Establishing the Foundations for Self-Determination in Young Children with Low-Incidence Disabilities

FINAL REPORT

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Background and Rationale

Children who are born with low-incidence disabilities often experience multiple limitations. Sensory impairments seriously compromise the extent to which children can learn about events and objects that are beyond their physical reach, while hearing impairments limit what they can learn about the environment from auditory sensations. Orthopedic impairments may limit experience with manipulating and exploring the physical environment. Social skill deficits may make it difficult for children to learn from interaction with their peers. Cognitive impairments may impede the integration of limited sensory experiences and detract from the ability to make sense of the social or physical environment. The tools necessary to comprehend the environment and to interact with it meaningfully may not develop spontaneously through the natural processes of discovery. Repeated experiences with failure, frustration and lack of control, coupled with the tendency of family members and professionals to provide more help than is necessary, may lead to excessive passivity and disinterest. A sense of helplessness may result, suppressing the ability to learn to act on or respond to the environment in new and effective ways. Teachers and parents also may experience perceptions of personal failure that may lead to frustration and lowered expectations for the child.

Instructional approaches developed for young children with special needs often assume a high level of dependency and actually end up reinforcing dependence rather than independence (Mithaug, Martin & Agran, 1987). For instance, passive sensory stimulation and hand-over-hand assistance are very likely to promote passivity in the young child who is deafblind (Chen & Haney, 1995). There has been a long history of instruction emphasizing compliance (Bricker & Cripe, 1992). Even approaches that target independent behavior often focus exclusively on the child's motor behavior, sometimes targeting skills that are beyond the physical limitations of a child with orthopedic impairments and often targeting skill areas (such as “daily living”) that are not highly valued by young children (Brown & Cohen, 1996). A focus on motor behavior is often coupled with a disregard for the *meaning* or *intent* of that behavior. This leads to teaching children to produce behaviors that have no meaning, function or value to them. It also leads to the suppression of unwanted or inappropriate motor behavior (“acting out”, self-stimulatory behavior) rather than an investigation of its meaning, and the provision of an appropriate means to express that meaning (Donellan, Mirenda, Masaros, & Fassbender, 1984).

The foundations of learning lie in the child's ability to initiate interaction with the social and physical worlds and to respond to the opportunities for interaction afforded by those worlds. Mastery of the physical and social environments is critical to learning new things. If we ignore the roots of learning we run the risk of fostering passivity and dependency and compromising early learning.

This project sought to develop a comprehensive instructional approach that would lay the foundations for self-determination. Brown & Cohen (1996) have examined the specific skills and the affective, cognitive and behavioral components that may result in self-determination in the young child. As they point out, however, component skill development is only one part of the picture: the larger picture involves the provision of opportunities to practice behaviors related to self-determination and to exercise control over the various aspects of one's existence. Thus, in the classroom, general teaching approaches and instructional strategies are crucial to the nurturance or suppression of self-determination.

> *"If special educators do not want to produce adults with learned helplessness--if they want to help produce adults who can make decisions and be self-advocates--they need to provide more opportunities within their programs, beginning with the youngest students, to develop and practice the skills that comprise the building blocks of self-determination (i.e., initiating activities, making choices, expressing preferences, participating in activities, developing interests, making simple plans in pursuit of these interests, displaying engagement and persistence, and exercising increased appropriate control over the environment." (Brown & Cohen, 1996, p. 25)*

Conceptual Basis for the Project

As this project began, we had already developed assessment instruments, instructional strategies and materials addressing the component skills that allow a young child to exercise control over the social and physical environments. One line of research addressed alternative means of communication for nonverbal children and the infusion of opportunities to practice social/communicative skills across an entire schedule of daily activities. A second line of research addressed the development of skills required to solve problems that arise in the physical environment by understanding the relationships between objects and between the self and objects. This project synthesized those two previous research efforts into one single approach that is systematic and child-centered. The Foundations for Learning approach involves three partners in a cooperative learning process based upon the understanding of all partners—the child, the teacher and the parent. Instruction targets the child's understanding of events in the social and physical worlds and the ability to initiate

interaction and respond to the opportunities for interaction afforded by those worlds.

Mastery of the social environment

Mastery of the social environment means that we can interact effectively with other people. That is, we can initiate communication with others and we can respond to their bids to communicate with us. Much is made of the need for social relationships, friendships, self-determination and choice-making--all of which require that the individual can communicate intentionally. This is not an assumption that can be taken for granted for the young child with severe disabilities. Communication and social skills allow the child to interact in a functional way with the social environment. An appropriate and effective communication system is necessary to interact socially. For instance, if a child needs to make choices, what mode of receptive communication can the child understand so that his teacher can communicate to him that there is a choice to be made? What mode of expressive communication can the child learn to use so that the teacher understands what choice he is making? For many young children with severe disabilities, effective communication involves an alternative (nonspeech) communication system.

Mastery of the physical environment

Mastery of the physical environment means that we can interact effectively with the inanimate environment. That is, we can initiate actions on objects, materials, equipment, and spaces and we can respond appropriately to the opportunities, problems and demands that arise in the physical environment. The skills that allow us to master the physical environment are the concept development skills necessary to understand the

uses of objects, the relationships between objects and actions, and ways to gain access to objects. Concept development skills allow the child to understand how to interact in a functional way with the physical environment. In the words of Williams & Kamii (1986) "It is not the manipulation of objects itself that is important for children's learning. What is important is the mental action that is encouraged when children act on objects themselves" (p. 26). These are generic skills -- they are tools that may be used to solve new problems as they appear in new situations or with new materials. They are skills that increase the user's independence and ability to adapt to the changing parameters of a normal lifestyle. If a child needs to learn how to solve a problem that occurs in the physical environment--perhaps the ball she is playing with has rolled under the sofa--what does she need to solve that problem? (She needs to understand that the ball hasn't disappeared-that it's still available, even if she can't see it; that if she can't reach underneath, perhaps she could rake it out with the help of a yardstick; and that if not, perhaps she needs to ask for help). Success in leisure, recreation, daily living and vocational tasks depends to a large extent on the individual's understanding of the physical environment. Young children must function in inclusive home, school and community settings, and they are faced with constantly changing and expanding environments. They need to understand how to activate a new mechanical toy, how to open a new type of milk container, how to open the door to the new classroom, how to make a detour around an unexpected barrier. Such understanding does not necessarily develop spontaneously in the child with low-incidence disabilities.

