software programs when an icon was activated, what needed to be completed to go on to the next page or activity, as well as what software program to use when working in the technology center.

- *Listens*. Listening behavior was found consistently across both E1 and E2 classrooms when children listened to peer suggestions and comments. Children listened to other children about where to navigate, what to choose to complete an activity, as well as discussions about what was happening in software applications.
- *Attends*. In both E1 and E2, children attended to the software application and to peer's suggestions and comments, as well as adult direction and comments.
- *Predicts sequence and outcomes*. Children predicted the outcome of activities and understood and demonstrated the sequence to get through an activity. This pattern of predicting outcomes occurred in both E1 and E2.
- *Shares/takes turns*. In both E1 and E2, children shared ideas and helped others navigate through programs. Children also took turns at the computer, sharing both time and hardware.
- *Social interaction among children*. Use of the model affected social interaction among children in both E1 and E2 treatment classrooms. Technology is not viewed as an isolated activity, but the computer center is seen as a place for discussions, and sometimes bartering of ideas. Children made suggestions to peers, observed peers using the computer, and assisted peers.
- *Social interaction between children and adults*. Children in both E1 and E2 had conversations with adults about turn taking and signing up as well as receiving assistance and carrying on conversations about what was happening in software programs.
- *Uses appropriate vocabulary*. Children used appropriate vocabulary when referring to navigation in software programs and what was occurring in the program. They used describing words as they pointed to graphics and talked about what would happen when something was clicked on or asked another child to 'do that.'

- *Solves problems*. Similar to children in E1 classrooms, children in E2 classrooms were involved in solving problems within programs through navigating and changing CD-ROMs. In the E2 classrooms, children also solved problems by asking for assistance and taking turns, similar to the E1 when research staff implemented the model.
- *Uses related literacy materials*. In E1 and E2, children used sign-up sheets for turns at the computer. Similar to E1, E2 Group 3 also used related hard book copies of the Living Books Software programs.

In addition, across the 3 years when E2 children used literature-based software, the following similarities were found with E1:

Self talk/self direction. Children talked about what they were doing and what they were planning to do as they worked through a software application.

Articulates key concepts. Children described in detail what the software characters were doing.

Looks at or 'reads' a book. Children demonstrated reading behaviors such as turning pages from the front of the book to the back, looking at and 'reading' pictures to tell the story.

Emergent writing. Children used emergent writing when using the sign-up book.

Identifies environmental print. Children identified environmental print when navigating through programs.

Implementing and Maintaining the System

Overall, the results demonstrated by G3 in Year 1 clearly indicate maintenance of the technology literacy model. Teachers in G3 had maintained the model over periods of time ranging from 1 to 4 years prior to Year 1's observational treatment. Maintaining the literacy model is demonstrated in both E2 QUAN and QUAL results. The present study's results support others' finding that implementing an innovation is not immediate but requires the passage of time

(Berman & McLaughlin, 1978, Hord & Hall, 2001; Morrow, Casey & Haworth, 2003). Teachers' abilities to implement an innovation do not emerge in entirety as quickly as new knowledge and skills are acquired. Teachers need adequate time, training, understanding of how the change will impact children, and technical assistance follow-up (Banicky & Foss, 1999; Hord, Rutherford, Hulint-Austing, & Hall, 1987; Howland & Maer, 1999). When teachers see changes in children's learning as a result of new practices, teachers' attitudes and beliefs are likely to change accordingly (Gusky, 1986). Wergin and Curry (1993) concluded that change (1) is political and requires political strategies; (2) is incremental and adaptive; (3) moves through several layers of support, making it imperative to identify 'innovators' and 'early adopters' as soon as possible; (4) requires participation by those most affected by it; and (5) requires perseverance and flexibility from those who champion it.

By the end of Year 3, treatment teachers reported continued implementation and maintenance. One of the two remaining G1 teachers reported that the technology center was fully integrated and not isolated in a corner and that children were more independent. She was also allowing children choices in changing CD-ROMs. The other teacher moved noisy centers away from the technology center to facilitate conversations and social interaction. She also moved the writing and listening center closer to the technology center to encourage more literacy-oriented activities.

Three of the G2A teachers reported using a sign-up method. All four had made changes in the computer environment, including location and accessibility. Two of the teachers were integrating technology into thematic units, and two of the teachers reported continued use of the sign-up book.

