DOCUMENT RESUME

ED 468 324 EC 309 162

AUTHOR	Hutinger, Patricia; Robinsosn, Linda; Schneider, Carol; Johanson, Joyce
TITLE	The Early Childhood Interactive Technology Literacy Curriculum Project: A Final Report.
INSTITUTION	Western Illinois Univ., Macomb. Center for Best Practices in Early Childhood
SPONS AGENCY	Special Education Programs (ED/OSERS)
PUB DATE	2002-03-11
NOTE	99p.
CONTRACT	H024B50064
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	EDRS Price MF01/PC04 Plus Postage.
DESCRIPTORS	*Assistive Technology; *Computer Assisted Instruction; *Computer Uses in Education; Demonstration Programs; *Disabilities; Early Childhood Education; *Emergent Literacy; Models; Special Needs Students; Toddlers; *Young Children
IDENTIFIERS	Illinois

ABSTRACT

This final report describes the activities and outcomes of the Interactive Technology Literacy Curriculum (ITLC) project. This federally funded 5-year model demonstration project was designed to advance the availability, quality, use and effectiveness of computer technology in addressing the acquisition of emergent literacy among young children with mild to severe disabilities. ITLC promotes literacy knowledge and behaviors in young children with special needs by providing children with stimulating, meaningful experiences generated by an engaging set of activities using computers, accompanying peripherals, and software that contain developmentally appropriate content and elements of interactivity. Underlying the model is the assumption that emergent literacy is an important process that gives children the ability to deal with abstractions later used in writing and reading, which have roots in the scribbles, images, and pretend play of the young child. ITLC established three demonstration sites and three replication sites in rural and urban locations in Illinois during the 5 years of the project. A total of 291 children, 289 families, and 18 early childhood team members participated. Of the 291 children, 32 demonstration-site children and 11 replication-site children participated in ITLC for 2 years, while 8 demonstration-site children participated for 3 years. Children's emergent literacy skills and understanding of literacy concepts, as defined in theory and by the ITLC, improved as a result of their participation in the project. Children demonstrated increased communication skills, social interaction, fine motor control, attending, planning, and problem solving skills. Teachers who participated in the model designed classroom environments that promoted emergent literacy and designed activities that supported emergent literacy development. They improved competencies related to literacy, computer operations and adaptations, computer applications for children, and family involvement. (Contains 61 references.) (Author/CR)

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Patricia Hutinger, Linda Robinson, Carol Schneider, and Joyce Johanson

An Early Education Program for Children with Disabilities
Early Childhood Demonstration Project
U.S. Department of Education
Office of Special Education and Rehabilitative Services
Office of Special Education Programs

CFDA 84.024B
Project Number: H024B50064

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March 11, 2002

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Abstract

The Interactive Technology Literacy Curriculum (ITLC) project, a 5-year model demonstration project, was funded by the U.S. Department of Education's Early Education Program for Children with Disabilities and developed by staff at the Center for Best Practices in Early Childhood (formerly Macomb Projects) at Western Illinois University. The major purpose of the ITLC was to advance the availability, quality, use and effectiveness of computer technology in addressing the acquisition of emergent literacy among young children with mild to severe disabilities.

The ITLC model promotes literacy knowledge and behaviors in young children with special needs by providing children with stimulating, meaningful experiences generated by an engaging set of activities that use computers, accompanying peripherals, and software that contain developmentally appropriate content and elements of interactivity. Underlying the model is the assumption that emergent literacy is an important process that gives children the ability to deal with abstractions later used in writing and reading which has roots in the scribbles, images, and pretend play of the young child.

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Goals and Objectives of the Project

The Interactive Technology Literacy Curriculum (ITLC) project, a 5-year model demonstration project which began October, 1, 1995, was funded by the U.S. Department of Education's Early Education Program for Children with Disabilities and developed by staff at the Center for Best Practices in Early Childhood (formerly Macomb Projects) at Western Illinois University. The major purpose of the ITLC was to advance the availability, quality, use and effectiveness of computer technology in addressing the acquisition of emergent literacy among young children with mild to severe disabilities.

The ITLC model promotes literacy knowledge and behaviors in young children with special needs by providing children with stimulating, meaningful experiences generated by an engaging set of activities that use computers, accompanying peripherals, and software[1] that contain developmentally appropriate content and elements of interactivity. As a result, children have something interesting to talk about, to tell stories about, to 'read'[2] about, to draw and 'write'[3] about, to solve problems about, and to make judgments about. Benefits extend to children's families. Underlying the model is the assumption that emergent literacy is an important process that gives children the ability to deal with abstractions later used in writing and reading which has roots in the scribbles, images, and pretend play of the young child. Literacy provides a

[1] The terms "software" and "program" are used interchangeably throughout this narrative.

[2]Children usually "read" meaning into pictures, icons, and logos before they actually read words according to the emergent literacy approach. Children have concepts about the function of print, where it begins on a page, which direction one reads, before they read words.

[3]Children engage in scribbling and "writing-like" or "mock writing" images before they write using the conventions of manuscript writing taught in schools. Mock writing begins in children's drawings.

vehicle for children to grow in accompanying and inter-related aspects of communication, social and emotional abilities, motor abilities, and adaptive abilities.

Project goals were fourfold:

1. To develop, implement, and demonstrate an effective, replicable Interactive Technology Literacy Curriculum Project model, based on related research findings, observational learning theory, and selected teaching and learning strategies, to ensure that young children from 3 through 6 with a wide range of disabilities have access to the benefits of technology and integrated emergent literacy activities engaged in by young children without disabilities in normalized settings;
2. To enhance the knowledge and skills of children's families and their local education agency and/or service agency staff so they can effectively use ITLC activities with the children;
3. To provide families and staff with timely recommendations for appropriate integrated technology and emergent literacy activities;
4. To disseminate the model to other schools and agencies across the country so they can replicate the ITLC elements.

Objectives. The objectives were designed to obtain the goals cited above. They were divided into two major components: 1) Model Development objectives and 2) Direct Service objectives. Model Development objectives included the following.

- Accomplish start-up activities.
- Develop an effective interactive emergent literacy curriculum for children with mild to severe disabilities ages 0 - 8.
- Develop procedures to assist in the presentation of activities to children using a variety of appropriate teaching/learning strategies.

- Develop effective procedures and products to work with families of children at the ITLC demonstration sites.
- Develop effective staff development procedures and products to instruct staff at the demonstration sites to use the ITLC.
- Develop effective products to assist site staff to implement the ITLC project model.
- Disseminate information about the ITLC.
- Evaluate the ITLC Model Development objectives.

Direct Service objectives included the following.

- Implement the ITLC in demonstration sites.
- Provide information and skills related to the ITLC to families.
- Provide staff development information and skills related to the ITLC to demonstration sites' staff.
- Evaluate ITLC Direct Service objectives.

Theoretical Framework

The ITLC Project's approach, integrating interactive technology applications to literacy experiences for children with disabilities, represents a unique and innovative strategy. The federal priority for Model Demonstration Projects for Children with Disabilities, under which this project was funded, supported projects that develop, implement, evaluate, and disseminate new or improved approaches for serving young children with disabilities (infants, toddlers, and children ages birth through eight) and their families. To the extent appropriate, such models were to provide services in the types of settings in which young children without disabilities would participate.

Literature Review

The beginnings of literacy lie in the everyday experiences of early childhood and seem to be crucial to literacy acquisition (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, 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). Neither do these children enjoy a literacy environment at home where stories are read to them (Marvin, 1994). The educational experiences of young children with disabilities tend to focus on gross and fine motor skills, communication, cognition, and self-help skills rather than on aspects of emergent literacy.

In programs typically operating for young children without disabilities, which often serve as sites for full inclusion of children with disabilities, such as nursery school, day care, Head Start, and kindergartens, emergent literacy is a topic of great interest and is used in practice. Literacy is a social, psychological, and linguistic process. Emergent literacy's foundation is based in cognitive psychology and psycholinguistics (Gunn, Simmons, & Kameenui, 1995; Hiebert & Papierz, 1990; Katims, 1994; Mason & Allen, 1986; McGee & Lomax, 1990; Sulzby & Teale, 1991). 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 (Clay, 1975; Harste, Woodward, & Burke, 1984; Sulzby, 1990) as opposed to rote learning of letters, words, or sounds. Further, literacy is multidimensional and tied to a child's natural surroundings (Teale & Sulzby, 1989). Research cited in the following sections also demonstrates that children with disabilities benefit from a variety of literacy experiences.

Emerging literacy. Literacy concepts emerge very early in life. A summary of basic emergent literacy assumptions (Barclay, 1994) is shown in Figure 1. One of the unique characteristics of emergent literacy is that literacy acquisition is considered from the child's perspective, rather than from adult standards (Sulzby, 1986). Katims (1991) indicates, as do Teale and Sulzby (1986), that traditional subskill-oriented reading readiness programs were built upon a logical analysis of literacy skills from an adult perspective.

The concept of emerging literacy differs fundamentally from traditionally held views about reading and writing (Dyson, 1992; Mason, 1992; Strickland, 1990; Weir, 1989). The traditional approach, espoused by Gesell (1940) regarded the mastery of reading and writing as a difficult learning task and a complex achievement which required a period of intense readiness. Strickland (1990) described the traditional assumptions underlying reading, indicating that "only after children were thoroughly primed with the necessary prereading skills was 'real' reading instruction begun." (p. 20) Getting children ready consisted largely of direct instruction in learning letter names, visual perception tasks, and letter-sound relationships. Children did not learn to write until reading was well underway. Not until reading and writing began to approximate adult models were children considered literate. Within the traditional readiness framework, the *teacher is both keeper and dispenser of knowledge*. According to Strickland (1990), little use is made of knowledge about language that children bring with them to school.

In contrast, the emergent literacy view emphasizes the ongoing development of skill in reading and writing. Strickland (1990) stresses that participation in literacy activities that are meaningful and functional from the child's point of view are important conditions in an emergent literacy curriculum. Greenspan's (1998) position that experiences that are emotionally meaningful to children are the most effective for fostering the growth of brain and mind seems in

tune with Strickland's assertion and the ITLC emphases. Wells (1986) points out that literacy, like oral language, is acquired through the child's active sense making and data encountered in adult-child interactions. The teacher's *role is a facilitator of learning*. Dyson (1992) emphasizes that children's abilities as "drawers, talkers, and social players are linked in dynamic ways to their emerging skills as writers" (p. 2).

Figure 1. Summary of Basic Literacy Assumptions

We use pictures and words to communicate.

Pictures have meaning.

Pictures tell stories.

Words have meaning.

Words are used to tell stories.

The words tell about the pictures.

Children can make their own stories using pictures and words.

Stories have a sequence.

Stories have characters, actions, and settings.

Stories have a beginning, middle, and an end.

We read words on a page from left to right.

We read words from the top of the page to the bottom.

There is a one to one correspondence between written and spoken words.

Each word we say can be written down, using one or more letters of the alphabet.

Written words are separated by spaces, just as spoken words are separated by pauses.

Writing emerges in children's drawings.

Dyson (1992) assumes a social constructivist view of development in her discussion of the role of written language. She assumes that children construct their own understandings about the

world, including the understanding of how symbolic media work. They construct these understandings as they engage in social activities with other people (Vygotsky, 1978).

Teale, Hiebert, and Chittenden (1987) formulated a set of early childhood literacy development conclusions:

(a) Listening, speaking, reading and writing abilities develop concurrently and interrelatedly not sequentially;

(b) The functions of reading and writing are as much a part of literacy learning as are the formal skills;

(c) Children's early behaviors are a legitimate phase, rather than a precursor to, literacy;

(d) These behaviors and conceptualizations develop in predictable ways toward conventional literacy.

Crain-Thoreson and Dale (1992) concluded that story reading with parents contributed to the development of emergent literacy in four-and-a-half year old children who were verbally precocious at 20 months. Toomey (1991) also studied families' effect on children's literacy development. Whitehurst, Falco, Lonigan, Fischel, DeBaryshe, Valdez-Menchaca, and Caulfield (1988) found that children's oral language skills were enhanced by highly interactive story-reading.

Emerging literacy and children with special needs. Since much of what is known about emergent literacy has been based on research with typically developing children (Cousin, Weekley, & Gerard, 1993), even if teachers of youngsters with disabilities know about emergent literacy practices, they may question use of such practices with their children (Patzer & Pettegrew, 1996). Many children with oral language delays and impairments have significant literacy problems before they are in first grade (Scarborough & Dobrich, 1990). Although some

suggest that children with mild to moderate disabilities develop literacy in ways that are quite similar to those of children without disabilities (Brazee & Haynes, 1989; Cutler & Stone, 1988; Erickson & Koppenhaver, 1995; Goodman, 1982; Hasselriss, 1982; Katims, 1991; Pierce & Porter, 1996; Reid & Hresko, 1980; Wiederholt & Hale, 1982), typically these children do not have the opportunity to do so and as such, are the children who fall behind in kindergarten and the primary grades. Children who fail to "catch on" early keep falling further and further behind and are likely to end up repeating a grade or are assigned to transition classes (Strickland, 1990). As children who are "behind" in reading move into the upper grades, they do not "catch up." Rather they stay "behind" (Clay, 1979). The outlook for children with disabilities to experience opportunities to develop literacy is grim.

Many teachers do not view children with severe disabilities as capable of learning to read and write and consequently provide them with few opportunities to learn written language (Light & McNaughton, 1993). Koppenhaver and Yoder (1993) point out that even if teachers view the child as capable, that child is more likely to receive word level skill-and-drill activities, seldom reading or listening to text and more rarely, composing text.

Emphasis is placed on developing expressive and receptive language skills in preschool programs for children with disabilities, as well a traditional approach to reading that stresses "pre-reading skills" or "reading readiness skills" such as learning the letters of the alphabet. Attention is generally not focused on concepts related to emergent literacy. While many intervention programs work to extend the length of a child's oral utterance, programs may be well advised to promote those utterances that are useful and meaningful to children in their daily interactions (Mattick, l965). DEC (l993) urges that the functional, oral use of language in the

child's present social setting (and the potential for enhancing participation in mainstream settings) guide the selection and prioritization of goals.

Literacy is more than reciting the alphabet. When preschoolers 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 scribbles and in drawings; or when a three-year-old recognizes the Hardee's logo and asks for french fries, these children demonstrate behaviors associated with the emergence of literacy. However, initial literacy concepts such as these are seldom addressed in special education programs.

The emphasis for intervention in early childhood special education programs in regard to literacy is most often placed on the child's ability to communicate. Communication is an important element in literacy and includes language, drawing, and writing. Oral communication delays in the preschool years are frequently the criteria which result in a youngster's placement in special education services. Sometimes a child with severe disabilities does not communicate because s/he does not have the physiological capability to do so. Sometimes a child does not communicate, although s/he is physically intact. Sometimes a child has few if any experiences s/he wants to talk about or has not experienced conversational opportunities in the environment.