Foundations for Learning

If we propose to teach a child how to master the social and physical environments, then we need to look at the generic skills of learning and consider how the child may acquire those skills. Whether in the social or the physical domain, the motor component is only one aspect of the targeted behavior. The *intent* of that behavior, the child's *understanding* of what needs to be done and why it makes sense to produce the behavior are far more fundamental aspects of behavior. Such awareness allows the child to regulate his or her own behavior, to demonstrate foresight, and to realize that it is possible to exert some control over both people and objects in the environment. In other words, learning is an internal achievement, not just a repertoire of discrete, observable behaviors. That is why it is so important to target the intent and meaning of behavior rather than its mere physical expression. Instructional approaches that focus on the comprehension, intent and meaning of behavior as opposed to its motor components are ones that are likely to foster learning.

When we contemplate strategies that might promote mastery of the physical and social environments, there are three major intervention targets. The first is the child's communicative, social and concept development skills, given appropriate adaptations to accommodate individual sensory and motor impairments. The second intervention

target is the social environment--that is the behavior of other people that may or may not provide the child with opportunities to interact with either people or objects (Halle, 1987; Rowland, 1990). The third intervention target is the physical environment--that is, the opportunities that may or may not be inherent in the materials, objects, equipment and spaces available to the child that would encourage the child to interact with objects or with people (Gaylord-Ross, Haring, Breen & Pitts-Conway, 1984; Martin, Brady & Williams, 1991). Social and physical environments may be engineered to encourage or to discourage experience, independence and mastery. A major barrier to learning is the tendency of adults to do things for the child, often in a well-meaning, but misguided, attempt to hasten their participation in ongoing activities.

The Foundations for Learning model and materials adhere to the conceptual basis outlined above. The intent of the child's behavior is as important as its physical demonstration. Interventions target not just child skills but also the social and physical environments. The next section describes the model and materials that make up the Foundations for Learning instructional approach developed through this project.

II. Foundations for Learning Model and Materials

The Foundations for Learning model is an educational approach for children with severe and low-incidence disabilities. The outcome targeted by the model is mastery of the social and physical environments. Mastery is defined as the ability to initiate and respond to interactions with the social and physical environments. Mastery of the social environment is achieved by communication development. Communication allows us to relay our own needs and desires effectively and to respond appropriately to the attempts of other people to communicate with us. Mastery of the physical environment is achieved through the development of concepts needed to understand how the world around us works. Concept development skills allow us to understand how we relate to the physical environment so that we can interact effectively with objects, structures and spaces.

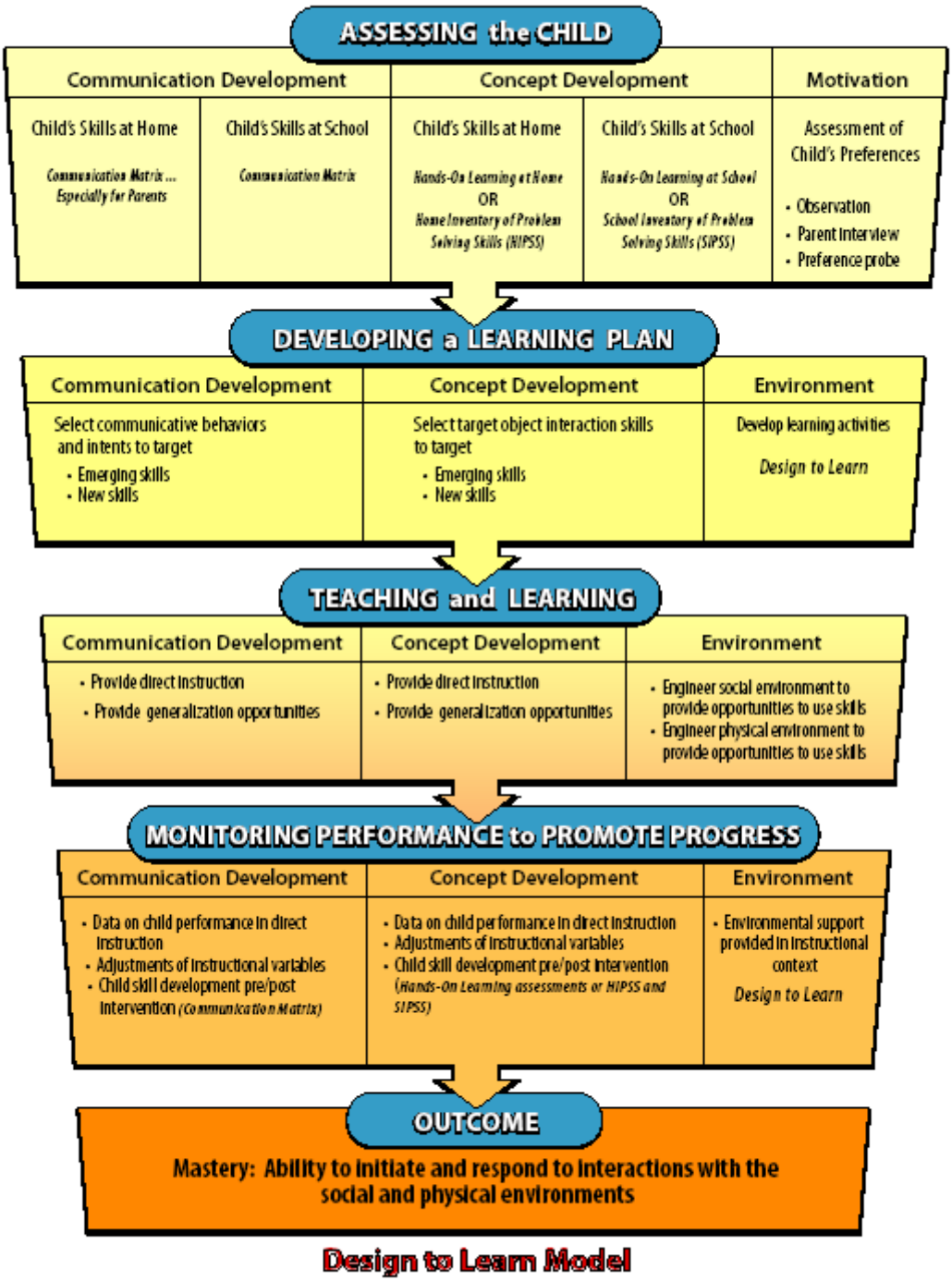
The Foundations for Learning model involves instruction in communication development and concept development that is integrated into typical classroom activities. Hallmarks of the approach include:

- assessment data are provided by parents as well as by educational professionals
- the focus is on instructional contexts and materials that are intrinsically motivating to the student, decreasing the likelihood that extrinsic reinforcement is needed
- social and physical environments are engineered to provide natural opportunities to learn new skills and to practice existing ones
- both the student's performance and the learning environment are monitored to evaluate instructional progress
- instructional strategies target the student's understanding of communication and concept development skills as well as the physical demonstration of those skills

The Foundations for Learning Model is represented on the following page. The four components of the model are: Assessing the Child, Developing a Learning Plan, Teaching & Learning and Monitoring Performance to Promote Progress.