Both of the G2B teachers reported more integration and free choice of software. One of the G2B teachers reported using more literacy materials, including a sign-up sheet while the other teacher changed her environment by placing the writing center near the computer center to encourage more literacy behaviors.

In September 2004, 3 years after the beginning of the study, E2 treatment teachers were sent a follow-up survey requesting information on the maintenance of the model in their classrooms. Of the 13 teachers who finished the project, 12 teachers were sent follow-up surveys. One teacher moved out of the state and could not be reached. Ten of the 12 teachers responded to the survey. The follow-up survey contained 25 *yes* and *no* questions related to the set up of the technology environment and the way it was supported in the classroom. The questions related to items found on the *Model Fidelity Profile*. If a teacher responded *no* to a question, she was asked to give a written explanation. Survey results demonstrated that teachers continued to maintain many aspects of the model. All 10 teachers responded positively to 21 of the 25 items on the survey.

All 10 teachers indicated that the placement of the technology center and equipment was conducive to social interaction and discussions by ensuring that more than one chair was available at the center. All teachers had a computer with color monitor and CD-ROM drive, as well as a variety of software programs, including drawing and writing programs. Teachers indicated that the technology was integrated into projects and thematic units related to children's experience. All used technology to support literacy, including oral language. Nine (90%) of the teachers reported offering children access and management of the computer, software choices, and using software that supported drawing and writing. Eight (80%) of the teachers reported that the hardware was accessible to children and that children used a sign-up method to access the computer.

The weakest area, as demonstrated in other data sources, was the limited or non-use of *HyperStudio*. Four teachers (40%) reported using *HyperStudio*. Two teachers (G3) reported continued use of *HyperStudio,* with a third teacher (G3) reporting limited use and a fourth teacher (G1) reporting she was "working on it."

Summary of Conclusions

Results of E2 demonstrate attainment of the study's major goals and the effectiveness of the model on 3- and 4-year old children's literacy behaviors. First, disseminating information about the model at conferences and on the web resulted in two new sites requesting to participate in the study. The ELiTeC website, found at <www.wiu.edu/thecenter/elitec>, provides resources to teachers and families about the model, training, and emerging literacy. The Toolkit, designed to use in model replication, contains the ELiTeC curriculum, 5 video/DVDs, plus a Resource Guide. Use of the Toolkit was recently written into a research proposal at another institution.

Second, E1's procedures were replicated in E2 in a range of typical rural and urban educational settings for preschool children with disabilities and those at risk across 17 treatment classrooms with 438 children, almost double the numbers of E1. E2 generally reflected E1 results.

Third, implementation and maintenance of the model were studied with associated findings indicating that the Group 3 E2 teachers, who first participated in E1, had maintained the model in E1 sites for periods of time ranging from 1 to 4 years prior to beginning E2. Results supported the assertion, found throughout the literature, that it takes the passage of a rather generous amount of time to implement an innovation. One or two years of training is not sufficient to produce full implementation of a model. Follow-up is likely to be essential. Conditions related to implementation were identified in the findings.

Two major assumptions upon which E2 was based were tested as the study progressed. Overall, results demonstrated that indeed, technology *did* provide access to literacy activities that benefited young children, whether they had disabilities or were at risk. Moreover, the integrated curricular approach used in the model offered a meaningful context for learning. Across a 3-year period, children in the treatment groups made gains in aspects of both literacy and technology use as shown in both quantitative and qualitative data. Across treatment groups, in Year 3, overall children's literacy gains and technology skills were greater in the treatment groups than in the comparison group.

Maintenance of the model was first tested in Year 1 in a comparison of G1 with G3. With one exception, at both the beginning and the end of Year 1, no significant differences were found between G1 and G3 children on the *ILA* or the *BIT*. Both groups made significant but similar gains as shown in post testing and classroom observations. G1 teachers had comprehensive E2 staff training and follow-up for the entire year while G3, composed of teachers who had used the model in E1, in outreach, or in model demonstration prior to the beginning of E2 were observed and children were tested. However, G3 teachers received no training or follow-up in Year 1. Nevertheless, their children made gains. G3 teachers maintained the model and began using computers with children early in the school year, often within two weeks of the start of school, while teachers in the other groups tended to wait longer, sometimes as long as two months.