Pierce and McWilliams (1994) in discussing literacy activities for young children with severe speech and physical impairments (SSPI) noted that all too often, preschoolers with SSPI appear to be more cognitively disabled than may actually be the case. Pierce and McWilliams suggest that perhaps we should heed the advice of those (Butler, 1979; Katims, 1991 & 1994; Koppenhaver, Colman, Kalman, & Yoder, 1991; van Kleek, 1990) who propose that "no child is too cognitively, physically, or communicatively disabled to benefit from experiences with written language." (Pierce & McWilliams, 1994, p. 53).

Individual Education Plans (IEPs) tend to emphasize fine motor tasks and self-help skills. Erickson and Koppenhaver (1995) found that when IEPs focused on academics, tasks were likely to include name recognition and rote memorization. Longitudinal case studies (Hutinger, Johanson, & Stoneburner, 1996) of fourteen children who demonstrated moderate to severe disabilities support Erickson and Koppenhaver's findings, revealing that those children, in spite of having sporadic access to technology applications as they progressed through school, rarely learned to read nor did their IEPs focus on literacy behaviors. Models of best practice providing strategies in how to provide appropriate literacy instruction to children with disabilities are scarce at best (Erickson & Koppenhaver, 1995).

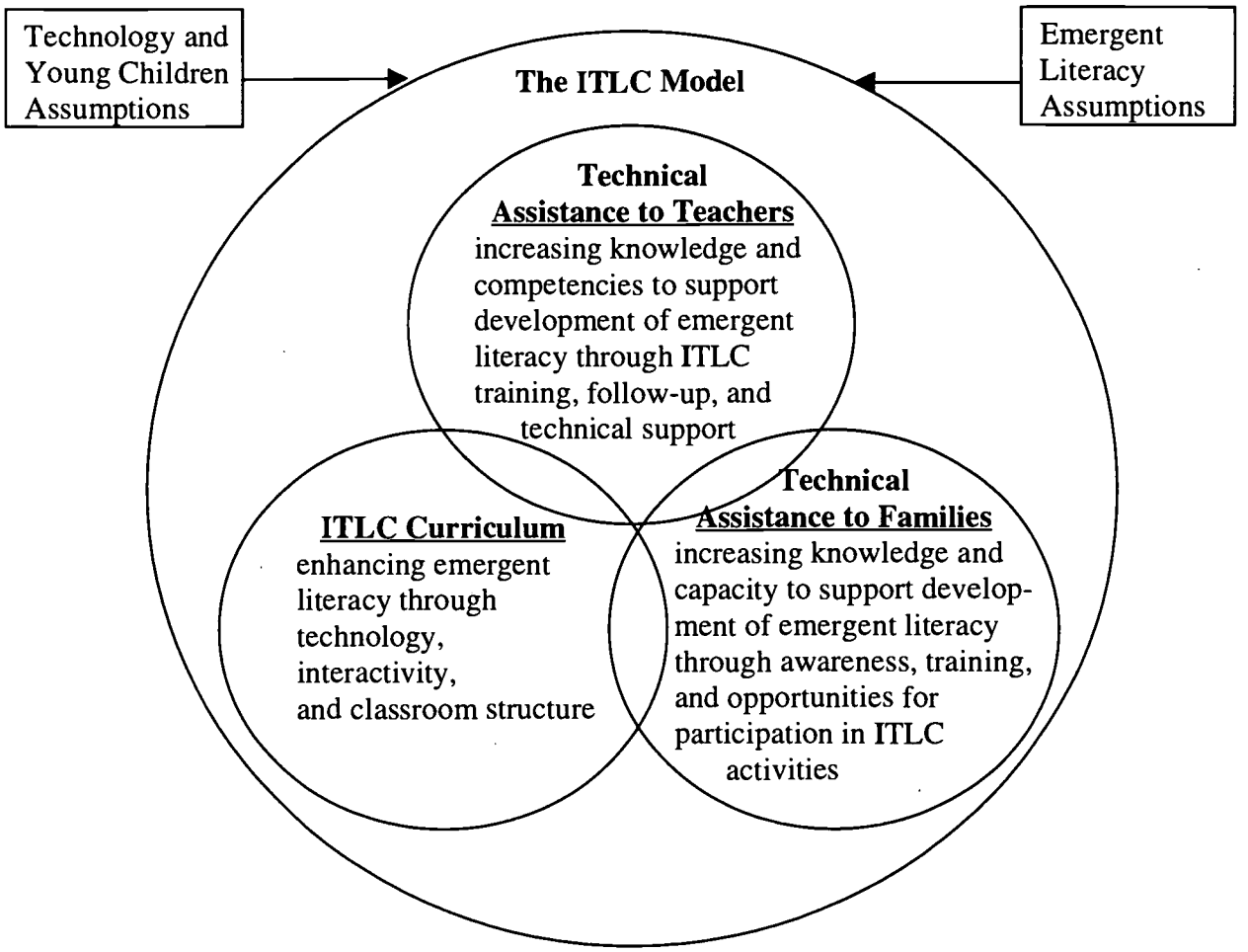
Rationale for combining interactive technology and emergent literacy. Computer technology, while not a panacea, provides access to instruction and learning for children with disabilities (Cassatt-James, 1992; Erickson & Koppenhaver, 1995; Hutinger, Johanson, & Stoneburner, 1996). Pairing appropriate literacy activities with current computer hardware and software provides interesting, activity-based experiences for children with or without disabilities. The ITLC is based on the level of interactivity and potency brought to emerging literacy activities by increasingly high quality software and hardware housing greater power and capability. A framework of assumptions related to the development of reading and writing influenced the processes used to develop the emergent literacy outcomes found in the curriculum. Interactive technology forms the basis for the activities that assist children to acquire and develop literacy and language pleasantly, productively, and appropriately.

Description of the ITLC Model

The Interactive Technology Literacy Curriculum Model is shown in Figure 2 and discussed in the following sections. Three components, Technical Assistance to Teachers, the ITLC

Curriculum, and Technical Assistance to Parents, provide the foundation for the model design. The model is based on the Early Childhood Emergent Literacy Technology Research Project[4] (Hutinger, Bell, Beard, Bond, Johanson, & Terry, 1998) procedures and materials, the theoretical formulations discussed in the literature, and Macomb Project's ongoing work with young children and technology.

Figure 2. The Early Childhood Interactive Technology Literacy Curriculum Model



[4] PR # H180G40078

ITLC model practices correspond to the 1998 reading research recommendations of the National Research Council.

Technical Assistance to Teachers is necessary in order to provide children and families with ITLC experiences. Included in this component are:

- Training on aspects of emergent literacy, technology applications, and the ITLC;
- Modeling ITLC activities in the classroom;
- Individual consultation and follow-up support.

The **ITLC Curriculum,** *eMERGing Literacy and Technology: Working Together*, integrates computer technology and emergent literacy experiences for children and includes the following:

- Emergent literacy theory and assumptions;
- Assumptions about technology and young children;
- Computer and peripheral operation;
- Software selection;
- On-computer activities derived from 1 and 2;
- Off-computer activities derived from 1 and 2.

Technical Assistance to Families is intended to improve the children's literacy environments in the home and includes the following:

- Awareness activities;
- Assistance with ITLC activities;
- Conducting ITLC activities at home and school.

Assumptions

The model is based on two sets of assumptions. One set regards emergent literacy (detailed in Figure 1 on page 10) and is derived from the literature. The second set of assumptions regards computer technology and young children. The technology assumptions were derived from more than 15 years of related research and development activities in Macomb Projects' funded model demonstration, outreach, inservice, software development, and research studies that focused on technology applications for young children with disabilities, their families, and staff members.

Assumptions regarding technology and young children. The following nine assumptions provided the technology basis for the model.

1. Computers and their accompanying peripherals paired with appropriate software equalize opportunities for children with disabilities and make it possible for them to interact with the environment in ways not possible before the advent of personal computers.
2. Computers and software are learning tools which have multiple uses, result in multiple learning experiences, and can be integrated, along with related off-computer activities, into a variety of early childhood curriculum strategies and content areas. Software can be used to introduce a new curricular topic or supplement an existing curricular theme.
3. Software appropriate for young children with disabilities is the same software that is appropriate for young children without disabilities although the adaptations for its use are different.
4. Appropriate software can provide experiences that are not available in any other single medium (i.e., pictures in stories can be animated, can produce sound, and can highlight words or phrases all at the same time).

5. Computers, assistive adaptations, and appropriate software allow children, including those with physical disabilities, to be in control of their own experiences and learning in ways that cannot be matched by other materials and experiences.
6. Computer activities lead to positive social interaction between and among young children.
7. Computer activities lead to communication events, problem solving, independence, and other positive developmental behaviors.
8. Children's typical experiences and activities are natural sources for learning as opposed to contrived activities in "workbooks," cartoons, and most current television shows and commercial curricular materials aimed at children.
9. Children learn through play and learn best when they are actively involved and interested in the learning experience.

Technical Assistance to Teachers

Before children and families can benefit from the ITLC, teachers must be trained to apply the elements of the model. Group workshop training on the model, including emergent literacy, technology applications, and the ITLC was conducted at the beginning of each school year and again in the early spring on campus at Western Illinois University. Information used in training was compiled and included in the ITLC curriculum. Training content includes information on the classroom environment, the computer center, software selection, equipment operation, curriculum integration, *HyperStudio* applications, family involvement, and assessment.

Cuban's (1997) assumptions about innovation and teachers address the differences in model implementation among teachers. He pointed out that change in teacher behavior is complex and multidimensional, involving (a) changes in teacher beliefs and theories about learning and teaching, (b) changes in teaching activities, (c) changes in instructional materials and

technologies, and (d) changes in the classroom's social organization. Cuban (1997) also referred to teachers as "gatekeepers" of their classrooms, where they are in control of the students and learning environment. Therefore, they tend to be selective about the innovations they choose to implement and often adapt only the portion of an innovation they find useful or convenient.

Teacher training topics were based on an informal needs assessment and included strategies to arrange the environment, making it conducive to children's learning in developmentally-appropriate ways while introducing computer literacy materials. Teachers learned to use different types of computer software with preschool children and learned ways to customize and make necessary adaptations to meet individual needs. This involved changing switches, using touch tablets, using adaptive keyboards with larger keys or creating overlays for keyboards so children would be able to 'turn the page' of a software book. Teachers learned to use augmentative communication devices and alternative input devices to help equalize motor impairments. Teachers learned to use amplified sound and provide visual reinforcement for children with auditory impairments. They learned to use touching and exploring accompanying three-dimensional figurines to feel the figures in the book for children with visual impairments.

The teachers had input into activities that could be shared with the other sites. During workshops and meetings, one or more sites shared a useful activity with the other sites. For example, Site 2 took a field trip to the zoo. Before they went, the children studied various zoo animals. The children's drawings of animals were made into heat transfers which, along with the name of the school, were then printed onto tee-shirts. The children wore these tee-shirts to the zoo as an aid for keeping the group together and easily identifying any children belonging to the group. All day at the zoo, people commented on the shirts and asked how they were created.

When the ITLC was first introduced into the sites, project staff spent several days a week at the site, modeling ITLC activities and adaptations in the classroom. Planning with the teacher, project staff modeled use of software while meeting conditions such as *'more than one child at the computer,' 'give children time to explore what the software will do,' 'responding to children's questions and comments,'* and *'facilitate rather than direct when possible.'*

Individual consultation and follow-up support were provided at each site. Teachers consulted with project staff by phone on topics ranging from computer trouble shooting to recommendations for buying software when school district funds were available. Support in developing *HyperStudio* stacks and specific adaptations were provided.

The Interactive Technology Literacy Model Curriculum

The curriculum, *eMERGing Literacy and Technology: Working Together* (Hutinger, et al., 2001) was developed in 1997 and later revised. The curriculum represents a collaborative effort among several experts who possessed a combination of literacy and technology experience. It is based on the assumptions cited in the preceding section, on tenets of emerging literacy described earlier, and the results of a literacy research study (Hutinger, et al.,1998). Equipment and software selection procedures and descriptions of each of the three ITLC sections follow.

Equipment. Assistive technology equipment includes computers and a variety of peripherals. Computers must have sufficient hard disk space to permit the installation of literacy-based software programs. The computers have CD-ROM drives and are capable of running software utilizing the CD-ROM technology which can store large amounts of information necessary for complex programs. Examples of alternative and adaptive input peripheral devices include the TouchWindow®, IntelliKeys™, Discover:Kenx®, switches, and the Key Largo™. Digital video and still cameras and scanners are used in the 'capture and create' process of

developing software. Printers capable of printing the child and classroom projects in color are essential.

Software selection. Figure 3 shows three categories upon which the ITLC staff and site teachers base software title selection. Software used in the ITLC is developmentally appropriate early childhood software that can be used in any setting by any child, whether the child has a disability or not. ITLC staff do ***not*** advocate specific kinds of software for a specific disability (i.e., specific titles for children with autism, or learning disabilities).

Figure 3. Considerations for Software Selection

Child Characteristics
1) Developmental Level
2) Abilities
3) Need for Adaptations
4) Interests
5) Educational Goals
6) Family Culture, Values, Environment
Classroom Curriculum, Teacher's Educational Goals
1) Daily Activities
2) Curricular Themes and Experiences
3) Children's Educational Goals (IEPs)
Software Characteristics
1) Level of Interactivity (See Figure 4)
2) Capability for Adaptation
3) Theme, Content
4) Technical Characteristics (e.g., compatibility with classroom computer; program features and options)

Three major types of software used in the model follow. (1) **Interactive literature-based software** can be used to extend literacy concepts and behaviors including the Living Books series such as *Just Grandma and Me*, *Harry and the Haunted House*, and *Stellaluna* . (2) **Authoring software** such as *HyperStudio* can be used by teachers and children to develop their own software based on meaningful experiences including a favorite story, a description of the children and their classroom, art work, a field trip to the apple orchard, and information and photographs of children's families. (3) **Tool function software** includes graphics and story-making software such as *Kid Pix 2*, *EA*Kids Art Center*, and *Stanley's Sticker Stories,* as well as *KidDesk*, a desk top management program.

Current developmentally appropriate software reflects a multimedia approach, incorporating sound (speech, music, noises), graphics, animation, text, photographs, and video (Hutinger & Johanson, 1998). Using such software provides experiences that cannot be accomplished in any way except through a combination of technology applications.

Interactive software is divided into five levels of interactivity based on criteria shown in Figure 4. Software titles used in the ITLC are also identified in Figure 4. Software interactivity is related to advances in technology, to the intended function of the program, and to the degree of interaction that occurs between the child user and the software program (Hutinger & Johanson, 1998). The more interactive the program, the more the child is able to manipulate what happens when the program is used. Level 1 software functions as tutorial software. It offers limited choices and follows a specific, preselected path. Levels 2 and 3 offer children multiple choices but little control over the path. Level 4 software gives many choices. Users can control the paths they wish to follow as they move through the story. Level 5 software give total control over a wide range of elements. Lahm (1996) reported that children preferred programs with higher

interaction opportunities. Increased interactivity offers the opportunity for a greater number of option choices; a wider range of responses and outcomes; and greater control of design features, such as sound, graphics, text, and outcomes. However, the alternative input methods, including switches and scanning, available at the present time sometimes limit the degree of interactivity that is possible in a software program.