Foundations for Learning **Materials**

The Foundations for Learning materials include some that were developed through earlier research projects and others that were developed specifically for this project. Materials developed through earlier projects had already been subjected to studies of their effectiveness and reliability. New products developed through this project include *First Things First*, the *Design to Learn DVD*, two new versions of the *Communication* Foundations for Learning *Model*. All of the materials except for *On the Same Page* and the *Guide to the* Foundations for Learning *Model* were designed for stand-alone *Matrix, On the Same Page* and the *Guide to the* use. Educators may pick and choose the assessment and instructional materials that seem appropriate for their own students'



Design to Learn Model

needs. The materials together form a comprehensive package to address the four major components of the Foundations for Learning instructional model: Assessment, Developing a learning Plan, Teaching & Learning and Monitoring Performance to Promote Progress. Many of the materials address multiple components of the model. The materials that make up the Foundations for Learning package are attached separately. The *Guide to the* Foundations for Learning *Model* explains exactly how the materials are integrated into one instructional approach. The materials are described below.

Materials related to Communication Development

Communication Matrix: an assessment of the child's communication skills. The original *Communication Matrix* is a communication skills assessment instrument for individuals functioning at the earliest stages of communication who use any form of communication, including pre-symbolic and augmentative or alternative forms. The *Matrix* covers seven levels of communicative development (from pre-intentional behavior through the use of early language forms) and is organized into four major reasons for communicating: to **Refuse** things; to **Obtain** things; to engage in **Social** interactions; and to provide or seek **Information**. This instrument has been extensively field-tested. The *Communication Matrix…Especially for Parents* is a "user-friendly" version designed to be easier for family members to use. The resulting profile is the same as the one that accompanies the professional format. The *Communication Matrix* is also available online as a free service at communicationmatrix.org. A profile and a list of the child's communication skills is automatically generated for printing from the web site. No identifying information is collected.

First Things First: an instructional guide on teaching pre-symbolic communication. This new instructional guide provides practical strategies for encouraging early communication in children who have no or minimal intentional communication. *First Things First* describes instructional strategies for children who are not yet ready to use symbols to communicate. This book focuses on teaching children to **Reinstate** desired events, to **Gain Attention** and to **Make Choices** using pre-symbolic behaviors such as gestures, facial expressions, vocalizations or (in the case of severe orthopedic impairment) switches. It also includes strategies for establishing motivating contexts and materials for instructional activities. *First Things First* includes forms for tracking and monitoring instruction and is illustrated with photographs of children in school and home settings.

Tangible Symbol Systems: an instructional guide and videotape on using tangible symbols to communicate. *Tangible Symbol Systems* instructional materials include a 75-minute video/DVD and 55-page illustrated manual. These materials show how to teach individuals to communicate using objects or pictures to represent items, people, and events in their daily lives. These products describe and illustrate alternative communication options and instructional strategies for a broad range of learners of any age who are unable to communicate using speech, manual sign language, or other

types of abstract symbols. Strategies for determining student preferences and motivating contexts for instruction are included. The field-tested materials are the result of extensive longitudinal research involving individuals who are deafblind or who have other severe and multiple disabilities.

Materials Related to Concept Development

The **Hands-On Learning** materials address a wide range of object interaction skills, including the use of objects in symbolic play and in social interactions. They focus on the child's interaction with the physical environment and specific object interaction skills that may reflect cognitive and social skill development. These materials were field-tested by teachers and parents of nonverbal children with pervasive developmental disorders and have subsequently proven applicable to nonverbal children with wide a range of severe disabilities.

Hands-on Learning at School. This is a 20-page assessment of object interaction skills that includes 39 skills in four strands: Obtaining Objects, Practical Uses, Representational Uses and Social Uses. It is designed to be administered in the school or child care setting by a professional. Examples are provided to show how each skill may be demonstrated in the typical classroom.

Hands-on Learning at Home. This instrument contains the same 39 skills as the School version, but is designed to be administered in the home by family members. Examples are provided to show how each skill may be demonstrated at home.

Teacher's Guide to Hands-On Learning. This is an instructional guide for teachers describing the Hands-On Learning approach to concept development and assessment materials. It includes strategies for determining motivating instructional contexts and selecting materials to target concept development skills.

Hands-On Learning Posters. These 11 X 17-inch full-color posters are used to remind classroom staff which object interaction skills are being targeted for specific students in each activity area. The posters contain the 39 skills from the child skill assessments. Eight posters represent generic activities such as circle time or structured play: the ninth poster is left blank for unique classroom activities.

Alternate Concept Development Materials

At the same time that the Foundations for Learning project was being conducted, we were conducting a second project that targeted children who were deafblind. Through that project we developed a parallel approach that targets the unique and more complex needs of children born with hearing and vision impairments. Most of the participants experienced additional impairments, were nonspeaking and had severe cognitive limitations. A second set of materials was developed through that project. Those materials are called the "Learning to Learn" materials. The only difference between the two sets of materials lies in the components related

to concept development. The alternate materials are the *School Inventory of Problem Solving Skills (SIPSS)*, the *Home Inventory of Problem Solving Skills (HIPSS)* and the accompanying *Teacher's Guide*. These alternate assessment instruments provide a very detailed breakdown of the most basic ways of interacting with the physical environment, including such items as approaching desired objects and transferring objects from one hand to another. In contrast, the concept development components of the Foundations for Learning materials don't include many items at those very early levels. But they do include items related to social uses of objects and representational uses of objects that are not included in the *HIPSS* and *SIPSS*.

For some of the students in this project, the Learning to Learn materials were more appropriate. Specifically, children who experienced both vision and hearing impairment, who were nonspeaking and who experienced severe cognitive and/or orthopedic limitations. Information about the "Learning to Learn" materials may be viewed on our web site, www.designtolearn.com. They are described briefly below.

School Inventory of Problem Solving Skills (SIPSS). The *SIPSS* is a 33-item child skill assessment designed to be administered in school or childcare settings by a professional. The assessment items are organized into three strands: **Basic Skills** (the most fundamental ways to interact with objects), **Ways to Gain Access** (skills needed to gain access to a desired item that is inaccessible) and **Ways to Use Objects** (skills needed to use items appropriately in functional contexts). Examples are provided to show how each skill may be demonstrated in the typical school setting. All items can be performed by children with both vision and hearing impairments and by children without expressive or receptive language.

Home Inventory of Problem Solving Skills (HIPSS). The *HIPSS* contains the same items as the *SIPSS* but is designed to be administered in the home either by family members or by a professional who interviews family members and observes the child at home. Examples are provided to show how each skill may be demonstrated in the typical home setting.