When G3 teachers participated in training and follow up in Years 2 and 3, G3 children started at a higher level and outperformed the other groups on many *ILA* and *BIT* factors. Further study of the G3 teachers indicated that they used more elements of the model more of the time and placed higher on *Model Fidelity* criteria. G3 teachers used twice as much literacy based software as the other treatment groups and about two-thirds more graphic and writing software. Although seven G3 teachers participated, which might account for the greater numbers, remember that they were not observed as frequently as teachers in the other treatment groups, so it is not likely that the greater number of teachers is the reason for a report of more use of authoring and graphic software. Generally, teachers themselves reported using less authoring software and graphic software with their children. *HyperStudio* was used in the study. Currently, other authoring software that is more teacher-friendly is on the market. *HyperStudio* was purchased and available for all the treatment classrooms. G3 teachers made greater use of *HyperStudio* than the other groups, but used it far less frequently than literature-based software.

High model fidelity evaluations did not seem to depend on teaching styles or on years of teaching experience. However, results favor teachers who expressed a desire to participate in the study as opposed to those whose administrators asked their teachers to participate.

While all the teachers in the study had computer experience, some were more comfortable with allowing children to carry out operations including selecting software, starting it, navigating through the software, and similar behaviors. G3 teachers, who had used the model the longest, were most likely to let children work at the computer without 'standing over them' and giving directions.

Whether children were identified as having disabilities or were at risk, their literacy behaviors and technology skills increased during model participation. In some *ILA* and *BIT* factors, children with disabilities did as well as those at risk, although the latter pulled ahead of the former on some factors. Developmental delays or speech and language labels made up the greatest number of disabilities demonstrated by children in the study. The remainder ranged from autism to cerebral palsy. A greater number of children were at risk as compared with the number with disabilities. Four-year-olds outnumbered 3-year-olds; however, analyses of the effects of age on the *ILA* and *BIT* have not yet been run. Reasons for fewer 3-year-olds are not known. If Child

Find efforts were effective, it would seem that greater numbers of threes would be evidenced. Other factors might include school policy regarding acceptance of children during a school year.

While the present report contains comprehensive data analysis, the authors recognize the importance of further analyses regarding selected findings. Sifting through the results of massive amounts of quantitative and qualitative data collected during E2's three operational years remains an ongoing effort, triangulating findings across groups, times, sites, formal measures, and observations. Findings to date point to the effectiveness of the model in the 'real world' classroom context.

Impact

Dissemination

ELiTeC 2 dissemination activities focused on awareness, information about the model's effectiveness, and specific topics from E2 modules and curriculum. The object of dissemination efforts was to "get the word out" but was also instrumental in gaining two research sites, a Year 2 Group 2A site and the Year 3 Group 2B site. Dissemination activities included conference presentations, listserv postings, and a website.

Conference presentations. Staff members presented at 16 conferences (national, regional, and state), including the Early Childhood Technology Conference (local technical assistance conference), Illinois AEYC, (state early childhood conference), Midwest AEYC (regional early childhood conference), NAEYC (national early childhood conference), DEC (national early childhood special education conference), CEC (national special education conference), and NECC (national education technology conference). Over 635 early childhood educators, therapists, professionals, and family members attended these presentations. ELiTeC presentations focused on promoting literacy through technology and included such topics as *HyperStudio, Literacy and the Internet*; *Promoting Literacy through Interactive Software*; and *Merging Literacy and Technology for the Early Years*. E2 information was also presented to other researchers at poster sessions in Washington, DC, at annual project directors' meetings.

Listserv postings. E2 information was disseminated through the NAEYC Technology Interest Forum listserv. Bell, E2 coordinator, serves as a member-at-large for the Forum and responds to questions or enters discussions related to early childhood technology, as do other members of Center staff. E2 personnel also monitored discussions on the National Family Listserv.

Website. The ELiTeC web site <www.wiu.edu/thecenter/elitec/> was uploaded in the fall of 2001. The website's home page features four links: *Support and Review, ELiTeC Information, Resources and Links,* and *Family Center*. Each contains a pull-down menu of resources related to the topic. Links in *Support and Review* support each of the five training modules. Links in *ELiTeC Information* take the user to the E1 final report and resources such as Concepts of Print, Stages of Emerging Writing, Curriculum Activities, Software Recommendations, and Software Evaluation. *Resources and Links* contains links to websites on early childhood, special education, emergent literacy, professional organizations, software, governmental sources, adaptive devices, and children's educational sites. *Family Center* contains links to software recommendations and activities related to software.