The intended purpose of the software must be factored into selecting elements of interactivity. The intended ITLC outcomes for software relate to a range of assumptions about emergent literacy (see Figure 1, page 10) such as "*a story has a beginning, a middle, and an ending*," and "*written letters have meaning.*"

When children have disabilities that require adaptations, selection involves the ease with which a program can be adapted. Sometimes commercial programs have built-in switch options, or have accompanying overlays for use with IntelliKeys or Discover:Kenx. Levels of switch progression developed by Project ACTT: Activating Children Through Technology (Hutinger, 1993,1996) are used in selecting switch software to match individual children's abilities. Software options for simple or complex scanning are considered for children who need switch access for communication. Programs, such as *Storytime Tales* and *Pippi,* have the options of switch use with scanning to turn the page in the story or to select objects to activate on the screen.

Programs which contain stimulating sounds are selected with attention to the type and variety of sounds for those with poor vision. When selecting storybook programs, the degree of simplicity of the story lines, size of the text on the screen, clarity and understandability of computer reading voice (most programs contain human voice which is easy to understand) are considerations. The design and color of the graphics on each page are evaluated as is the presence of a clear image on

Figure 4. Characteristics of Five Levels of Interactivity Paired with Software Used in the ITLC

Levels of Interactivity	Software Examples
Level 1 • Minimal choices are offered • Path is pre-determined • Choice response is fixed • Text (if any) is set and cannot be controlled or manipulated • Sound control is limited to on/off; up/down • Graphics are fixed and cannot be controlled or manipulated	*Amanda's Stories* *Baby Bear's Bubble Bath* *Chick Chicka Boom Boom* *Cinderella* *Circletime Tales* *JumpStart Toddlers* *The New Kid on the Block* *Press to Play—Animals* *The Rodeo* *Storytime Tales* *Switch Intro* *The Tale of Peter Rabbit* **All software at this level related to ITLC Section I**
Level 2 • Multiple choices are offered • Path is divergent but predictable • Choice response is varied • Text (if any) is set and cannot be controlled or manipulated • Sound control is limited to of/off; up/down • Graphics are fixed and cannot be controlled or manipulated	*The Backyard* *Bailey's Book House* *Berenstain Bears in the Dark* *Harry and the Haunted House* *How Many Bugs in a Box* *Just Grandma and Me* *Just Me and My Dad* *Little Monster at School* *Magic Tales* series *McGee* series *Muppets on Stage* *The Playroom* *Stellaluna* *Toystore* **All software at this level related to ITLC Section I**
Level 3 • Multiple choices are offered • Path is divergent and user is given moderate control • Choice response is varied • Text (if any) is set and cannot be controlled or manipulated • Sound control is limited to of/off; up/down • Graphics are fixed and cannot be controlled or manipulated	*A to Zap* *ArtSpace* *Busytown* *Green Eggs and Ham* *Just Me and My Mom* *Let's Explore the Airport* *Let's Explore the Farm* *Let's Explore the Zoo* *My First Incredible Amazing Dictionary* *Pippi Longstocking* *Ruff's Bone* *Workshop* **All software at this level related to ITLC Section I**
Level 4 • Multiple choices are offered • Path is divergent and user is given total control • Choice response is varied • Text (if any) is set and cannot be controlled or manipulated • Sound control is limited • Graphics can be somewhat controlled or manipulated	*Big Job** *Colorforms* *Crayola Art Studio* *EA*Kids Art Center* *Explore-A-Classic series* *Explore-A-Folktale series* *Explore-A-Story series* *Gryphon Bricks* *Kid Pix* *Kid Works 2* *KidWorld* *Stone Soup* *Storybook Theatre* *Storybook Weaver* *Thinkin' Things** **All software at this level related to ITLC Section III, except those marked*, which are Section I software**

Level 5
• User is given wide variety of choices and has total control over
  • path
  • responses
  • text
  • sound and sound effects
  • graphics
  • content
	Blocks in Motion
	HyperStudio
	Logo
	All software at this level related to ITLC Section II

each screen that relates directly to the story's text. These factors are important for keeping the child's attention at the computer and maximizing emergent literacy gains.

The ITLC Curriculum Section Content

Section I targets interactive literature-based early childhood software which can be used to extend literacy concepts and behaviors. Living Books (Brøderbund) software and other programs based on popular children's stories are effective literacy materials and often include a hard-copy book which children use both during computer use and in off-computer activities. When children use storybook software, such as Living Books' *Just Grandma and Me,* they can choose a "Read" or "Read to Me" mode or a "Play" or "Let Me Play" mode. Some of the Living Books programs also offer the option of hearing the words in English or Spanish (*Just Grandma and Me* has a third option of Japanese), making the software appropriate for multicultural use. Individual words or phrases are highlighted as the story is read. When children play with the text, they can click on one word any number of times to hear and see the highlighted word repeated. The sequence of the story is predictable; however, children also can click on various figures or objects on the screen that react in unexpected ways. For example, one day children in the Site1 classroom found a funny character that came out of the beach towel on a page of *Just Grandma and Me*. The two boys at the computer laughed loudly and kept going back to that character, their laughter drawing other children's attention to what they were doing. Children were attracted by the gaiety and gathered around the computer to see what was happening. Later, each child in the class wanted to find that page in the story and spent the time necessary to do so.

With programs such as *Stellaluna,* children tend to spend the most time on pages containing animation and sounds. When they first use an interactive program such as *Stellaluna*, some children may engage in extended exploration of the first page of animation. *Green Eggs and*

Ham contains picture representations of some of the words in the story, so children can click a word to see the corresponding picture. They remember which words they can click in order to get the picture. Since words in the Living Books software are spoken individually by clicking the word, children explore the sound of words, repeating interesting words, then move on to new interests.

Section II focuses on the authoring program *HyperStudio,* which allows children and teachers to make interactive, multimedia software, unique to experiences in their own homes and classrooms. Creating classroom software using *HyperStudio* involves producing a series of 'cards,' and 'stacks.' One or more cards are linked together by 'buttons' (hot spots) to make a stack. Buttons on the individual cards trigger sound effects, animations, real time video, text, and transitions to the next card in the stack. *HyperStudio* includes graphics tools to draw on each card although photographs, drawings, and video footage may be imported to the card. The program includes sounds but also allows sounds, such as the voices of children, family members, pets, and staff, to be recorded. The ITLC curriculum contains information about using *HyperStudio,* as well as suggestions for creating *HyperStudio* stacks.

HyperStudio products can be based on the authentic experiences and interests of young children. Such content can logically be extended for use in multicultural settings as well as inclusive settings since it can be individualized and addresses the usual and unusual daily experiences of a wide range of children both with and without disabilities (Bell, Clark, & Johanson, 1998). Stacks can be used to relive family and classroom events, to retell familiar stories, to author new stories, and to reinforce and facilitate learning activities and experiences at home and school.

For example, a Site 2 *HyperStudio* project involved a predictable story, *The Gingerbread Man*. After reading the already familiar book, children drew pictures and, with the teacher, produced their own version and incorporated characters from the pictures. Their pictures were scanned into *HyperStudio*, so that each child had his/her own page in the story. 'Hot buttons' were added that caused animation, triggered sound effects, and activated the narration. Words were also added. If the word clicked on was a verb, then action occurred as the word was spoken. Each button could be activated repeatedly. In the final version of the software, a click on a child's picture caused that child's voice to be heard or a video of the child to be activated. A click on the gingerbread man made him *run, run, run as fast as he can.* A click on the arrow in the lower right corner caused the page to turn and the next part of the story to be displayed. By participating in this *HyperStudio* project, children learned that text proceeds from left to right, sequence can be predicted, and that they could retell a story.

Section III focuses on the tool use of graphics, management, and story-making software. Tool function software is identified in Figure 4. Graphics (drawing and painting) programs, such as *Kid Pix*, were used to make images on the monitor screen or printed to make hard copy. These pictures were used in *HyperStudio* stacks, displayed in the classroom and taken home, and used for other purposes such as making cards and books. Pre-made icon stamps from *Kid Pix* were also used in the stacks.

KidDesk, a desktop management system, played a special role as a tool program for both the teachers and children. Each child's picture and desktop were included in the program. When a child approached the computer, he/she found his/her picture and made a choice of a software program, unless the teacher had a program opened that she wanted the children to use. Even then, if a child wanted something else he/she could usually figure out how to get back to his/her

desktop in *KidDesk*. If a child entered another child's desktop, she noticed right away either by the picture, the style of desktop, or the program choices. She might choose to go back to her own desktop or to explore the other child's program choices. *KidDesk's* e-mail and voice mail capabilities increased the emergent literacy behaviors within a classroom and facilitated children's choices and decision-making (i.e., what software program shall I use today?)

Tool use software includes programs such as *Everyday is a Holiday,* which allow children to create their own story by selecting and placing characters and objects on specific backgrounds. Children's pictures were printed and shared with family members or displayed in the room. Each of these programs contains different options for creating a story. For example, using *Everyday is a Holiday,* children clicked and selected ready-made characters and settings and moved things around on the screen easily. *IntelliPics* was used to create animated pictures and stories with text and drawings or clip art.

Although Section III is based on graphics software, *Kid Pix Deluxe* contains an option to create a slide show and tell a story. Since the program is easier to use than *HyperStudio*, it may be introduced before moving to the more complex program. Children drew pictures with *Kid Pix*, then added sounds such as speech, sound effects, or music to produce pages in a story. Using the slide show option, the pages run automatically. Site 2's slide show focused on a field trip to the Apple Orchard and is shown in *A Preschool Story.* Content of another slide show was based on children's impressions of their first few days at school. This slide show was then shown at an open house for families at the beginning of the school year in both Site 2 and 3 classrooms.

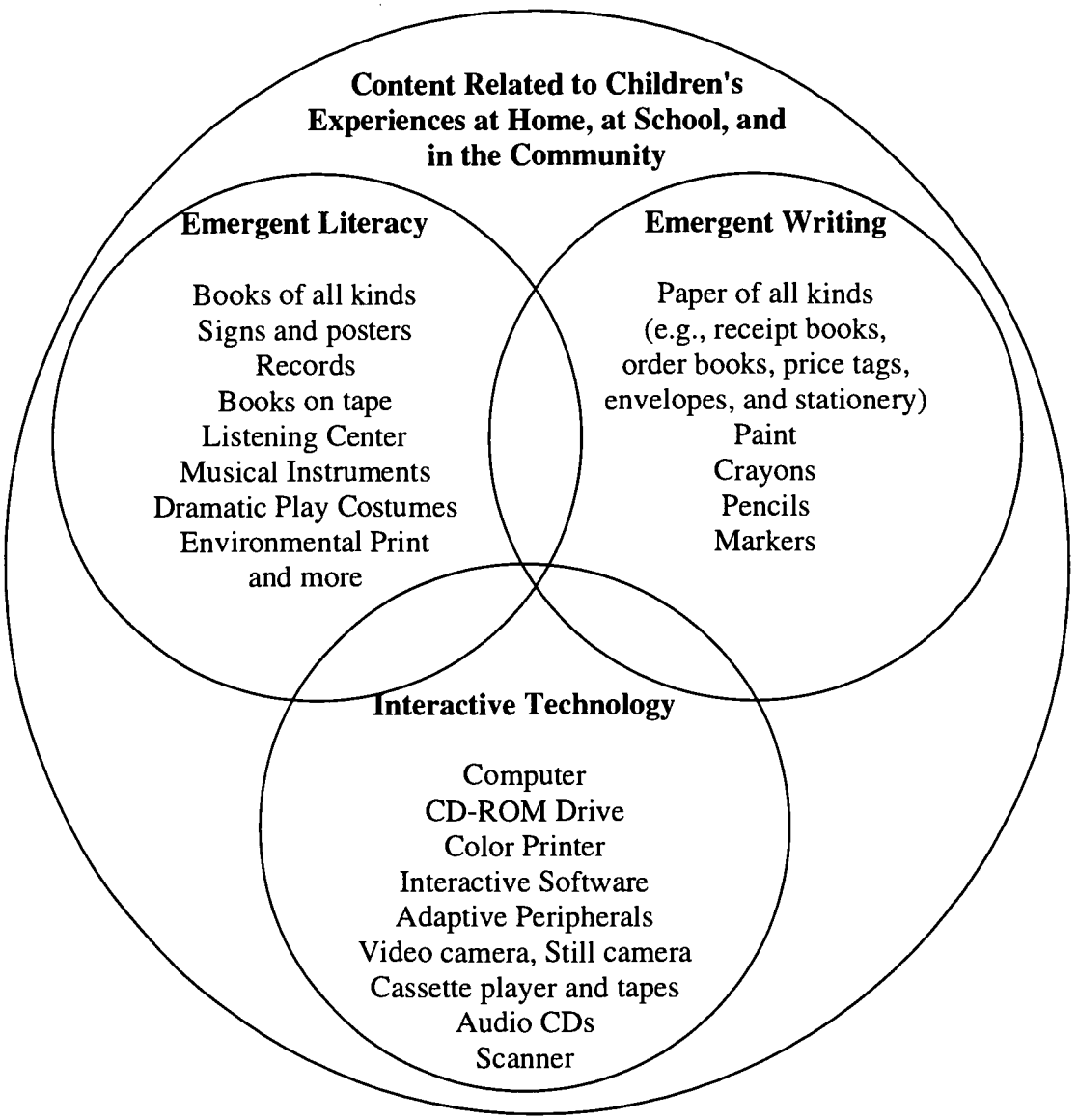
ITLC Structure

Organizing the curriculum to include emergent literacy activities involves adult planning, organizing space and materials, structuring and implementing activities, and evaluating

activities. Structure in early childhood programs can be defined according to four different dimensions: (1) structuring materials; (2) structuring activities; (3) structuring time; and (4) structuring space. Viewing structure in terms of these elements provides useful discriminations for planning early childhood services and relates to Montessori's structured, 'prepared environment,' child-sized materials, sequences of procedures, and big blocks of time so that children are not rushed from one activity to another.

Structuring materials and equipment. Structuring materials and equipment relates to availability and arrangement of materials. Figure 5 shows ITLC curricular materials useful in emergent literacy, emergent writing, and interactive technology. Books and activities related to software, such as copies of books from the Living Books collection, are arranged attractively on shelves and/or tables close to the computer. Software is organized so that children can make choices and start the programs of choice or the software the teacher intends to use will be ready to operate when children arrive. In addition to resources for books, paper, crayons, paint, pencils, and other materials related to literacy, dress-up clothes and props (such as chef hats and aprons to go along with *Pippi)* are stored close by the playhouse and easily accessible to a table or clear floor space. Related materials for drawing and painting, such as those needed to make a Villavillakulla sign for *Pippi*, are rotated in and out of the art center, stored close together and easily accessible. If props are to be made by drawing with colored non-toxic markers on cardboard boxes (i.e., the construction of small houses to go along with the construction theme in *Kids on Site)* the materials are arranged close to a floor space that will allow the work to progress smoothly away from the computer center.