Hands-On Problem Solving for Children with Multiple Disabilities: Guide to Assessment and Teaching Strategies . This is an instructional guide for teachers describing the Hands-On Problem Solving approach to concept development and assessment materials. It includes strategies for determining motivating instructional contexts and materials for targeting concept development skills.

Problem Solving Posters. These 11x17 inch full color posters contain the 33 skills from the *HIPSS* and *SIPSS*, and provide space to indicate which

skills are being targeted in a particular activity for up to three children. The nine different classroom posters represent generic activities (e.g., sensory time, structured play, etc.), with examples of how object interaction skills may be incorporated into such activities.

Materials Related to the Learning Environment

Design to Learn Inventory and Guide. The *Design to Learn* environmental inventory is used to track the opportunities to learn communication and object interaction skills that are provided in classroom activities for a specific student. The inventory was developed especially for children with pervasive developmental disorders (including autism) and it is applicable to nonverbal children with wide a range of disabilities. *Design to Learn* is compatible with the *Hands-On Learning* assessments and with the *Communication Matrix* in that it specifically addresses opportunities to demonstrate the skills included in each of those instruments. The inventory contains 67 statements in eight categories (**Transitions**, **Activity**, **Adult's Interaction**, **Student's Communication System**, **Peer Interaction**, **Opportunities to Communicate**, **Opportunities to Use Objects**, and **Materials**) that represent methods for encouraging learning in classroom activities. The guide book contains the inventory, an introduction and a description of each item on the inventory, followed by options for implementing each one.

Alternate Environmental Inventory

An alternate version of *Design to Learn* is available that is completely compatible with the concept development items on the *HIPSS* and *SIPSS* described above under Alternate Concept Development Materials. Information about the alternate environmental inventory, *Time to Learn*, may be viewed on our web site, www.designtolearn.com.

Putting It All Together (integrative materials)

On The Same Page: learning plan form. On the Same Page is a form for integrating assessment information from home and school and for developing and monitoring an integrated learning plan. This form provides space to enter the results of communication and concept development skills derived from administering the *Communication Matrix* and the *Hands-On Learning* assessments at school and at home. *On the Same Page* makes it easy for parents and teachers to compare how the child behaves in the two different environments and to discuss and generate logical new skills to target. The form also includes space to evaluate the teaching environment using *Design to Learn* data to identify environmental supports for learning. (An alternate version of *On the Same Page* is available for use with the "Learning to Learn" materials through www.designtolearn.com.

Guide to the Foundations for Learning *Model and Instructional Materials*. This is a 10-page booklet that describes all of the Foundations for Learning materials and explains

how they address each of the four components of the instructional model. The table below shows how the materials described above fit into the four components of the instructional model.

Assessing the Child

Model Component	Related Materials
Communication Development	*Communication Matrix … Especially for Parents*
	Communication Matrix (professional version)
	Tangible Symbol Systems (pre-test, Ch. 9)
Concept Development	*Hands-On Learning at Home (or HIPSS)*
	Hands-On Learning at School (or SIPSS)
Child's Motivation	*First Things First (Ch. 3)*
	Tangible Symbol Systems (Ch. 5)
	Hands-On Learning, p. 22 (or Hands-On Problem Solving Guide, p.12)

Developing a Learning Plan

Model Component	Related Materials
Communication Development	*First Things First*
	Tangible Symbol Systems
Concept Development	*Hands-On Learning (or Hands-On Problem Solving Guide)*
Environment	*Design to Learn Inventory*
Learning Plan	*On the Same Page*

Teaching and Learning

Model Component	Related Materials
Communication Development	*First Things First*
	Tangible Symbol Systems (manual)
	Tangible Symbol Systems (videotape/DVD)
Concept Development	*Hands-On Learning (or Hands-On Problem Solving Guide)*
	Hands-On Learning Posters (or Hands-On Problem Solving Posters)
Environment	*Design to Learn manual*
	Design to Learn (DVD)

Monitoring Performance to Promote Progress

Model Component	Related Materials
Communication Development	*First Things First (Ch. 4-7)*
	Tangible Symbol Systems (Ch. 13-15)
	Communication Matrix (Parent and Professional)
Concept Development	*Hands-On Learning, pp. 31-34 (or Hands-On Problem Solving Guide, pp.19-21)*
	Hands-On Learning at Home/School (or HIPSS/SIPSS)
Environment	*Design to Learn Inventory*

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III. Summary of Project Activities

Objectives 1-3 (Demonstration, Replication and Dissemination) constitute the major objectives of the project. In the following section, activities accomplished to achieve those three objectives are described.

Objective 1. Demonstration

There were three model classrooms involved in demonstration efforts for this project. Model Classrooms #1 and 2 were public pre-school classrooms located in Portland, Oregon. Model Classroom #1 participated in Years 1-3 and was dissolved by the school district in the following year. Model Classroom #2 participated in Years 1-2 of the project and then was dissolved by the school district. Model Classroom #3 was a public elementary school classroom located in Beaverton, Oregon that initially served as a replication classroom in Year 3. This classroom was converted to a model classroom for Years 4-5 of the project after the first two model classrooms had been discontinued. This elementary site continued to serve as a model classroom until the conclusion of the project. There were a total of 20 participants across the three model classrooms. Demographics for student participants are provided in the Results section.

Activity 1.1. Provide staff training in model classroom.

Each teacher participated in training offered by project staff on the communication component. This included an in-depth discussion of the *Communication Matrix, Tangible Symbol Systems*, pre-symbolic communication and the environmental inventories, Design to Learn and Time to Learn. A separate ½ day meeting involving the model classroom teachers was provided to familiarize all staff with the concept development component of the model. Once the conceptual background for the project was reviewed by parents and staff of the model pre-school classrooms, further training continued as participants were assessed. Training in the elementary school model classroom began as participants were identified and consents were received.

Development of learning plans for participants in the model classrooms occurred as part of their IEP meetings. Project staff participated in those meetings with the family and other team members during Years 1-3 as new students joined the project. Staff guided the members of the team through the assessment, analysis and goal-setting aspects of the model. In the remaining years, the teachers of the model classrooms assumed primary training responsibilities for the assessment and planning meetings. During Years 2-4 training continued to be a part of our twice-monthly meetings with the model classroom teachers as project and classroom staff advanced from one phase ofthe model to the next. Allied services staff, and particularly speech/languagepathologists, participated in these meetings regularly. Other attendees included occupational and physical therapists and vision and hearing consultants. During the initial years of the project, paraprofessional staff persons in the model classrooms were trained in ways to evaluate materials in the learning environment in terms of the concept development skills they could encourage. In subsequent years project staff encouraged classroom

teachers and paraprofessionals who were familiar with the materials to conduct such training.