Products

Products include video, print, and electronic materials. Details of each follow.

Video. *Early Learning Standards: Supporting Language Arts with Technology* was originally broadcast nationally in January 2002 via the WIU Satellite Education Network as an Illinois STARNET-sponsored satellite program. E2 staff and a Group 3 teacher discussed an approach to curriculum integration using an ongoing classroom project about trains. She explained how technology was used to support her curriculum, identified Illinois literacy standards met, and highlighted ways children's learning occurred. The broadcast was videotaped, and the video added to E2 training materials to demonstrate the use of different technologies and ELiTeC model implementation.

Toolkit. The Toolkit was developed as a complete resource for sites implementing the model. It can be used as a training package for model implementation. Each Toolkit contains the following materials:

(1) the *emerging Literacy and Technology: Working Together* curriculum guide;

(2) five DVDs: *LitTECH Interactive Presents: The Beginning of Literacy; Your Preschool Classroom Computer Center: How Does It Measure Up?; A Guide to Selecting Software for Young Children; Supporting the Early Childhood Curriculum with Technology;* and *Tools of the Trade: Early Childhood Software*;

(3) *Supporting Resource Materials*, a bound book of handouts used in workshops; and

(4) a CD containing evaluation instruments, module agendas, software and hardware resources, and evaluations of new software. The CD can be updated as new resources are published.

The Toolkit, completed in September of 2004, is being marketed through ads in *Illinois Reading Council Journal* and flyers distributed at conferences. We are also seeking collaboration with a commercial vendor for the Toolkit's production and distribution.

Future Activities

Future activities include further analyses of E2 data and to investigate interesting questions arising from E2 findings. The Center staff will keep abreast of current literature and current technology advances, using both to refine the model. Further research into specific aspects of literacy, the differential effects of technology on children with disabilities, and related areas will continue to be studied.

Dissemination of findings, training, consulting, and establishing replication sites will continue. In March 2003, the Center for Best Practices in Early Childhood proposed and was subsequently funded to engage in an outreach project titled "LitTECH Outreach." LitTECH is based on ideas that work–the results of E1, outreach and model demonstration projects, and E2. LitTECH's 3-year funding period began January 2004. The project's main goal is to link the effective results of emergent literacy technology research findings to early childhood practice to increase and improve emergent literacy practices for young children with disabilities and their families. The funding allows the Center to improve educational practice by linking tested research results of E1 and E2 to practice in replication sites; provide access to the general curriculum, specifically related to literacy development, to children with disabilities; promote awareness of the positive effects software and adaptations can have on children's literacy skills; provide effective teaching/learning strategies for early childhood personnel and families; advance the knowledge and competencies of those using emergent literacy technology applications with children with disabilities; provide an emergent literacy interactive technology curriculum, training modules and related training products; and increase local capacity.

LitTECH currently serves rural and urban sites in multiple regions in Illinois and Missouri. Classes within these sites were randomly assigned to either a treatment (replication) or comparison group. Five teachers from E2 serve on LitTECH Outreach's advisory panel. LitTECH is designed to further investigate the nature of effective administrative support for successful replication and to determine in which sites the model can be best implemented. Results will be disseminated to a variety of target audiences and will be incorporated on the Center's web sites. Center staff will continue to develop materials and to make available information on current software and technology applications as they become available.

The Center is currently working with ITLC (Interactive Technology Literacy Curriculum) Online, a 2-year Phase 1 Steppingstones of Technology Project funded in 2003, that also makes use of elements of E1 and E2. ITLC Online is designed to provide online workshops to early childhood teachers so they can implement the interactive technology and literacy model.

The ITLC Online website <www.wiu.edu/users/itlc/> contains six workshops, *Literacy Foundations*, *Literacy Environments*, *Children's Software*, *Technology Integration*, *Authoring Software*, and *Literacy Assessment*. Each workshop contains an introductory page with Purpose, Key Terms, Workshop Objectives, suggestions for further discussion, references, graphics, downloadable PDF files, and links to outside resources. A Resources section contains a glossary of terms, articles related to emergent literacy, a listing of recommended websites of organizations, software companies, family resources, and a searchable database of children's books. Other components of the website include About Us, ITLC FAQs, Using ITLC, and a Site Map.

The ITLC Online website is now in its final stages of development. Field-testing will be completed and final revisions made to the website during August and September 2005.

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