Figure 5. Interactive Technology Literacy Curriculum Materials



Structuring literacy activities. Strategies are incorporated in the ITLC to integrate a variety of curriculum areas including science, social interaction, daily life activities, music, and art into the literacy activities. Activities are planned and implemented which can be used in different ways by different children, depending on specific needs. For example, groups or individual children can put together stories about their own family or about classroom group events with *HyperStudio*, using alternative input if physical needs require adaptations. The story can be

printed as a book to share at school or at home. If the children's work is collected to make a class book, the hard copy produced on the printer by the child with severe disabilities can be included or the picture can be taken home to display in the home art gallery—usually the refrigerator door!

Structuring activities may mean providing graphic, written, or verbal directions to determine a sequence of steps (e.g., children follow drawn instructions [icons] for planting grass seeds in a cup). Structuring materials relates to availability of materials and to adaptations of materials for use by children with severe disabilities. For example, a child with physical disabilities may need a customized switch set-up opened on the computer before she can use a software program, while another child with mild disabilities is able to open a program on his own.

Structuring time and schedules. Emergent literacy activities are integrated into daily schedules. Structuring time is related to schedules which affect both children and adults. Ample time is allowed for developing interactive technology literacy authoring projects such as *HyperStudio,* rather than adhering to strict schedules. Children who are attending to an activity have time to complete it rather than being interrupted in the middle of something they deem important. Literacy activities occur during free choice time and during planned activity time and are expected to minimally average 20 to 30 minutes or more, depending on the activity, 5 days a week.

Sign up sheets, pages, or books are used to manage turn-taking on the computer (Godt, Hutinger, Robinson, & Schneider, 1999). Teachers may choose to use one or more procedures for signing up as explained in the ITLC curriculum.

Structuring space. This element is related to room arrangement and organizing space to facilitate carrying on a variety of activities. The ITLC curriculum addresses issues and

recommendations related to arranging the environment for both literacy and computer activities. Structuring materials is closely related to arranging the physical environment.

Meeting Individual Goals

Literacy technology activities contained in the ITLC can be tailored to meet the individualized needs of preschool children. The activities are viewed by the teachers as activities that provide the strategies to meet goals, rather than as the goals themselves. School district policies for writing IEPs are in place and teachers do not change them. Suggested applications, materials, and equipment assist families and teachers in ensuring that each child has the opportunity to meet goals planned for the year. Project staff provide consultation to families and site staff as needed to make adaptations for children with severe disabilities. A list of the recommendations we speak to teachers about include the following: (a) Improve language skills by labeling items in books, retelling stories, making up stories, answering questions about a story; (b) Improve cognitive skills by identifying name in print, pointing to a labeled picture in a book, predicting events in a story, sequencing a story; (c) Improve fine motor skills by writing name on computer sign-up sheet, using mouse or adaptive input device to access software, pointing to text on a page from left to right, pointing to text as it is read.

Teaching Strategies

While an activity or experiential based curriculum for special needs preschool children is recognized as developmentally appropriate, the path towards learning has many routes. Some children with special needs learn in child-directed activities while others may need a more structured approach. Wolery (1994) noted that child-initiated interactions with the environment are valued highly since they allow children to be independent learners as well as to interact in

creative and useful ways. Further, such interactions provide a way for children to acquire the skills of self-direction and control.

A variety of strategies are employed in the ITLC to accommodate differences in teachers, children and experiences because we believe that it is important for teachers to analyze their own instructional style and behavior then use appropriate strategies to accommodate for differences in children. Differences may be related to culture, values, multiple intelligences, developmental levels, and disabilities. ITLC supports a variety of teaching strategies, including structuring space, structuring the social dimension, using children's preferences, structuring routines, structuring play activities, structuring computer activities, using differential reinforcement, using naturalistic teaching strategies (such as modeling), using peer-mediated strategies, and using response-prompting procedures.

Technical Assistance to Families

The Technical Assistance to Families component involves activities provided by site staff. This component is intended to improve the children's literacy environments in the home. Parent involvement in the model assumes three levels—awareness, assisting, and conducting literacy activities. However, most parents and teachers in the model sites seemed most comfortable participating at the awareness level. School district policies, written and unwritten, affect family participation and evaluation as well as teachers' willingness to carry out a variety of activities for families.

Parent events described in the curriculum include informational meetings, newsletters, literacy materials, and sharing class-made *HyperStudio* books and writing materials. Workshops provided the most appropriate form of technical assistance and seemed to fit with the busy lives

families lead. Additionally, parents facilitated literacy activities at home based on information received in the newsletters.

Demonstration and Replication Sites

ITLC established three demonstration sites and three replication sites in rural and urban locations in Illinois during the 5 years of the project. Demonstration sites which began during the first three years were Site 1 in Bushnell, and Sites 2 and 3 in Springfield. During the fourth and fifth years, ITLC established three replication sites, Sites 4, 5 and 6. The sites were in three different locations, Site 4 in Farmingdale, Site 5 in Springfield, and Site 6 in LaHarpe.

Description of Participants

Number of participants involved. During the 5-year project, a total of 291 children, 289 families, and 18 early childhood team members participated at one of six rural and urban project sites. The three demonstration sites had 119 children, 117 families, and 9 early childhood staff, while the three replication sites had a total of 172 children, 172 families, and 9 early childhood staff members. Table 1 shows the distribution of children, family, and staff at each site over the 5-year period. Out of the 291 children, 32 demonstration site children and 11 replication site children participated in ITLC for 2 years, while 8 demonstration site children participated for 3 years. Table 2 shows the distribution of children at each site according to number of years participation.

Table 1: Distribution of Children, Families, and Staff at Each Site During Years 1-5

	Children					Families	Teachers/Staff
	Year 1	Year 2	Year 3	Year 4	Year 5	Years 1-5	Years 1-5
Site #1	10					10	2
		14				13**	(2)
			17			16**	(2)1
				14		14	(3)
					10	10	(3)
Site #2		19				19	2
			20			20	(2)
				19		19	(2)
					19	19	(2)1
Site #3		19				19	3
			20			20	(2)
				16		16	(2)
					12	12	(2)
Site #4				14		14	3
					17	17	1(3)
Site #5				19		19	2
					15	15	(2)
Site #6					17	17	3
Total	10	52	57	82	90	289	18

** Some families had more than one child in the classroom.
( ) Indicates teacher/staff was in program from previous years.
Total Children for Years 1 - 5 = 291

Table 2: Distribution of Children According to Years of Participation

Site	1 Year Participation	2 Year Participation	3 Year Participation	Total
Site #1	47	12	6	65
Site #2	64	12	1	77
Site #3	58	8	1	67
Site #4	26	5	0	31
Site #5	28	6	0	34
Site #6	17	0	0	17
Total	**240**	**43**	**8**	**291**

Disabilities. Children displayed a variety of disabilities as shown in Table 3. The largest percent of children (48.82%) exhibited speech and language disorders, while 25% had developmental delays. Smaller numbers of children displayed other disabilities. The number of disabilities displayed at each site is discussed in the site's description. All children participating in model development were 3 to 5 years of age and were eligible to receive special education services according to the criteria established by local school districts in keeping with the policies of the Illinois State Board of Education.

Program staff. Teachers at all six sites possessed some computer skills before starting the project. The Site 1 teacher had the most experience at integrating technology into her curriculum and was able to quickly adopt the ITLC model. The three Springfield site (Site 2, 3, and 5) teachers had technology activities in place on a smaller scale in their classrooms. The Site 4 teacher also had previous experience with technology since she had received training through one of the Center's other technology-related projects. The Site 6 teacher had the least amount of computer expertise when she began replicating the ITLC model.

Characteristics of Sites

The six early childhood classrooms in West Central Illinois implementing the ITLC model represented differing communities and differences in the length of time and degree they implemented the model. The demonstration sites had longer involvement with ITLC than the replication sites. Site 1 had 5 years involvement, while Sites 2 and 3 implemented the model for 4 years. Replication Sites 4 and 5 both had 3 years involvement, while Site 6 was involved in ITLC for only one year. Sites 1, 4 and 6 are in rural Midwest farming communities, while the

Table 3: Disabilities of ITLC Children from 1995-2000

	95/96	96/97	97/98	98/99	99/00		
	# of Children	# of Children	# of Children	# of Children	# of Children	Total # of Children	Total %
Developmental Delay	7	11	10	23	23	74	25.44%
Speech & Language	1	28	38	43	32	142	48.82%
Behavior Disorder	1	0	0	2	2	5	1.72%
Physically Handicapped	0	0	0	2	4	6	2.06%
Other Health Impaired	1	5	0	4	9	19	6.53%
Mentally Impaired	0	2	1	1	6	10	3.44%
Physically Handicapped/Developmental Delay	0	0	2	0	2	4	1.37%
Developmental Delay/Speech & Language	0	0	0	0	4	4	1.37%
Developmental Delay/Other Health Impaired	0	1	1	1	0	3	1.03%
Cerebral Palsy	0	4	0	0	0	4	1.37%
Speech & Language/Vision/Behavior Disorder	0	1	0	0	0	1	.34%
Autism	0	0	1	2	0	3	1.03%
Vision	0	0	1	0	0	1	.34%
Physically Handicapped/Vision	0	0	1	0	0	1	.34%
Mentally Impaired/Vision	0	0	1	1	0	2	.69%
Physical Handicapped/Speech & Language	0	0	1	0	0	1	.34%
Mentally Impaired/Speech & Language	0	0	0	1	0	1	.34%
Physical Handicapped/Mental Impaired	0	0	0	1	0	1	.34%
Other Health Impaired/Speech & Language	0	0	0	1	0	1	.34%
At-Risk	0	0	0	0	8	8	2.75%
Total	10	52	57	82	90	291	100.00%

three urban sites in Springfield, Sites 2, 3, and 5 represent a wider range of cultures, socio-economic conditions, and disabilities.

Demonstration Sites

Site 1. The initial ITLC site (Site 1) was located in Bushnell, Illinois, a rural community of 3200 people. This site represents a small school district and has two half-day classes that meet for two and a half hours each day. One teacher and one program assistant served 10 children with mild to moderate disabilities during Year 1. The number of children fluctuated between 14 in Year 2, to 17 in Year 3, and back to 14 in Year 4. During Year 5, ten children participated in the program. A total of 65 children from Site 1 participated in ITLC over the 5-year period of the project. Twelve of those children participated for 2 years and 6 participated for 3 years. Disabling conditions remained consistent across all 5 years and included developmental delays, speech and language, behavior disorder, and other health impaired.

Site 2. During Year 2 the ITLC Project expanded to include two urban sites in the state capitol, Springfield, a city in West Central Illinois with a population of 110,700. Site 2 at Blackhawk School served 19 children in Year 2, 20 children in Year 3, and 19 children again in Years 4 and 5, for a total of 77 children. Twelve children participated in ITLC for 2 years and 1 participated for 3 years. Speech/language was the dominant disabling condition each year, with other conditions including developmental delay, physically handicapped, mentally impaired, autism, visual impairment, and other health impaired. One classroom teacher and a program assistant served the children at this site. The site had 2 1/2-hour morning and afternoon sessions, 5 days a week.

Site 3. The other demonstration site in Springfield was Site 3 at Laketown School. One teacher and two program assistants served 19 children in Year 2. When the classroom moved to

Blackhawk School in Springfield (same location as Site 2) in Year 3, the same teacher and one of the program assistants served 20 children. In Year 4, 16 children participated in the program, while enrollment dropped to 12 children in Year 5. A total of 67 children were served by this site during ITLC's involvement. Eight children participated for 2 years and 1 child was involved in ITLC for 3 years. Children at this site exhibited multiple disabilities, six had cerebral palsy and mental impairment. However, the majority of the children had speech and language disorders. The site had 2 1/2-hour morning and afternoon sessions, 5 days a week.

Replication Sites

Site 4. Site 4 was the Early Childhood Program located at the Farmingdale Elementary School in Farmingdale, Illinois, with a population of 970. This site is in a rural community served by the Sangamon Area Special Education Cooperative, which serves schools surrounding Springfield. The program is staffed by one early childhood teacher, a program assistant and varying numbers of one-on-one aides, depending on the needs of the children. The site served 14 children in Year 4 and 17 children in Year 5 for a total of 31 children. Five of those children participated in ITLC for 2 years. The majority of the children had developmental delays (11 in Year 4 and seven in Year 5), while other disabilities included speech/language, physical handicaps, mentally impaired, and other health impaired. Children participated in one of two half-day sessions.

Site 5. Site 5, the third ITLC site located in Springfield, Illinois, was the Early Childhood Program at Hay-Edwards School. The teacher and one classroom assistant started replicating the ITLC model in Year 4 with 19 children. In Year 5, 15 children participated in the program. A total of 34 children participated in ITLC in the 2-year period. Six of those children were in ITLC for both years. The majority of children had speech/language disabilities (15 in Year 4 and 10 in

Year 5). Other disabilities included autism, behavior disordered, mentally impaired, and other health impaired.

Site 6. The Early Childhood Program in LaHarpe, Illinois, a small farming community with a population of 1,407, became an ITLC replication site in Year 5. One teacher and a program assistant served 17 children that year. Nine children with developmental delays and other health impairments participated in the special education program in the morning, while eight children at-risk participated in the Pre-K program in the afternoon, 5 days a week.

Site Activities

ITLC staff conducted site visits on a regular basis in coordination with the teacher's schedule. During Year 1, staff visited Site 1 twice a week, later reducing visits to once a week in Year 2, twice a month in Year 3, and monthly thereafter. Staff made visits to Sites 2 and 3 twice a month in Year 2, and monthly during the last three years. Staff visited the three replication sites (Sites 4, 5, and 6) monthly during their involvement in ITLC. During site visits, staff recorded observation notes about individual children, groups of children, and teacher strategies, videotaped children during literacy and computer activities, took digital and 8mm photos, and assisted the teacher with technology activities if needed. Group training sessions for all sites were conducted twice each year.

Teaching Strategies

The ITLC model employed a variety of strategies to accommodate differences in teachers, children, and experiences. Teachers were encouraged to analyze their own instructional style and use strategies most suitable to children's learning styles. Project staff observed teaching styles of each site teacher and recorded notes on changes over the years. Staff noted that teachers at Sites 1 and 2 adopted more child-directed strategies in the classroom and that these sites produced

more *HyperStudio* stacks and generated more curriculum integration activities. Sites 3 and 4 teachers were more teacher-directed in their approach when working with children with severe disabilities in their classrooms. Although children had a large amount of free play time at the computer, there was limited integration of technology into the curriculum.

When Site 5 teacher was first involved in ITLC, she conducted activities in a teacher-directed manner; however, staff noticed a change to a more child-directed approach especially in her use of technology during Year 5. Children participated in a variety of technology activities, including creating *iMovies* about their classroom experiences, such as making a giant whale. The Site 6 teacher employed a child-directed approach with many of the activities in her room; however, computer equipment and software problems prevented her from using the computer in an integrative manner in the room. Overall, staff noted that the teachers who employed a more open and child-directed teaching style, also integrated technology the most effectively in their curriculum.

Findings

Claims of Effectiveness

Young children with disabilities and their families experience many benefits when they engage in the ITLC. The claims of effectiveness are derived from analyzing and summarizing results of the model development evaluation plan and the outcomes for children, families, and staff participating in the project.