Activity 1.2 Assess target students in model classroom.

The assessment phase of the Foundations for Learning approach stresses the importance of gathering information about how the child functions at home, at school and in the community. It refers users to specific assessment tools developed for teachers and family members to use to assess the child's skills, needs and preferences. The outcome of assessment activities is a portrait of the child's current performance that shows the child's skills and needs in terms of his ability to interact effectively and appropriately with people and with the physical environment.

The Foundations for Learning assessment materials include parent and teacher versions of the *Communication Matrix*, *Hands-On Learning at School* and *Hands-On Learning at Home* (and the alternate versions, the *HIPSS* and *SIPSS*). All have been described in the previous section of this report. Development of a learning plan calls for choosing activities in which it would be appropriate to learn and practice these skills. These contexts must be compatible with the learner's preferences as well. The assessment component also includes strategies for determining learner preferences. Three different approaches are presented. They are: making choices of preferred items, requesting reinstatement of preferred activities and video analysis of more subtle behaviors for children who are difficult to "read." These strategies are described in First *Things First*, *Tangible Symbol Systems*, and *Hands-On Problem Solving for Children with Multiple Disabilities: Guide to Assessment and Teaching Strategies*. The Tangible Symbols Pre-test, a systematic strategy for determining the level of representation (the type of symbol) a learner understands is included in *Tangible Symbol Systems*.

We believe that it is crucial for teachers and parents to have a common understanding of a child's social and concept development skills as they negotiate a learning plan. This is supported at the assessment phase as parents and teachers collaborate to arrive at an accurate picture of the learner's skills that can be translated into logical intervention plans. To this end *On the Same Page*, a decision-making protocol, was developed. It was designed to consolidate all the assessment pieces from home and school, and describe the learning environment as well as the child. Based on the results from the communication, concept development, and motivation assessments, an appropriate learning plan can be formulated using *On the Same Page*.

Activity 1.3 Administer environmental inventories in model classroom.

Once assessments were completed and motivating learning contexts chosen, the environmental inventory (*Design to Learn* or *Time to Learn)*, was administered to two regular classroom activities (depending on which assessment was used to evaluate the child's concept development skills). These activities were selected for their fit with the skills to be targeted, the child's interest in the activity, and the frequency and the regularity of the activity. It was recognized that an activity that occurred only once a

week, even though reinforcing to the learner, would likely not be a good setting for initial instruction because it would not afford sufficient practice to acquire a new skill. On the other hand, where generalization of an emerging skill was the goal, a less frequent activity might be suitable. Results from the environmental inventory revealed the degree to which opportunities for learning were already in place in the chosen activities and which additional strategies should be added to enhance the instructional activity. All of this information was added to *On the Same Page*, completing the learning plan.

Activity 1.4 Design interventions for model classroom.

Teachers and project staff collaboratively reviewed the assessment results along with IEPs. Then interventions were developed for each participating student. The locus of intervention was the social environment (that is, the interactive behaviors of classroom staff or peers), the physical environment (that is, the materials and classroom arrangements) and the child's skills; or, most likely, all three. As the project progressed, classroom staff continued to assume more of the responsibility for the design of interventions with ever-fading support from project staff, in conjunction with increased reliance on instructional guides. Teaching guides for communication instruction included *First things First* for the pre-symbolic communicator and *Tangible Symbol Systems* for the learner at the symbolic communication level. For concept development, teacher's guides included *Hands-On Learning* and *Hands-On Problem Solving for Children with Multiple Disabilities*. The concept development guides include a checklist for rating the materials available in the classroom for their relevance to specific object interaction skills. As described in Activity 1.3 above, the addition of initial data on characteristics of the learning environment furnished from the environmental inventories added another element to the design formula. Classroom staff assumed most of the responsibility designing interventions with support from project staff; by Years 4 and 5 all programs were designed entirely by classroom staff.

Activity 1.5 Implement interventions in model classroom.

The classroom staff took on increasing responsibility for interventions as the years progressed. They utilized a variety of materials, depending on the specific needs of the individual learner. The teacher's guides listed in the previous activity and described in Section III guided instructional activities related to communication and concept development. The *Hands-On Learning* posters were employed in those instances when the classroom wanted to provide visual reminders to the staff to provide a particular object interaction opportunity for a particular student. This would frequently be the case for the child who no longer needed direct instruction to acquire a new skill but rather required increased opportunities throughout his day to practice it.

The environmental inventories provided teachers with direction as to how to enrich the learning opportunities within a particular activity for a specific child. The focus of these inventories is not the learner's skill, but the quality of the learning environment. Both the *Design to Learn* manual and the *Time to Learn* manual and DVD provide suggestions

for making adjustments to the social and physical environments to encourage learning for a specific child. The *Time to Learn DVD* makes it possible for the user to go directly to examples for a specific section (Transition, Communication System, etc.) and there access numerous videotaped examples of how one might modify that aspect of the activity to enhance learning. The video scenes are all derived from classrooms that participated in the development or field-testing of project materials and the instructional model.

Instruction was embedded into daily activities within a specific learner's social and physical environments. In the first year of a model classroom's participation, project staff took the lead role in the implementation of the chosen instructional activities. In their second year of involvement, project staff provided demonstrations when needed and support in acquiring or adapting materials as needed to nurture learning. However, classroom staff conducted all ongoing instruction. By that time, teachers and para-educators from other participating classrooms were able to visit the model classrooms to observe the "how-to" of implementation.

Activity 1.6 Monitor student progress and provide support as needed.

Promoting steady and meaningful progress requires regular documentation of child performance, the review of data and the adjustment of intervention responsive to performance data. The Foundations for Learning approach involves a data-driven instructional process. Each component, whether it regards communication, concept development or the learning environment, provides strategies for the collection and analysis of data that are manageable in the typical classroom setting. Strategies for reviewing data and making decisions based on data are also presented. Techniques are explained for adjusting activities to promote a logical sequence of learning toward a defined goal based on the success or difficulty that the child is experiencing. The materials emphasize adjusting learning activities to promote the shift of control from artificial or teacher-controlled stimuli to more natural environmental stimuli. What we are striving for is a systematic yet flexible instructional process for learning, rather than a "cook book" approach. As such, monitoring as described in Foundations for Learning recognizes and accommodates the uniqueness of each learner and his/her respective environment. Intervention records allow the practitioner to track the instructional variables that they are adjusting and provide ideas as to how instruction might be modified based on the learner's performance.

Periodic analysis of the learning opportunities incorporated into instructional activities was accomplished through the *Design Time to Learn* or *Time to Learn* inventories. This form of monitoring was the major vehicle for communication and feedback between project and classroom staff as the project progressed. This exercise keeps the practitioner attuned to other opportunities that could be added to enhance the learning environment. Such modifications of the environment help insure that the learner is maximizing natural cues and reducing dependence on artificial stimuli. Data from previous studies conducted by this project had already found a high correlation between

an opportunity-rich environment and child skill acquisition. This approach emphasizes the environment and the teacher's skill in creating an opportunity-rich environment as compared to approaches that focus exclusively on the child's competencies.

In Years 3 and 4 more emphasis was added to the regular collection and analysis of child performance data. All monitoring was focused on promoting progress either by reducing the demands of instruction that was currently too frustrating for the learner, or by increasing the demands to 'up the ante' as the learner progressed. Teachers were referred to the *Intervention Records* included in *Tangible Symbol Systems*, *First Things First* and the *Hands-On Problem Solving* or *Hands-On Learning* guides. Initially, the different intervention record forms incorporated in these guides were used to track changes in instruction. The *Presymbolic Intervention Record* was used to monitor changes made to pre-symbolic communication intervention. The *Tangible Symbols Intervention Record*, was used if the child was ready for expressive communication using tangible symbols. The *Object Interaction Intervention Record* was used to identify changes made to the teaching of concept development skills. These three forms are now folded into a single generic form with specific glossaries, depending on the application (pre-symbolic, symbolic and or concept development). In each case, the key variables of instruction have been identified; these variables provide the structure to systematic intervention. This approach to monitoring instruction is flexible since it calls for instructional variables to be adjusted if and when the particular learner requires it to further promote learning. These forms are attached in Appendix A.

The instructional guides describe intervention in terms of the instructional variables include on the *Intervention Records* and glossaries. For example, instructions from *First Things First* (p.22) state:

> If learning or generalization does not occur, refer to the key variables of instruction and consider which may be impeding learning. Make changes in these variables systematically and strategically, taking data that will reveal when a specific change results in learning. If an adjustment does not produce the desired change, then try another one. Monitor the learner's performance to determine whether the change is helping or not. The point is to modify instruction to ensure steady learning. When the data show that the child has succeeded at the current step of instruction, "up the ante." Variables that are most highly related to reinstatement are listed below.

This same text provides the following examples of variables to consider when determining how to adjust instruction (p.23):

> Materials. If learning is not occurring, you may need to look for more motivating materials to offer. If learning has occurred, you may want to add new materials so that the reinstatement behavior will generalize to additional items.
>
> Instructional Cues. Perhaps the learner needs more information to understand that you are expecting him to communicate. For example, you might stop the action more suddenly so it's clearer that you have stopped, exaggerate the tone of your voice when you ask if he wants more, or remove your hand from his leg after you bounce him on the ball. Or, if the child is doing well, you may

be able to use less obvious and more natural cues.

Targeted Behavior. Perhaps the targeted communicative behavior is inappropriate because it is too difficult for the child to make or not sufficiently under the child's control. Alternatively you may be able to require a clearer response. You may now require that the child sustain a tap for at least several seconds instead of accepting a momentary tap to request more of something.

Finally, performance was monitored through periodic re-administration of the *Communication Matrix, Hands-On Learning at School* or the *SIPSS* to document overall progress in the child's communication and concept development skills over the course of each school year of participation. These pre-post intervention assessments revealed overall gains in the skill levels of each participant.

Objective 2. Replication

Activity 2.1 Identify replication sites.

Two replication sites were identified in the neighboring school district of Beaverton, Oregon, where activities commenced in the fall of 2001. Both sites were classrooms in public elementary schools that included children with low-incidence disabilities. Five additional replication sites were added in Year 4. These were in Lacey, WA, San Antonio and Lamesa, TX, Santa Rosa, CA and another classroom in Portland, OR. These were all elementary level classrooms in public schools. One of the original replication sites in Beaverton was shifted into the role of model classroom in Year 4 after the original model classrooms were dissolved.

Activity 2.2 Provide staff training in replication sites.

Teachers and, in most instances, related service staff from the student's educational team, attended training sessions during Year 3 and/or the fall of Year 4. The trainings generally ran from 16-20 hours total and covered assessment of child skills (pre-symbolic and symbolic communication and concept development) as well as assessment of the learning environment using the materials described in Section III. Training also presented an overview of how to integrate assessment data from home and the school into a meaningful learning plan. The training described intervention options, and strategies for maintaining learning. *On the Same Page* was presented as the "binding" for all of these elements.

Activity 2.3 Design interventions for replication sites.

The instructional materials developed through this project provide a clear strategy for designing interventions that are driven by a thorough assessment of the child and the environment. This involves assessment input from the home as well as the school, and

an evaluation of the learning opportunities offered by the environment. *On the Same Page* was used by replication teachers and the parents of participants to integrate this information and to select educational goals and design interventions.

Activity 2.4 Implement interventions in replication sites.

Implementation in replication sites was supported by regular consultation with project staff. Consultation between project and replication classroom staff was structured around the exchange of videotapes of target children. The classroom teachers also administered the *Design to Learn* or *Time to Learn* inventory for two classroom activities for each target student. These activities were selected for their fit with the skills to be targeted, the child's interest in the activity and the frequency and regularity of the activity. The next step was developing a learning plan based on this information about the learner and the environment. The various sites provided project staff with a copy of their completed *On the Same Page* as documentation of parent participation, current level of learner functioning, and goal development. At that point the consultation shifted to teaching and learning. With information from the assessments as a guide, project staff regularly reviewed the videotapes from replication sites and provided feedback in the form of a *Design to Learn* or *Time to Learn* analysis of the videotaped activity. This form of monitoring was the major vehicle for communication and feedback between the project and replication classrooms. Project staff visited the replication site in Oregon several times, and visited the site in Lacey WA once. Replication site staff in the Pacific Northwest was able to visit the model classrooms in Portland to make observations and talk with experienced staff. Attached in Appendix B are samples of consultation notes based on the environmental analyses for several of the replication sites.

Activity 2.5 Monitor student progress and provide support as needed.

For replication sites in the Portland area, project staff was able to travel to the sites to collect independent measures of child performance during the course of replication activities. For participants in other states, we relied upon data collected by staff at those sites. One part of monitoring was regular collection and analysis of child performance data. Sample data collection forms were shared with the replication sites, but teachers were encouraged to develop their own. When the focus of consultation expanded from structuring the learning environment to monitoring instruction, feedback from project staff began to include *Intervention Records*. Project staff completed the *Intervention Records* based on the videotapes and other correspondence provided by the replication sites. This process of feedback and support provided a way to demonstrate the monitoring of instructional variables included in the *Intervention Record.* A sample completed *Intervention Record* is attached in Appendix C. Replication classrooms were encouraged to use this form of tracking themselves as part of their regular monitoring and communication with the project, along with the periodic re-administration of the environmental inventories. In addition, student progress was monitored through the twice-yearly administration of the *Communication Matrix* and *Hands-On Learning* or the *SIPSS*.