Children. Claims of effectiveness relating to children include:

- Children with a variety of disabilities engage in emergent literacy activities.
- Children improve emergent literacy skills and understanding of literacy concepts as defined in theory and by the ITLC.

- Children improve communication skills, social interaction, fine motor control, attending, planning, and problem solving skills.

Families. Claims relating to families include:

- Families participate in classroom literacy activities.
- Families engage in literacy activities with their child(ren) at home.

Teachers. Claims of ITLC effectiveness relating to teachers include:

- Teachers design classroom environments that promote emergent literacy.
- Teachers design activities that support emergent literacy development.
- Teachers improve their own ITLC competencies.

Evaluation Methodology

The project used both quantitative and qualitative measures as part of the evaluation plan. Quantitative measures included pre- and post-test data on the Informal Literacy Assessment (ILA) measure, and the Behavior Interaction Tool (BIT). Qualitative measures included content analysis of field notes from more than 635 hours of observations, videotapes, portfolios of children's drawings and writing samples, program notes, teacher and family questionnaires and interviews. Data triangulation was accomplished as comparisons were made among family and teacher interviews, questionnaires, videotapes, field notes, and items on the ILA and the BIT.

Data Collection

The measures used for data collection are based on those used in the Emergent Literacy Technology Research study carried out by Macomb Projects between 1994 and 1997 (Hutinger et al., 1998) as well as the Early Childhood Comprehensive Technology research project (Hutinger, Johanson, & Rippey, 2000). The measures are available from the Center.

Measures used with children. The following measures were used as data sources to evaluate ITLC's impact on children.

1. Informal Literacy Assessment (ILA)

A set of 28 items detailing a child's specific literacy skills involving emergent reading and writing was used as a pre- and post-measure each year. Children's attention to stories being read; handling of books; and ability to sequence, predict, and retell a story are assessed as the teacher observes children being read to and children reading to themselves or peers. The score at the end of the year is compared with the one from the beginning of the year to identify progress.

The original version of the ILA was a 12-item instrument developed for use in the Emergent Literacy Technology research study. A literacy expert and a group of advisors developed the instruments using the elements of existing preschool literacy measures by Dyson (1982), Katims (1991), Strickland (1990), Sulzby (1986, 1988), and Teale and Sulzby (1986).

The ILA was revised after Year 2, since many of the items were too difficult for the children with disabilities participating in the model. The revision added 16 items to the original 12 items. Additional items focused on early skills, such as *asking to be read to*, *listening to a story*, and *visually attending to pages in a book*. The ILA is divided into three sections: (1) behaviors observed as a book is being read to the child; (2) behaviors observed as the child 'reads' a book to an adult, and (3) attending behaviors while 'reading' a book. The present assessment consists of a set of 28 questions about the children's reading abilities. The first section contains 7 items, the second 14, and the third section has 7.

Project staff administered the ILA during the first two years of the project and during each site's initial year of involvement. Teachers were trained to administer the ILA during their third year in the project. ILA data was statistically analyzed using multiple *t*-tests across pre-post

scores for six sites and were adjusted with Bonferroni's method (each of *p* values was multiplied by 3 and are identified as *Bp* in the results) to compensate for the fact that 3 sub-tests were analyzed. The Bonferroni correction is a statistical adjustment that raises the standard of proof needed when making multiple comparisons.

2. Behavior Interaction Tool (BIT)

ITLC staff administered the BIT, an observational checklist of 52 behaviors shown by a child at a computer, at the beginning and end of each year. Children's behaviors are recorded on the BIT as they interact with a peer(s) and an adult at the computer and while using a computer by themselves. All BIT observations were recorded during single day periods, unless the child did not interact with a peer at a computer and needed a second day of observation. Subtests of the BIT include (1) Attending, (2) Resisting, (3) Demonstrating cause/effect, (4) Expressing him/herself, (5) Following directions and rules, (6) Displaying independence, (7) Displaying planning abilities, (8) Obtaining attention of adult in positive manner, (9) Obtaining attention of adult in negative manner, (10) Using computer with peer, (11) Displaying cooperative behavior, and (12) Exhibiting competitive behavior. As with the ILA, ITLC staff administered the BIT during the site's first year of involvement; thereafter, site staff were trained to administer the BIT to children. Bonferroni's method (*Bp*)was used to analyze the significance of the BIT data.

3. Child Portfolio

ITLC teachers collected samples of children's literacy productions, including selected drawings, writings, *HyperStudio* stacks, and photographs of individual children as contents for child portfolios. Teachers received guidance on how to select items. At the end of the year, teachers shared portfolio contents with families, then gave them to ITLC staff to review and summarize. An assessment of the contents shows children's progress in writing skills, their

progression in stages of drawing, and inclusion of writing in their drawings. The progression in children's skills is impressive when viewed at the end of the year.

Besides keeping paper copies of children's work, ITLC staff created electronic portfolios by scanning children's drawings and pictures into a computer. Digital photos were also taken throughout the year and collected for individual files. Large paintings and drawings were recorded and maintained in a computer file, eliminating the need for classroom storage space. Images were printed and kept in the child's portfolio. Staff transferred the electronic contents into computer slide shows or *HyperStudio* stacks as a record of child progress. These technology portfolios were then shared with families and, with permission, shown as samples during conference presentations.

4. Children's Written Signatures

ITLC staff encouraged all teachers to use the sign-up sheet as an emergent literacy strategy as well as a computer management technique. Teachers then collected children's signatures over time from these dated sign-up sheets. ITLC staff analyzed them according to stages of writing.

5. What I Liked Best About the Computer

ITLC staff asked children at the end of each year to draw a picture of what they liked best about the computer. These drawings were collected and summarized according to software that was featured, the visual art/emergent literacy stage, child's comments and the category of software represented in the drawing.

6. Classroom Observational Field Notes

Project staff recorded field notes during classroom visits to document behavior and activities. Still photographs and videotape supported the field notes.

Measures used with families. The following measures were used as data sources to measure ITLC's impact on families.

1. Family Literacy Questionnaire (FLQ)

The FLQ is a survey of questions regarding the home's literacy environment. Items ask about the number of books and magazines in the home, the use of computers, amount of television watched, and how frequently the family members read to the child. The questionnaire was distributed at the beginning of the school year to all the families with children enrolled in the ITLC Project to find out about the home literacy environment.

2. Family Computers and Books

ITLC site staff asked families for feedback at the end of the year on what children say about the computer at school, reports of changes in children's reading and writing behaviors, and the family's perceptions of how the computer benefited their child. Items on this measure are cross-referenced to items on the FLQ.

3. Participation in classroom activities.

This documentation included teachers' records of family participation in project activities, whether initiated by teachers or staff. Project staff or the teacher took photographs with an 8mm or digital camera and video of families participating in class activities.

Measures used with teachers. The following measures were used as data sources to measure ITLC's impact on teachers.

1. Teacher Literacy Questionnaire (TLQ)

The TLQ included 41 items concerning classroom literacy materials and activities. ITLC teachers completed the questionnaire at the end of each year.

2. ITLC Competencies

This checklist of staff members' personal computer and literacy skills contained 80 competencies developed and refined by project staff over the years. Teachers filled out the checklist when they began ITLC involvement and updated it yearly.

3. Software products - *HyperStudio* and *iMovies*

ITLC staff kept a record of the *HyperStudio* products created by each classroom teacher. A list was maintained which documented the number and nature of the unique, situational-specific software programs. Staff also kept a written record and copy of each *iMovie.*

4. Classroom Observational Field Notes

ITLC staff recorded observations of teaching style and activities conducted by teachers during each classroom visit. Staff also used videotapes and still photographs as documentation of teacher activities.

Claims of Effectiveness

Claims of Effectiveness Related to Benefits for Children

Claim 1. Children with a variety of disabilities engage in emergent literacy activities.

Every child at each site participated in ITLC activities during the 5 years of model development and replication. Children's interest levels were high as they participated in literacy activities with accompanying computers and software. Every child was able to participate in activities due to customized adaptations.

The BIT was used to measure children's participation on a computer, while the ILA measured literacy behaviors acquired. Table 4 contains BIT scores for all six model sites for Year 2 through Year 5 of the project (BIT results from Year 1 are not included because the measure was different and cannot be compared with the other years) on seven items that were not

at ceiling on the first observation. 'Ceiling' was established as 90% maximum of the pre-test scores for each section of the BIT.

When the average pre-test score was at or above the ceiling, it was eliminated from further analysis. *Attending to the computer* and *Displaying independence at the computer* were at ceiling levels in all six sites during pre- and post-testing, as were *Child resists computer*, *Obtains attention in a negative way*, and *Exhibits competitive behavior* where a 'No' answer was scored as positive. Results indicate that a computer is interesting and engaging to children from the onset and lead to few negative behaviors. These results in themselves comprise a positive finding for the model and support ITLC claims.

A review of the BIT results over the 5-year period indicates significant positive changes across all sites. Children showed increases over the course of each year in behaviors measured by the BIT. The most significant changes were shown on Item 7 (*child displays planning abilities on the computer*). Children's behaviors on this item increased the most (36%; $Bp<.007$) in Year 2. Other years showed increases of 22% ($Bp<.0007$), 19% ($Bp<.0315$), and 27% ($Bp<.0007$). Children also showed increases on Item 8, *obtaining attention of the adult in a positive way*, with 29% ($Bp<.007$) in Year 2, 17% ($Bp<.039$) in Year 4, and 20% ($Bp<.0007$) in Year 5, and *using the computer with a peer* (Item 10). Significant increases were also show on Item 11, *child displays cooperative behavior at the computer center*, with 35% ($Bp<.0007$) in Year 3 and 31% ($Bp<.0008$) in Year 4.

Table 4: BIT Results Years 2-5

Sites 1, 2, and 3 Year **2** (1996) Pre - Post Behavior Interaction Tool Scores and Statistics for Variables Not at Ceiling
(*N*=36 Children)

Variable/ Number of Items		Maximum Score Possible	Pre-Test Score	Post-Test Score	% Change	MD	SD	SE	t	p	Bp
3.0	2	72	59	61	3%	0.056	0.630	0.105	0.533	nsd	nsd
4.0	2	72	37	49	17%	0.333	1.195	0.199	1.670	nsd	nsd
***5.0**	5	180	83	116	18%	0.917	1.763	0.294	3.120	<0.004	<0.028
***7.0**	5	180	46	110	36%	1.778	2.126	03.54	5.017	<0.001	<0.007
***8.0**	9	324	112	206	29%	2.611	2.333	0.389	6.714	<0.001	<0.007
10.0	5	180	85	112	15%	0.750	1.991	0.332	2.260	<0.030	nsd
11.0	5	180	93	110	9%	0.472	2.210	0.368	1.283	nsd	nsd

Sites 1, 2, and 3 Year **3** (1997) Pre - Post Behavior Interaction Tool Scores and Statistics for Variables Not at Ceiling
(*N* = 35 Children)

Variable/ Number of Items		Maximum Score Possible	Pre-Test Score	Post-Test Score	% Change	MD	SD	SE	t	p	Bp
***3.0**	2	70	53	66	19%	0.371	0.286	0.101	3.673	<0.0008	<.006
4.0	2	70	31	44	19%	0.371	0.386	0.137	2.721	<0.0102	nsd
5.0	5	175	116	125	5%	0.257	0.118	0.417	0.617	nsd	nsd
***7.0**	5	175	72	111	22%	1.114	0.553	0.196	5.696	<.0001	<.0007
8.0	9	315	143	168	8%	-0.714	1.054	0.373	-1.917	nsd	nsd
***10.0**	5	175	64	107	25%	-1.229	0.891	0.315	-3.899	<0.0004	<.0028
***11.0**	5	175	56	118	35%	-1.771	0.829	0.293	-6.046	<.0001	<.0007

Table 4: BIT Results Years 2-5

Sites 1, 2, 3, 4, & 5 Year **4** (1998) Pre - Post Behavior Interaction Tool Scores and Statistics for Variables Not at Ceiling
(*N* = 44 Children)

Variable/ Number of Items		Maximum Score Possible	Pre-Test Score	Post-Test Score	% Change	MD	SD	SE	t	p	Bp
3.0	2	88	133	146	15%	-0.15909	.569	0.085671	-1.857	<.0351	<.2457
4.0	2	88	47	66	22%	-0.43182	.790	0.119006	-3.62853	<.0004	<.0028
5.0	5	220	71	83	5%	-0.27273	.8733	0.131521	-2.07364	<.0221	<.1286
***7.0**	5	220	60	103	19%	-0.59091	1.42	0.213988	-2.76141	<.0042	<.0315
***8.0**	9	396	199	266	17%	-1.09091	2.813	0.423688	-2.57479	<.0068	<.039
***10.0**	5	220	85	151	30%	-1.45455	1.96	0.295231	-4.92681	<.0001	<.0007
***11.0**	5	220	73	142	31%	-1.65909	1.685	0.253815	-6.53662	<.0001	<.0008

Sites 1, 2, 3, 4, 5, & 6 Year **5** (1999) Pre - Post Behavior Interaction Tool Scores and Statistics for Variables Not at Ceiling
(*N*=65 Children)

Variable/ Number of Items		Maximum Score Possible	Pre-Test Score	Post-Test Score	% Change	MD	SD	SE	t	p	Bp
3.0	2	130	97	113	12%	-0.24615	0.506211	0.062788	-3.54463	<.0004	<.0028
4.0	2	130	99	107	6%	-0.12308	0.578875	0.071801	-1.4737	<.0727	<.5089
5.0	5	325	85	117	10%	-0.16923	0.927154	0.114999	-1.62462	<.0546	<.3822
7.0	5	325	85	174	27%	-1.46154	1.617958	0.200683	-8.46013	<.0001	<.0007
8.0	9	585	311	427	20%	-1.83077	2.620647	0.325051	-6.87333	<.0001	<.0007
10.0	5	325	175	228	16%	-0.8	1.655411	0.168705	-4.74199	<.0001	<.0007
11.0	5	325	144	184	12%	-0.55385	1.848206	0.229242	-2.82353	<.0032	<.0224

Behavior Interaction Tool Variables Reported in this Table:

3.0 Child demonstrates cause/effect relationships between input device and monitor
4.0 Child expresses him/herself
5.0 Child follows directions and rules at the computer center
7.0 Child displays planning abilities at the computer
8.0 Child obtains attention of an adult in a positive way
10.0 Child uses the computer with a peer
11.0 Child displays cooperative behavior at the computer center

* significant, Bp <.05 or better
MD = Mean of Pre-Post Differences
SD = Standard Deviation of Differences
SE = Standard Error of Differences
Bp = Bonferroni adjusted probability

Powerful computers, developmentally appropriate software, and an integrated approach to using technology were responsible for children's willingness to participate. Insuring that children had opportunities for independent and autonomous use of software, complemented by the management tools used in the project resulted in continuing participation for the children.

Adaptations and assistive devices made it possible for children with moderate to severe disabilities to participate in literacy activities by accessing stories, creating stories, drawing and making music, and accessing the environment. Children with severe disabilities who are not physically able to handle a book were able to access stories through a switch. Although they did not attend or seem interested in books during circletime, individually they attended to the pages of a computer book. As they used story software, such as *Just Me and My Grandpa*, or *The Smelly Mystery*, some children stayed on the first few pages of the story for several sessions and spent a long time exploring each page, activating characters and objects.

Technology adaptations were determined so that children with moderate to severe disabilities could participate in literacy activities. Adaptive devices, including switches and touch tablets, offered children the means to participate in ITLC activities. Switch-operated software based on children's stories, such as *Circletime Tales* and *Storytime Tales*, was used often as well as switch operated toys that related to classroom and software themes.

The fact that no child refused to 'read' a book or listen to a book being read is evidence of willingness to participate. Even those children with physical disabilities at Sites 3 and 4 listened to a book being read to them by an adult and on a computer. During free play time, children were observed 'reading' books at the reading center. Results from the ILA during Years 3, 4, and 5 (During Years 1 and 2 a different version of the test was used.) shown in Table 5 show that, both

at the beginning and end of the year, children demonstrated increased skill in reading a book (Sections II and III) and having a book read to them (Section I).

Teachers and families reported children's engagement in literacy activities at all sites. The Site1 teacher noted in Year 5 that all of the children wanted to look at books in the reading center after snack time. She saw children's interest in books increase each year.

Claim 2. Children improve emergent literacy skills and understanding of literacy concepts as defined in the ITLC.

Informal Literacy Assessment results. Over the 5-year period of this project, the increases in children's scores on measures of informal literacy behaviors have all been significant, with children's scores doubling and often tripling over the course of each year. Table 5 summarizes Year 3, 4 and 5 results, indicating that these children made gains in the amounts of information they knew and behaviors they exhibited around books when literacy skills were measured over time.

Each year the pre-test scores of the children were slightly higher than they had been for the previous sets of children entering the program. While 51 children remained in the program for more than a year, 240 did not, although some did have siblings who had previously been in the ITLC program. This increase in literacy skills seems to indicate that overall, more attention is being paid to pre-literacy skills in children's lives. It is unclear whether these results are true of this particular sample, whose parents have been receiving messages from the staff about the importance of literacy behaviors, or is true of the general population as a whole.

Table 5: Informal Literacy Assessment (ILA)
Scores and Analyses Years 3-5

Sites 1, 2, & 3 **Year 3** Pre/Post
N=29

Section	Number of Items	Maximum Score Possible	Total Pre-Test Score	Total Post-Test Score	MD	SD	SE	t	p	Bp
I	7	203	96	172	2.621	1.208	0.224	11.700	<.001	<.003
II	14	406	82	156	2.552	1.723	0.320	7.975	<.001	<.003
III	7	203	14	49	1.207	0.940	0.174	6.936	<.001	<.003

Sites 1, 2, 3, 4 **Year 4** Pre/Post
N = 58

Section	Number of Items	Maximum Score Possible	Total Pre-Test Score	Total Post-Test Score	MD	SD	SE	t	p	Bp
I	7	406	238	295	-0.98276	1.7955	0.237821	-4.13235	<.0001	<.0003
II	14	812	207	297	-1.5	2.13548	0.282853	-5.30331	<.0001	<.0003
III	7	406	41	90	-0.84483	1.569	0.153211	-5.51416	<.0001	<.0003

Sites 1, 2, 3, 4, 5, 6 **Year 5** Pre/Post
N = 68

Section	Number of Items	Maximum Score Possible	Total Pre-Test Score	Total Post-Test Score	MD	SD	SE	t	p	Bp
I	7	476	288	366	-1.11765	2.073496	0.251448	-6.01957	<.0001	<.0028
II	14	952	273	392	-2.01471	2.85976	0.346797	-6.87738	<.0001	<.0028
III	7	476	67	110	-0.33088	1.085455	0.093077	-4.94779	<.0001	<.0028

Whatever the cause of the slight increases in incoming scores in the ILA, after participating in the ITLC program for a year, the children's post-test scores showed significant gains during each year of the project. The children made statistically significant gains in literacy skills during the time that they participated in the program. Observational notes, videotapes, family and teacher comments, and assessment measures all demonstrated that children learned concepts of print.

Pictures have meaning and tell stories. Children demonstrated their understanding of these literacy concepts in Section III of the ILA when they 'read' a book. Results show significant gains from the beginning of the year to the end (Year 3, $Bp<.003$, Year 4, $Bp<.0003$, Year 5, $Bp<.0028$). Children labeled objects in pictures and told their own version of a story. Moreover, when they 'read' a book to an adult, they showed increases in telling about the story from the pictures, pointed to pictures while picture reading, and identified familiar items in pictures.

Children increased their understanding of "pictures have meaning" through software use. Software takes advantage of pictures not only in the story line but also in the form of icons, symbols which represent actions or procedures programmed into the software. Children recognized that the arrows pointing right took them to the next page of a story and arrows pointing left took them back to the previous page. A stop sign icon symbolizes the "Quit" option. Clicking on a printer icon results in a printed copy of a drawing or picture.

Words have meaning and tell stories. Children demonstrated their understanding of concepts related to words having meaning in a variety of activities, including their use of *KidDesk*. Children sent written messages to each other through a computer. Children learned that their written name has meaning as they signed up to use a computer and found their own files on *KidDesk*.

In Year 5, children at Site 1 were able to read titles on book covers displayed in the room. During a special unit on mice, 19 books about mice were displayed in the reading center. The teacher made a corresponding bulletin board which showed the book jackets of each book. As the children read a book together they stamped a path from a paper mouse in the middle of the board to the jacket of the book that was read. Due to the literacy-rich environment and the many literacy activities in the classroom, one child was able to read the covers of the books before the books were read in the class. To further the children's literacy experiences with the mouse unit, an *iMovie*, *A Mouse Theme for Literacy*, was made for the class and shared at the computer center.

Children told stories through their own drawings at the end of the year when they were requested to draw *What I Liked Best About the Computer*. Many children incorporated writing into their drawings. Out of 70 responses in Year 5, 37 children indicated a preference for a particular software program, 34 of whom referred to a commercial program. Only two children drew or talked about a *HyperStudio* stack, while one child mentioned *Kid Pix*, a tool program.

Stories can be made up. Children showed gains in their ability to make up stories and tell a version of a story as evidenced by significant increases on Section III of the ILA. *HyperStudio* stacks also provide evidence of this concept. In Site 2's version of *It Looked Like Spilt Milk*, the children drew pictures and told something about their picture on their *HyperStudio* page. Children at the Hay-Edwards site (Site 5) created their own version of *The Mitten* story. Each page made up a part of the story to put into *HyperStudio*.

Stories have sequence. ITLC staff observed children retelling a story at a computer while interacting with a Living Books software program. Children exhibit sequencing behavior when they act out a story, such as *Stellaluna* or *The Three Bears*, during dramatic play. Children

perform a sequence of actions in order to find their name and open a program in *KidDesk*. They also perform sequencing skills as they navigate through software, turning pages in a story, going forward and backwards, and selecting options of reading or playing in the program. Children demonstrate planning and expressive abilities as they add their own page to a class story in *HyperStudio*. The ILA and the BIT both show evidence of children's increased sequencing abilities.

Stories have a beginning, middle, and end. Children demonstrate this concept as they navigate software, produce *HyperStudio* stacks, and use stories in dramatic play. Children at Site 1 could retell the story of *Stellaluna* after using the software and looking at the book. They talked about what happened to Stellaluna in the beginning when the bat's mother was lost; they knew the middle of the book was when the birds take care of Stellaluna; and they were happy to talk about the ending when Stellaluna finds her mother. Some children could retell the story with all three parts and others would act out the three parts.

Stories have characters, actions, and settings. ITLC staff observed children at all sites participating in dramatic play activities that relate to computer stories and books read in the classroom. Site 1 acted out *The Three Bears* story each year with children taking turns being the different characters. The whole class painted and constructed the background settings after they discussed what was needed for the story. This site also created dramatic play activities around characters in *Stellaluna, Green Eggs and Ham*, and *The Three Billy Goats*. Sites 2, 3 and 5 created play activities around *If You Give A Mouse A Cookie*, *If You Give A Pig A Pancake*, and *The Mitten*.

Children's end-of-the-year drawings about what they liked on the computer showed their awareness of characters from stories in software. Fourteen out of 70 drawings in Year 5

contained characters related to a software program. Similar results were found in previous years. Arthur and Little Monster were popular characters drawn by children the past 2 years, while Pippi and Stellaluna were seen in children's drawings during the early years of the project.

Stories can be predicted. ITLC staff observed children predicting what comes next in a story on the computer. With stories such as *The Smelly Mystery*, children were able to tell staff what would be next on the screen before clicking the mouse. The Site 2 teacher made a chart of children's predictions on what character had stolen the smells in the story. Some children were able to give reasons for their predictions. With other programs based on Mercer Mayer stories, such as *Just Me and My Dad* or *Just Me and My Mom*, children were able to predict what a character would do when it was activated on a particular page. Children had favorite parts in the story to which they would often return.

Prediction behaviors were also recorded on the BIT under item 7. Children were observed "*naming expected results from the software program,*" and "*taking action to reach a desired goal from the software program.*" Results show children made significant gains in this area in Year 3 ($Bp<.0007$) and Year 5 ($Bp<.0007$).

Text and writing proceed from left to right and top to bottom. Children learned this concept from the Living Books programs with text appearing on the screen and being highlighted as words were read to them. The sign-up sheets used at the computer center also show a progression of children's writing from left to right and top to bottom. ITLC staff observed children pointing to text in a book version of the Living Books software as the text was read by a computer. The Site1 teacher commented on how children used the book with *Green Eggs and Ham* software. "*The children would go get the book and take it to the computer center. Then they'd say, 'It's the same. It's the same!' They are more likely to go get the book now that they*

have interacted with the software and done some of the activities." The Site 4 teacher noticed that children were more interested in the books after using software such as *Ruff's Bone.* Children would follow along with the book, pointing to words and pictures they saw on a computer.

Words can be written. Children demonstrate this literacy concept through the writings they include in their drawings. ITLC staff summarized the drawings from *What I Like Best About the Computer* and found that children display different stages of writing with the majority being at the scribbling stages. However in Year 4, across all the sites, 41% (N =76) of the children displayed mock letters or conventional letters in their drawings at the end of the year. Children's comments about their writing usually related to a software program.

Teachers noted more writing being done by children during free play activities. For example, children would write orders for food or make lists for shopping. Families even noted more writing at home. Comments on the end-of the-year questionnaire, Families Computers and Books (Table 6) include "*He tries to write checks or bills to us."* and "*He likes to write stories and then tell it to me. He loves to design maps and follows them.*"

Overall, children's interest in literacy activities increased as each year progressed. The Site 1 teacher commented that children looked at books more often and at different times during the day. Families consistently reported seeing such a change in the way their child(ren) used books from the beginning of the school year. An average of 84% (N =159) of families from Year 2 through Year 5 reported seeing this change at the end of the year.

Table 6: Family Computers and Books – Summary

Family Computer and Book Survey Return Rate

n=37	*n*=55	*n*=46	*n*=21	Total *N* = 159
Spring 1997	Spring 1998	Spring 1999	Spring 2000	
82%	51%	60%	24%	

Questions	Answer	Spring 1997	Spring 1998	Spring 1999	Spring 2000
Does your child talk about using computer at school?	Yes	83%	75%	65%	77%
Have you seen a change in the way your child uses books?	Yes	86%	96%	82%	71%
Does your child try to print letters, words, or stories?	Yes	N/A	79%	61%	74%
Does your child use "writing" in play activities at home?	Yes	72%	68%	65%	74%
How often does your child attempt/pretend to read aloud to a family member?	Daily	N/A	29%	40%	29%
	Several times a week	N/A	46%	50%	48%
How often does your child look at books or read by him/herself?	Daily	N/A	43%	48%	48%
	Several times a week	N/A	36%	41%	35%
How often does your child use books in his/her play activities?	Daily	N/A	36%	35%	27%
	Several times a week	N/A	43%	39%	40%
How long has your child been involved with the ITLC Curriculum at school?	Less than 6 months	N/A	21%	24%	13%
	One Year	N/A	36%	35%	55%
	Two Years	N/A	25%	17%	16%
	Three Years	N/A	4%	4%	6%
	No Answer	N/A	14%	20%	10%
What family members have been involved with computer literacy activities in your child's classroom?	Mother	N/A	27%	31%	27%
	Father	N/A	9%	27%	23%
	Brother	N/A	12%	10%	8%
	Sister	N/A	15%	12%	4%
	Other	N/A	9%	10%	8%
	No Answer	N/A	27%	10%	0%

How have family members been involved in ITLC activities?	Received ITLC Info	N/A	38%	49%	46%
	Observed ITLC activities	N/A	18%	13%	17%
	Participated at home	N/A	8%	11%	8%
	Participated school time	N/A	18%	18%	21%
	Participated in workshop	N/A	0%	9%	8%
	No Answer	N/A	18%	0%	0%

Do you feel that you have gained knowledge and/or skills from being involved ITLC with your child?	Yes	N/A	64%	76%	39%
	No	N/A	21%	22%	35%
If so, what have you gained?	Technology skills	N/A	18%	25%	19%
	Tool to communicate	N/A	18%	26%	13%
	Programs/Activities	N/A	16%	23%	29%
Do you think that your child benefited from involvement with ITLC activities?	Yes	N/A	86%	76%	68%
	No Answer	N/A	14%	22%	23%
If so, how did your child benefit?	Socialization	N/A	20%	16%	21%
	Communication	N/A	17%	26%	18%
	Language Development	N/A	19%	22%	21%

Claim 3. Children improve communication skills, social interaction, fine motor control, attending, planning, and problem solving skills.

Communication. The computer programs used in the ITLC, with their interesting stories and associated activities provided a common experience for children to talk about. During the teacher interview in Year 5, the Site 1 teacher told us "*I had a student that could talk, but wouldn't say anything in my room. I put in a Living Books program and this child talked perfectly to the computer.*" When asked what differences she had seen in children at the computer, Site 5 teacher answered, "*The children are a lot more verbal . I hear more animated verbal responses.*" Site 2 teacher reported seeing changes in children's communication, "*The language developed between the kids themselves. There are usually three or four watching and talking about the computer. It carries over into other centers and at different times. The children had a discussion on how to pronounce 'Pippi." There is so much talking and so much enthusiasm.*"

Families have also noted increases in children's communication as evidenced by their response on the Families, Computers, and Books survey at the end of each year. Seventeen to twenty-six percent of the159 families who answered the survey listed communication as one of the benefits of their child's involvement in ITLC. One parent commented that her daughter, "*talks sometimes about the things she does. It is usually when they have done a book at school and she can read it at home. She talks about what she 'made' on the computer.*"

Social interaction. The majority of time, at all sites, a computer was used by more than one child. Even if one child started at a computer alone, he/she was usually joined quickly by another child. Turn taking was evident and usually done willingly. The computer sign-up sheet helped to remind the child who was next. Positive peer interaction was noted often in observational notes and teachers' reports.