Objective 3. Dissemination

Dissemination efforts have included presentations, professional articles and book chapters and the provision of project materials to appropriate audiences.

Activity 3.1 Develop first draft of teacher training materials.

New materials developed expressly for this project were developed over the first two years of the project and revised continually as teachers provided feedback as to their utility.

Activity 3.2 Revise teacher training materials.

All of the materials were revised repeatedly over the course of the project in response to feedback from teachers at both model and replication sites. Ratings of project materials are provided in the results section of this report. Final versions of the materials were developed following exhaustive review and revisions of the individual components. The final materials are described in the Section III of this report and are attached separately.

Activity 3.3 Present results to appropriate audiences.

Below is a list of presentations that featured Foundations for Learning strategies and materials made to a variety of audiences over the course of the project and to date.

Rowland, C. & Schweigert, P. Tangible Symbols, Tangible Outcomes. Placer County Department of Special Education, Sacramento, CA, April, 1999.

Rowland, C. & Schweigert, P. Tangible Symbols, Tangible Outcomes–New Research and Case Studies. Division for Early Childhood Conference on Children with Special Needs, Washington, D.C., December, 1999.

Rowland, C. & Schweigert, P. Assessing the Problem Solving Skills of Nonverbal Children who have Multiple Disabilities, 2000 CEC Annual Convention, Vancouver, B.C., April, 2000.

Rowland, C. & Schweigert, P. Tangible Symbols, Tangible Outcomes–New Research in Communication Intervention. 2000 CEC Annual Convention, Vancouver, B.C., April 2000.

Schweigert, P.D. Cognitive communication assessment and instruction for the child with vision impairments or deafblindness. Texas Focus Conference, El Paso, TX. June, 2000.

Schweigert, P.D. Developing and using communication systems for children with severe disabilities, including deafblindness. Montana Council for Exceptional Children, Missoula, MT. March, 2001.

Schweigert, P.D. Tangible Symbols Systems: Teaching strategies and case studies. Yolo County Department of Education, Davis, CA. March, 2000

Rowland, C. & Schweigert, P. Communication and Cognitive Development: Assessment and Intervention for Children with Multiple Disabilities. Region VI Education Service Center, College Station, TX, April 2001.

Schweigert, P.D. & Rowland, C. Research on the Acquisition of Tangible Symbols by Nonspeaking Children. International Association of Logopedics and Phoniatrics, Montreal, August 2001.

Rowland, C. & Schweigert, P. Communication and Cognitive Development: Assessment and Intervention for Children with Multiple Disabilities. Region VI Education Service Center, Victoria, TX, November 2001.

Rowland, C. & Schweigert, P. Communication and Cognitive Development: Assessment and Intervention for Children with Multiple Disabilities. Region VI Education Service Center, San Antonio, TX, November 2001.

Rowland, C. & Schweigert, P. Communication Assessment for Children who are Deafblind. Oregon

Department of Education. Eugene, OR, November 2001.
Schweigert, P., Communication development and teaching strategies for children with severe and multiple disabilities, Breckenridge, CO. June, 2002.
Rowland, C. & Schweigert, P. Assessment of Children with Low-Incidence Disabilities. Region III Education Service Center, Victoria, TX, September 2002.
Schweigert, P., Communication development and teaching strategies for children with severe and multiple disabilities, Houston, TX. January, 2003.
Schweigert, P., Communication development and teaching strategies for children with severe and multiple disabilities, Anchorage, AK. February, 2003.
Schweigert, P. Tangible symbols systems for children with severe and multiple disabilities, Denver, CO. February, 2003.
Schweigert, P. Communication and cognitive assessment and interventions for students with multiple disabilities, Fort Worth, TX. June, 2003
Schweigert, P. Communication and cognitive assessment and interventions for students with PDD Denver CO. November, 2003
Schweigert, P., Communication development and teaching strategies for children with Deafblindness. Denver CO. November,03
Schweigert, P., Communication development and teaching strategies for children with severe and multiple disabilities, Albany NY. January, 2004.
Schweigert, P. Communication Development and Teaching Strategies for Children with Severe Disabilities; Parent Workshop, Portland OR. Feb. 04.
Schweigert, P. Communication Assessment and Intervention for Children with Autism Spectrum Disorders. National Autism Conference Penn State University PA, August 2004.
Rowland, C. Assessing Communication Skills in Children with Severe and Multiple Disabilities, Hearing Speech and Deafness Center, Seattle, February, 2005.
Schweigert, P. Communication Assessment and Intervention for Children with Severe and Multiple Disabilities. Utah Deaf-Blind Services, Salt Lake City, Utah, March 2005.

Activity 3.4 Develop technical article.

Articles that have been published to date that involve Foundations for Learning strategies and materials are listed below. Additional articles are under development.

Rowland, C. & Schweigert, P. Tangible symbols, tangible outcomes. Augmentative and Alternative Communication, 2000, 16 (2), 61-78.
Rowland, C., Schweigert, P. Assessment and instruction of hands-on problem solving and object interaction skills in children who are deafblind. British Journal of Visual Impairment, 2001, 19, (2), 47-58.
Rowland, C., & Schweigert, P. Niños sordociegos: Evaluación y enseñanza de habilidades para la resolución de problemas a través del tacto y la interacción con objectos." Entre Dos Mundos: Revista de traducción sobre discapacidad visual, 2002, 18, 59-80.
Rowland, C. & Schweigert P. (2003) Cognitive Skills and AAC: Where we've been, what we know and the questions we should ask. In, J. Light, D. Beukelman & J. Reichle (Eds.) Communicative Competence for Individuals Who Use AAC, Baltimore: Paul Brookes.
Rowland, C. (2005) But what CAN they do? Assessment of communication skills in children with severe and multiple disabilities. ASHA DAAC Perspectives, April 2005.

Activity 3.5 Provide final products to appropriate audiences.

Final products have been put into publishable format. The Foundations for Learning

materials will be made available for purchase through our web site www.designtolearn.com. Materials are sold at close to cost through this web site. Sample packages will be provided to individual professionals and parents who have expressed interest in the materials, and to those who participated in the project.