The BIT results support cooperation among the children. Staff noted that Item 11, *Child displays cooperative behavior at the computer center* increased dramatically in Year 3 (35%) and Year 4 (31%). Also Item 12 *Competitive behavior* was seldom exhibited since the appropriate 'No' answer was at ceiling on both pre- and post-tests. In Years 4 and 5 children showed significant increases ($Bp<.007$ each year) across all sites in behaviors related to using a computer with a peer.

The Site 3 teacher commented that the set up of the computer environment encouraged children to interact while using a computer. During Year 3 she obtained a second computer for her classroom and placed the computer at the opposite side of the room from her other computer. When she moved the two computers together so that they were side by side, she noted an increase in children working together and watching each other. Children also became more interested in using a computer together.

The Site 1 teacher saw children cooperate at a computer more than they do at other activities. She noted that they help each other more, and that "*turn taking is easier at the computer.*" The Site 4 teacher noted that children helped each other at a computer and helped select a program in *KidDesk.*

Fine motor control. Children at all six sites increased their accuracy on using mouse input as evidenced by classroom observations and BIT scores. Although most of the children were able to activate the mouse on the pre-test as evidenced by item 1 being at ceiling, ITLC staff recorded more extensive use of the mouse as each year progressed by the children who used it minimally in the beginning of the year.

Attending. When children were not involved in computer activities, it was common to find them attending to books, especially to books related to software programs. They also attended as

stories were read to them. During the Year 5 teacher interview all site teachers noted an increase in children's interest in books.

Videotapes taken during the year reveal children engaging in computer activities for longer periods of time as the year progressed. Site 3 children stayed at the computer for short periods of time, usually less than 6 minutes, during free play at the beginning of the year. At the end of the year, children who came to the computer center during free play would stay there until the end of the period which was usually 45 minutes to an hour. Videotapes from other classrooms showed similar increases in time. Children are observed attending to stories on software or being involved in planning and putting together *HyperStudio* stacks. Teachers' comments on attending behaviors confirm that behaviors do increase throughout each year.

Planning. Behaviors related to planning abilities at a computer (item 7 on the BIT) were found to be significant (ranging from $Bp<.0315$ to $Bp<.0007$) during all 5 years of the project. Children planned the steps to use a computer and navigate software. ITLC staff also noted children's increased planning abilities as each year progressed. Children were able to select a program from *KidDesk,* start the program, decide where to go in the menu and then interact with the program. Often, two or more children would talk about what would happen next in the program.

Autonomy, independence, and child initiated activities. ITLC staff noted increased child-initiated activities that grew out of interactions with computer stories and *KidDesk.* Children used *KidDesk* to select a software program or to change to a different program. Most children at the ITLC sites were able to quit a program and go back to *KidDesk.* During Year 4, a child at Site 2 who had participated in ITLC for 2 years, explored *KidDesk* on his own and figured out how to delete children's pictures from the desktop. When the teacher asked how he did it, this

nonverbal child with autism demonstrated it on a computer. When she asked him to put the pictures back on the desktop, he was also able to figure that part out on his own.

Children's confidence and self-esteem grew as a result of computer use. The Site 1 teacher commented, "*Once they get over being timid on the computer, they have confidence....They may not gain confidence in other areas, but they do on the computer.*" Some children become the class computer experts, someone others can turn to when they need help at a computer. When ITLC staff asked the teachers during a Year 5 interview if they had specific children who were computer experts in their room, they each named children who helped others and knew the most about a computer.

Problem solving. When children used software, they made choices, asked for help, and helped others. Children were involved in solving problems when they navigated through programs and decided which icon to click to take them where they wanted to go.
BIT item 7 (*Child displays planning abilities at the computer center*) contains behaviors which show problem solving skills, such as *'Takes action to reach a desired goal from the software program.*' Overall children made significant progress (ranging from $Bp<.0315$ to $Bp<.0007$) on this item across all the years and sites.

Technology Literacy Recommendations for Individual Goals

ITLC staff assisted teachers and families in incorporating technology into emergent literacy activities for their children. Site 3 children who had severe physical disabilities needed the most help with individual goals. Staff worked directly with the mother of one child during Years 2 and 3 to give her ideas of activities she could do with her child on their home computer. Recommendations included using a Big Red Switch with simple story software, such as *Storytime Tales*, so that the child could control the page turning as she enjoyed the story. The

mother asked for a list of recommended equipment and software so that she could apply for funding to insure that her child would continue using technology after she left the early childhood program.

Another child at Site 3 used a portable communication device with choices related to his favorite book. He could retell the story by pressing a sequence of desired pictures on the device. He would delight in knowing he could change the story by himself. He also used a switch and a switch-operated story creation program, *Toy Store*, to make choices in putting together a story on the computer. He enjoyed participating with other children at the computer.

ITLC staff provided training on IntelliKeys to Site 4 teacher so that she could create overlays to use with individual children in her classroom. The teacher made overlays related to one boy's communication choices. She also used the device in group activities so that all children could participate equally in an activity at the computer.

A child at Site 2 who participated in ITLC for three years, used the computer and Living Books software to increase language skills. He was non-verbal during his first and second year, but did initiate some verbalizations at the computer the third year. His parents appreciated the support technology gave him in the classroom. They commented that the computer was something that their son was good at, and it provided their son with a sense of accomplishment.

During the course of the project, four children with visual impairments participated in ITLC. They each had goals related to simple attending and early language skills. One child was able to use books with Braille tape. She could retell the story by feeling the tape. Two of the children used a switch at the computer with software which contained interesting sounds or stories which were read. The main goal for a fourth child was to develop causality which he accomplished through using a switch and toy during free play.

Although none of the children at ITLC sites had technology specifically written into their IEPs, they benefited from adaptation recommendations to help them meet their goals. ITLC staff worked closely with teachers and parents to provide assistance for individual children as needed during the course of the project. Based on training and individual consultations, these teachers and parents have a better understanding of how to use technology to enhance emergent literacy and related IEP goals.

Claims of Effectiveness Related to Families

Claim 1. Families participate in classroom literacy activities.

Although family participation varied across classrooms, families did attend special classroom events and workshops. Families also provided materials for classroom *HyperStudio* stacks and used classroom-provided books and writing materials at home. Teachers from Sites 1 and 2, who had been involved in ITLC the longest, planned more family literacy activities than the other sites. However, all six teachers reported more family participation in classroom events when technology was included.

Families participated at different levels, depending on their wishes and values. The ITLC model defines three levels of family participation: (1) awareness; (2) assistance in integration; and (3) carrying out activities at home and school. A great deal of ITLC family participation was at the awareness level.

At the awareness level, families received information about the technology literacy activities from the site teacher, either in the classroom newsletter or through verbal explanation when the families visited the classroom. Families were invited to special events related to ITLC activities. Each of the six sites had a Family Open House night at the beginning of the year. They each used technology in different ways to capture families' interest. Each year the Site 1 teacher set

computers up in her classroom with children's software for families to view during open house. Sites 2 and 3 created a *Kid Pix* slideshow in Year 3 which had pictures of the classroom and told a story of a typical day's activities. (A copy of this slideshow was recorded on videotape and sent to Nancy Treusch, OSEP's Preschool Grants Coordinator at her request). These same site teachers created similar slideshows in Year 4. The Site 4 teacher invited families to an informational session on technology. She showed software and answered their questions. In Year 5, the Site 2 teacher created a *HyperStudio* stack containing the children's pictures and favorite activities, titled "What I Like Best About School." Families enjoyed seeing their children's pictures and hearing their voices on a computer.

The Site 1 teacher also invited families to view the *HyperStudio* stack the children had created on "Babies" during their unit on babies. Families contributed baby pictures to create the stack. Every year the teacher invited mothers on the Friday before Mothers' Day to view the cards their children made with *HyperStudio*.

Site teachers printed *HyperStudio* stacks as books for children to take home and share. The Site 5 teacher included a page at the end of the book for families' comments. The children's products helped to involve families in their children's progress and the ITLC, and served as a bridge between home and school.

Beginning in Year 4, Site 1 families were able to check out software from a specially funded lending library established by the classroom teacher. Only three families borrowed software to use at home that year. In Year 5, the teacher wanted to emphasize reading to the families. She used her special funds to purchase books throughout the year which she sent home for families to keep.

Workshops were offered periodically for families who wanted to learn more about using a computer for themselves or their children. The Site 1 teacher received grant funding to equip her room with a new computer, digital camera, software and books and to offer family workshops each year. She focused on technology during Years 1 and 2 workshops, while adding the literacy element to the workshops in Years 3, 4, and 5. Her goal was to "*model reading, do craft activities with books, and use the computer.*"

Sites 1 and 2 offered families a videotape at the end of the year of their children participating in computer activities. The videotapes, offered as a gift of appreciation for completing a questionnaire, showed progress over the year and were received with enthusiasm. Family response rates ranged from 92-95% when sites offered the videotape to families.

Claim 2. Families engage in literacy activities at home.

Results of the Family Literacy Questionnaire (FLQ) showed a remarkable increase in family literacy activities over 5 years (Table 7). Since there was only one ITLC site in Year 1 and only five families returned their questionnaires, the Year 1 data is not discussed here, but the results can be found in Table 7. Families reported having more children's books available in their homes. During the last two years, 58% and 64% (Year 4, *N*=69; Year 5, *N*=71) of families indicated that they had thirty or more children's books in the home, while only 11% and 33% (Year 2, *N*=55; Year 3, *N*=42) of parents in the two previous years gave this answer. ITLC activities and family involvement strategies may have contributed to these parents' interest in supplying more books at home for their children to read. These same parents did not report any major differences in the number of books for adults in the home during this same time period.

The amount of time which families spent reading to their children increased slightly over the 5 years. The biggest increase was between Years 3 and 5. In Year 3, 21% (*N*=42) of families

Table 7: Family Literacy Questionnaire Results – Longitudinal

Question	Answer	1 site $n = 5$ 1995	3 sites $n = 55$ 1996	3 sites $n = 42$ 1997	5 sites $n = 69$ 1998	6 sites $n = 71$ 1999
Reading Questions						
1. Do you read the newspaper?	Yes	80%	95%	67%	71%	78%
2. How often?	Daily	0%	45%	38%	38%	28%
3. Read Magazines?	Yes	100%	85%	79%	88%	80%
4. Child has magazine or book subscriptions?	Yes	20%	33%	36%	35%	33%
5. Child requests library visits?	Yes	40%	5%	5%	28%	22%
6. Family borrows books from the library?	Yes	60%	44%	40%	40%	43%
7. Child requests purchase of books?	yes	60%	56%	55%	65%	68%
8. # of books for adults in the home?	>30	40%	33%	33%	45%	39%
9. # of books for children in the home?	>30	20%	11%	33%	58%	64%
10. How often do you read to your children?	Daily	40%	33%	21%	31%	42%
11. Child reads/pretend reads to family?	Daily	20%	18%	26%	31%	19%
	Several times per week	0%	36%	21%	27%	38%
12. Regular reading time?	Yes	40%	49%	40%	42%	46%
13. Child has a favorite book?	Yes	80%	62%	67%	60%	61%
14. Child tracks print by pointing to words or pictures?	Yes	100%	78%	76%	76%	77%
15. How often does child read to him/herself?	Daily	20%	29%	24%	45%	49%
16. How often does child use books in play?	Daily	20%	25%	17%	33%	28%
	Several times per week	40%	33%	45%	16%	27%
17. Family does storytelling?	Daily	0%	7%	7%	13%	5%
	Several times per week	40%	24%	21%	31%	31%
18. Child listens to taped books?	Yes	40%	60%	60%	51%	43%
Writing Questions		**1995**	**1996**	**1997**	**1998**	**1999**
20. Child prints letters or words?	Yes	80%	51%	57%	39%	60%
21. Child uses writing at home?	Yes	60%	27%	31%	37%	34%
22. Child requests adult to create symbols or signs?	Yes	20%	40%	52%	38%	49%
Computer Questions		**1995**	**1996**	**1997**	**1998**	**1999**
23. Child uses computer?	Yes	100%	36%	62%	62%	54%
24. Where does child use computer?	School	60%	33%	33%	34%	20%
	Home	20%	13%	17%	14%	16%
25. How does child use computer?	Play	60%	24%	33%	31%	42%

26. Parents use computer?	Yes	80%	71%	86%	80%	86%
27. Where do adults use computer?	Home	40%	27%	19%	25%	48%
	Work	0%	56%	43%	28%	37%
	at child's school	40%	2%	12%	5%	4%
28. How do adults use computer?	Word Processing	40%	21%	20%	23%	24%
	Other	20%	21%	28%	26%	23%
29. Does child watch Television?	yes	100%	89%	95%	93%	92%
30. How many hours per day?	1-2 Hours	60%	35%	36%	47%	51%
	3-4 Hours	20%	40%	43%	27%	26%

read daily to their children while 42% (N=71) responded the same way in Year 5. The number of families who reported *children reading to them daily* increased from 18% (N=55) in Year 2 to 31% (N=69) in Year 4. The number of families who report a *regular reading time* has stayed nearly the same over all the years (in the 40%-49% range). The number of families who report that their *child has a favorite book* has been very stable as well (roughly 60%).

The one area showing the biggest increase was the amount of time that the *child 'reads' to him or herself.* For this age group, 'read' means the child is actively engaged in looking at the book and understanding the story. The child may move from one page to the next, retelling the story to him/herself using words in the text or their own words, or oftentimes, a combination of both. During the first 3 years, 20-29% of the families reported that their child 'read' to him/herself daily, compared with 45% and 49% over the last two years. It appears that the extra books families obtained are being read by the children themselves.

Families report a decline in the average number of hours that their preschool children watched television during the last four years. The number of children *watching three or four hours of television a day* dropped from 40% (N=55) in Year 2 to 26% (N=71) in Year 5. An increase was reported in the number who watched only *one or two hours a day*, 35% (N=55) in Year 2 and 51% (N=71) in Year 5. Children were apparently more involved in other activities, perhaps reading books, during the most recent years.

Families report that children ask to go to the library more now than they did in the early years of the project. Only 5% of families (3 out of 55) in Year 2 and (2 out of 42) in Year 3 indicated that their *child requests library visits*, while 28% (19 out of 69 families) answered "yes" to this question in Year 4 and 22% (15 out of 71 families) in Year 5. It is interesting to note that responses to a similar question, *Family borrows books from the library* have remained stable

over the last four years, ranging from 44% (24 out of 55 families) in Year 2 to 40% (17 out of 42) in Year 3, to 40%(28 out of 69) in Year 4, and to 43% (30 out of 71) in Year 5. Children were requesting more visits, but apparently families were already going to the library more frequently than the children asked.

The number of children using a computer at home has remained fairly stable over the last four years of the project. Seven out of 55 families (13%) in Year 2 indicated that their child used a computer at home while 11 out of 71 families (16%) in Year 5 answered in this way. Although child computer use has not changed over the years, parent computer use has increased from 27% (14 out of 55 families) in Year 2 to 48% (34 out of 71 families) in Year 5.

Families consistently reported seeing a change in the way their child used books from the beginning of the school year; as shown in Table 6. An average of 84% of families (133 out of 159) from Year 2 through Year 5 reported seeing a change at the end of the year. One parent commented that her son "*sits and pretends to read out loud. He makes his own books. He plays dad and reads me a book at bedtime.*" Another child "*likes to read to his brother - like his teacher, Jean.*" Another parent said her son "*pretends to read one book he knows by heart. He also likes to make his own story when he looks at books.*"

Responses from families were consistently high when asked at the end of the year about their children's writing activities at home. Almost three quarters of the families reported that their preschool children do try to write, with responses ranging from 61%(*N*=46) in Year 4 to 74% (*N*=21) in Year 5. Responses to a related question on children using 'writing' in play activities at home were almost identical, ranging from 65% (*N*=46) in Year 4 to 74% (*N*=21) in Year 5. One parent commented, "*Kyle has written me notes about how he misses me while I'm at work. He*

makes lists of things we need or pretends to be a clerk or waiter." Another parent said her daughter "*makes lists for the store and writes the store name.*"

The majority of families, ranging from 86% (*N*=55) in Year 3 to 68% (*N*=21) in Year 5, indicated that they thought their child benefited from involvement with ITLC activities. Parents reported increases in language development (21%), communication skills (20%), social skills (19%), listening (17%), reading (12%), and writing (11%). Results from the FLQ, the end of the year survey, interviews and observations support claims of effectiveness on families.

Claims of Effectiveness Related to Technical Assistance to Teachers

Claim 1. Teachers design classroom environments that support emergent literacy development.

Teachers at all sites made positive changes in their literacy environment since the project began as documented through observational notes, teacher reports (Teacher Literacy Questionnaire), ITLC competencies, photographs and videotapes. The amount, appropriateness and accessibility of literacy materials and software increased. ITLC staff noted structural and organizational changes in reading centers, writing centers, and computer centers at sites.

Reading Center. All teachers had Reading Centers in their classrooms at the beginning of their involvement with ITLC. Teachers all made positive changes in their centers' designs as a result of ITLC training. Teachers made their Reading Centers more inviting with books displayed at children's level. ITLC staff gave each site book holders so that *HyperStudio* books could be displayed and enjoyed by the children. The Site 1 teacher added beanbag chairs and a small rocker to her center during Year 3. Her children were able to check out books daily and take them home in cloth bags. The next year she increased the number of cloth bags available due to the increased demand for books by the children.

Writing Center. Sites made changes in writing centers over the 5 years of the project. Sites 1, 2, 5, and 6 had writing centers when they began their participation in ITLC; however, changes were made to make the materials more accessible and inviting to children. Sites 3 and 4 had limited space for writing centers, but children were encouraged to write during table activities. Both of these sites served more children with severe disabilities than the other sites; therefore, writing tools were adapted and positioned appropriately for individual children.

Computer Center. ITLC staff noted positive changes in each site's computer environment during their first and second year of participation. Teachers indicated that they acquired new competencies related to designing the computer environment. Teachers arranged the equipment on computer tables and carts with the monitor at a suitable eye level for the children. Site 4 was the only site that had difficulty making the environment easily accessible to children. For those in wheelchairs the equipment was at the suitable level; however, other children needed to sit on adult chairs or stand to view the monitor at the appropriate height.

Labeling. Sites 1 and 2 classrooms were the only sites that used labels prior to ITLC involvement. Both of these sites increased their use of labeling, and the Site 5 teacher began labeling as a result of ITLC training. All three of these sites now use labeling routinely. Labeling helps children establish the association between the written word and an actual object, person, or event. Teachers reported that they used environmental print in classroom activities, and the Site 2 teacher commented that she made environmental print books for the children to 'read.' All six sites displayed the printed form of children's names in some form, either cards or charts, often accompanying photographs that were also included on the desktop of *KidDesk*.

Appropriate and accessible literacy materials. All six teachers increased the number of books in their classrooms. Three teachers (Sites 1, 2, and 4) increased the number of books in

their room from over 30 during the first year of their participation in ITLC to over 100 books in Year 5. All classrooms had books arranged on low shelves or in book holders so that they were readily accessible to children. Children could pick out a book to read during free play or while they were at a computer.

Appropriate and accessible software. All sites acquired developmentally appropriate software including a variety of Living Books programs, *Kid Pix* and *HyperStudio.* Teachers at Sites 3, 4 and 5 also used switch-operated software to meet the needs of some of their children. Since becoming involved in the project each teacher has requested a larger software budget from her school district. The Site 1 teacher successfully wrote grants to acquire classroom technology equipment and software.

Claim 2. Teachers design activities that support emergent literacy development.

All teachers implemented strategies from ITLC training to provide literacy activities for their children. ITLC staff noted an increase in literacy-related tasks in each classroom. Teachers indicated that they gained new competencies in designing computer literacy curriculum activities. They were more likely to create *HyperStudio* books with their children than before participating in the project. The teachers gave children more theme-related books to accompany the ITLC activities. Stories on the computer versions of Living Books software and classroom-produced *HyperStudio* stacks were often repeated and used in dramatic play.

Results from the Teacher Literacy Questionnaire (TLQ) indicate that the Site 2 teacher increased the frequency that she read to the children from less than once a day in Year 2 to more than once a day in Year 5. Teachers from Sites 1, 4, and 6 established the routine of reading to the children once a day. Site 3 and Site 5 teachers read to the children several times a week. All of the teachers encouraged children to point to text or pictures in a book. They also had puppets

or props children could use during storytelling activities. Each site encouraged children to use a computer for story activities.

All six sites used a computer during storytime activities. Children listened to stories, wrote or drew stories, and re-read stories from the software. Teachers used a computer to incorporate *HyperStudio* into literacy activities. They also used pictures or a computer as a book to 'read' the story. Computers were used as an "*extension of units we are working on; free choice center to go to; vehicle for listening to stories and doing follow-up activities.*" Five of the six teachers in Year 5 used a computer to publish books.

Teachers encouraged children to use a computer for writing activities. The Site 1 teacher used *KidDesk* as an integral part of a Post Office unit with children sending e-mail messages to her and to one another. Children wrote messages to their families on special occasions, such as Mothers Day and Christmas.

Teachers used informal observations more frequently to assess literacy progress among children. In response to a TLQ question regarding assessing developing literacy concepts, three site teachers indicated that they use the ILA as a guide for literacy assessment. During a Year 5 interview the teachers discussed how the ILA provided a progression of literacy skills to assess and to promote in the classroom.

Teachers gained skills in using *HyperStudio,* developing individualized stacks with content appropriate to promote literacy in their classrooms. Stacks were created around class themes or storybooks, using elements to encourage literacy concepts, such as turning the page, reading left to right and top to bottom, relating written words to spoken words, and understanding that pictures have meaning. The Site 1 teacher used *HyperStudio* consistently, creating 40 stacks during her 5-year involvement in ITLC, while the Site 2 teacher created 18 stacks during a 4-

year period. Due to time limitations and problems with the software and equipment, the other four teachers were not as consistent in their use of *HyperStudio.*

The Site 5 teacher created two *HyperStudio* stacks in Year 4, then switched to using *iMovies*, another type of authoring software, for literacy activities in Year 5. She was the only teacher who acquired a new computer system and the capability to create movies with her digital camera. She created movies around classroom themes such as "Whales" which was created during an ocean unit. The movie was based on the children's experiences in creating a giant whale to hang in the classroom. The teacher added music to the movie and sent it through e-mail to ITLC staff. Other *iMovies* based on children's experiences, such as going on a train ride or visiting a nursing home, were created with ITLC staff assistance.

Claim 3. Teachers improve ITLC competencies.

Site teachers acquired and used competencies related to literacy, computer operations, computer applications for children, adaptations, and family involvement. Competencies are also documented in field notes, videotapes, and photographs.

Each teacher possessed competencies in assembling basic equipment components, such as a computer, monitor, and printer, and using software at the beginning of ITLC involvement. The most significant gains (67%, N =6) teachers made through ITLC training were in attaching and using a switch, determining placement of a device, selecting software to meet literacy goals, and evaluating children's progress. Other competencies gained by at least half of the teachers related to determining literacy goals and planning off-computer activities to reinforce literacy skills that focus on designing the environment, designing computer intervention, designing computer literacy curriculum activities, and developing procedures to involve families in computer

activities. During a Year 5 interview teachers commented that they also learned how to use digital cameras and put pictures in *KidDesk*.

Although each teacher displayed gains in competencies during ITLC involvement, each expressed the value of having ITLC site visits and on-site consultations. Informal follow-up contacts with these teachers after the project ended revealed some equipment problems but overall continued progress with literacy activities.

Project Impact

ITLC's impact has both local and national implications. Over the 5 years of the project, ITLC had significant benefits for 291 rural and urban children with disabilities from West Central Illinois in the areas of emergent literacy, communication, attending, problem solving, attending, planning, fine motor control, and social interaction. All children were able to participate in literacy activities with the help of technology and customized adaptations. Children learned early print concepts as they used interactive software which included Living Books programs, *Kid Pix*, and *HyperStudio*. With the use of *KidDesk*, children were able to independently select software and send messages to each other. Families, teachers, and ITLC staff noted that children's interest in books increased during each year of the project. Children's interest in writing also increased as they signed up to use a classroom computer. As each year progressed children also included more writing in their drawings.

ITLC impacted 289 families over the 5-year period as evidenced by families' reports on their children's progress and their increased home literacy activities. Families acquired more books for their children and spent more time reading to their children each week. Children also spent more time reading books to themselves at home, a benefit carried over from classroom literacy activities. Families attended workshops and special classroom events more frequently when

technology was involved. Families reported that their children *did* benefit from ITLC, especially in the areas of communication and social interaction.

Site teachers and program assistants benefited from ITLC training, both group and individual sessions, and from consultations during site visits. All six teachers increased the number of literacy materials and activities in their classrooms. Each teacher has adopted the ITLC and has made the technology literacy activities a permanent part of the curriculum. They all realized the benefits of using interactive software, and those who consistently used *HyperStudio* found this authoring program to be a beneficial literacy tool. All of the teachers expressed appreciation for the support they received from ITLC staff. The Site 2 teacher was visibly upset during the last site visit, crying as staff left the room, a testimony to the support project staff provided. Although staff expect that sites will experience computer equipment problems occasionally, teachers assured us at the end of Year 5 that the ITLC component will remain a consistent part of their curriculum.

National Impact

Besides the local benefits, the ITLC project had an impact on educators across the country through product dissemination, conference presentations and workshops, and website access. In 1997, the ITLC staff, in partnership with the Center's literacy research project staff, developed the curriculum, *eMERGing Literacy and Technology: Working Together*. Further activities, an assessment chapter, and website resources were added to the second edition in 1998. In 2001, the curriculum was updated once again, adding even more activities based on ideas from site teachers, adaptations, and resources. The curriculum is disseminated to early childhood educators across the country.

The ITLC Coordinator presented information on the ITLC model as a member of a panel on the December 1996 Apples Magazine broadcast, *Once Upon a Time...Computers and Early Literacy Development.* A videotape of the broadcast has been disseminated to early childhood personnel in Illinois and other states and is available from the Center for Best Practices in Early Childhood and the Curriculum Publications Clearinghouse at Western Illinois University.

Project staff developed a brochure in Year 1 describing the purpose, benefits and applications of ITLC. The brochure was distributed to teachers and families involved in the project and to participants at conference presentations. Other materials developed by ITLC staff include a training manual, a family manual, a site newsletter, three videotapes, and four CD-ROMs.

Videotapes developed by staff included an overview tape, *Interactive Technology Literacy Curriculum*, which shows ITLC activities and computer applications along with interviews of site teachers on the literacy benefits they have seen with their children. A second videotape, *Technology and Literacy: A Preschool Story* focuses on books children made in site classrooms using *HyperStudio*. The video from the Apples Magazine broadcast is the third videotape product.

Staff put together one CD-ROM of site *HyperStudio* stacks and three CD-ROMs of *iMovies* based on site activities. The first *iMovie* is entitled "*A Mouse Theme for Literacy*," and combines literacy and expressive arts activities. The second *iMovie* is "*The Bushnell Preschool Train Project*," based on a train unit with computer and off-computer activities. The third is "*It's My Turn*," which shows various literacy activities in the classroom. These *iMovies* and *HyperStudio* stacks are used during training and presentations as samples of literacy activities and, in some cases, teacher products.

ITLC staff have presented information on the model at regional, national, and international conferences. Between 1995 and 2001, staff presented at 26 conferences impacting 622 participants. Presentation topics included designing a literacy-rich environment, selecting software for literacy activities, adapting activities for children, using *HyperStudio* and *iMovies*, and other teaching strategies and curriculum ideas related to literacy and technology. In 1998, staff were invited to present information about the project to a group of USDE officers in Washington, D.C. Seven officers, including the Preschool Grants Coordinator, attended the session and were interested in the ITLC curriculum activities which were discussed and demonstrated. ITLC staff also conducted two regional workshops in Iowa and Texas on specific software and adaptive input applications. In December, 2001 project staff were invited to conduct a half day preconference session on technology for the 2001 Division for Early Childhood (DEC) Conference in Boston.

Staff also wrote 30 articles related to emergent literacy and technology. In 1999, an article, *A Simple Strategy to Encourage Emergent Literacy* (Godt, Hutinger, Robinson, & Schneider, 1999) by the project's Evaluator, Director, Coordinator, and Curriculum Specialist appeared in *Teaching Exceptional Children*. Twenty-seven articles by ITLC staff have been published in *ACTTive Technology,* a quarterly publication by the Center.

In 1998, staff developed a web page for ITLC which provided visitors with information about the project, sample curriculum activities, adaptations, and resources for families and teachers. The web site can be viewed at http://www.mprojects.wiu.edu/itlc/. ITLC staff have received eight direct requests for technology literacy information in the past year from visitors to the web page. Requests for information are also received from the Center's main web page.

Future Plans

The ITLC content has been use as a basis for an emergent literacy on-line workshop that is part of the Early Childhood Technology Integrated Instructional System (EC-TIIS) Project (PR #H327A000071), a Steppingstones Phase1 Development Project funded by OSEP. EC-TIIS staff adapted the ITLC training materials and curriculum to a format suitable for web-based training. The emergent literacy workshop along with other EC-TIIS workshops are found at <www.wiu.edu/users/ectiis/>.

In November 2001, the Center for Best Practices in Early Childhood submitted a model demonstration proposal to OSEP's Research and Innovation to Improve Services and Results for Children with Disabilities based upon the ITLC model. Competition results are not expected to be announced until summer 2002.

Preliminary analyses have been done on the differences among teaching styles and their impact on child results. Further analyses will be conducted and the results used as a basis for an article.

Assurance Statement

A complete copy of this report has been sent to ERIC. Copies of the title page and abstract have been sent to NEC*TAS, the National Clearinghouse for Professions in Special Education, the National Information Center for Children and Youth with Disabilities, the Technical Assistance for Parent Programs Project, the National Diffusion Network, the Child and Adolescent Service System Program, the Northeast Regional Resource Center, the MidSouth Regional Resource Center, the South Atlantic Regional Resource Center, the Great Lakes Regional Resource Center, the Mountain Plains Regional Resource Center, the Western Regional Resource Center, and the Federal Regional Resource Center.

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