IV. Project Results

Evaluation of Instructional Materials

Teachers at the replication sites formally evaluated each component of the Foundations for Learning materials package during the last year of the project. Six teachers from Washington, California and Texas participated in these evaluations. The assessment and instructional materials had already been evaluated during the course of projects through which they were developed to ascertain their reliability and validity and to evaluate consumer satisfaction with them. The purpose of these evaluations was to collect data on *the process of using the materials in an integrated fashion*. Four sets of materials were sent to the replication sites over the course of four months and respondents were given 3 weeks to evaluate each set. Responses were collected by non-project staff and were presented to project staff in an anonymous format so that they could not identify which respondents provided which feedback.

A summary of the evaluations of the materials is provided on the following pages. For each material, the questions asked of the replication site teachers are provided, with the associated mean rating across respondents. All questions were answered on Likert-type scales that ranged from 1 to 5, with 5 always representing the most positive response.

Assessment

Communication Matrix

The information on the Matrix helped to document communication skill development across the school year.	4.7
The combination of information on communication skills from home and school helped me to more accurately understand my student's skills.	4.0
The combination of information on communication skills from home and school helped me to discuss the student's skills with parents.	4.3
The information on the Matrix helped to generate meaningful instructional goals.	4.7
The information on the Matrix helped to document communication skill development across the school year.	4.7

Concept Development Assessments (Hands-On Learning at School/Home, SIPSS and HIPSS

The information generated by the HIPSS and SIPSS was useful for the initial evaluation of the learner's object interaction skills.	4.3
The combination of information on object interaction skills from home and school helped me to more accurately understand my student's skills.	4.2

The combination of information on object interaction skills from home and school helped me to discuss the student's skills with parents.	4.2
The information from the HIPSS and SIPSS helped to generate meaningful instructional goals.	4.5
The information from the HIPSS and SIPSS helped to document object interaction skill development across the school year.	4.5

Strategies for Determining Preferences

Procedures for assessing the learner's preferences (as presented in the workshop and in consultations) helped me to determine the learner's preferences.	4.6
Procedures for assessing the learner's preferences (as presented in the workshops and in consultations) helped me to select contexts for instruction.	4.8

Developing a Learning Plan

Design to Learn/Time to Learn

Using Time to Learn at the planning phase was useful in developing a learning plan.	4.7

On the Same Page (original version)

The combination of information on student preferences and communication and object interaction skills from home and school with environmental support information helped me to generate a clear and reasonable learning plan.	4.4
Using On the Same Page seemed to help parents to participate in the development of reasonable learning goals for their child.	4.2
It was easy to enter results onto the On the Same Page form.	4.2
Having a large amount of information about the child's skills from home and school and environmental supports literally together on one page is helpful.	4.6
On the Same Page was useful in conveying information during the process of the student transitioning to another school or classroom.	4.0

On the Same Page (revised version)

The color-coding on the revised On the Same Page will be helpful.	4.8
The re-organization/re-numbering on the revised On the Same Page will be helpful.	5.0
Listing each Time to Learn item makes it easier to use and share with others.	5.0

The instructions for using the revised version of On the Same Page are clear.	4.8
The sample data provided on the revised version of On the Same Page is easy to follow and helpful.	4.8

Materials Checklist (from Teacher's Guide to Hands-On Learning)

Evaluating the materials in my classroom in terms of the skills that could be used to interact with them would be helpful in developing a Learning Plan.	4.5

Teaching and Learning

Teacher's Guide to Hands-On Learning and Hands-On Problem Solving for Children with Multiple Disabilities: Guide to Assessment and Teaching Strategies

The information contained in this Guide was thorough in its discussion and explanation of how to use these strategies.	4.5
This Guide was helpful in implementing instructional programs.	4.8

Tangible Symbol Systems (Chapters 11 and 12)

The information contained in these chapters was thorough in its discussion and explanation of how to use these strategies.	4.5
These chapters were helpful in implementing instructional programs.	4.8

First Things First excerpts

The information contained in these chapters was thorough in its discussion and explanation of how to use these strategies.	5.0
These chapters would be helpful in implementing instructional programs.	5.0

Hands-On Learning and Problem Solving Posters

These posters are a helpful tool for incorporating problem solving skills into activities throughout the day.	4.3
The eight contexts represented on the posters adequately cover the daily activities in my classroom.	4.8
The posters are a helpful visual reminder to classroom staff to embed opportunities to use problem solving skills into classroom activities.	4.8
The posters are a helpful tool for collecting data on child performance.	4.3

Design to Learn and Time to Learn

Time to Learn was useful in terms of engineering the environment to ensure learning opportunities for the student.	5.0

Monitoring Performance to Promote Progress

Excerpt on data collection from Tangible Symbols Systems (Ch. 13 & 15)

The description of strategies for collecting student performance data (Ch. 13) was thorough in its discussion and explanation of tracking child performance in instructional programs related to learning to use tangible symbols.	4.7
The Intervention Record described in Ch. 15 is helpful for tracking a student's progress in learning to use tangible symbols.	5.0
The Intervention Record described in Ch. 15 is helpful it terms of providing clear direction for planning tangible symbols instruction (i.e. for deciding what to do next).	5.0

Excerpt on data collection strategies from First Things First (Ch. 7)

The description of strategies for collecting student performance data in Ch. 7 was thorough in its discussion and explanation of tracking child performance in instructional programs related to learning to use pre-symbolic communication.	4.3
The Intervention Record described in Ch. 7 would be useful for tracking a student's progress in learning to use pre-symbolic communication.	4.3
The Intervention Record described in Ch. 7 would be useful in terms of providing clear direction for planning pre-symbolic communication instruction (i.e. for deciding what to do next).	4.2

Excerpt on data collection strategies from Teacher's Guide to Hands-On Learning and Hands-On Problem Solving for Children with Multiple Disabilities: Guide to Assessment and Teaching Strategies

The description of strategies for collecting student performance data was thorough in its explanation and discussion of how to track child performance in instructional programs related to object interaction.	4.3
The Intervention Record included with this material is helpful for tracking a student's progress in learning object interaction skills.	4.3
The Intervention Record included with this material is helpful in terms of providing clear direction for planning object interaction instruction (i.e. deciding what to do next.)	4.0

Intervention Record and Glossaries (from Tangible Symbol Systems and First Things First)

It will be helpful to have a generic intervention record that combines the previous versions into a single form that can cover three types of instruction.	4.7
This new form is an improvement over the existing separate forms for each type of instruction.	4.7

Design to Learn and Time to Learn

Time to Learn was helpful for monitoring the learning environment and making adjustments to promote further progress	4.3

Summary

The Foundations for Learning materials were rated highly by teachers who had used them in replication sites. Although the respondents were not completely objective reviewers, they were the only teachers who were familiar with the materials and who we were certain had used the materials to structure their educational approach for children with low-incidence disabilities. We did not ask teachers in local classrooms in Oregon to evaluate the materials because they had been deeply involved in developing many of the new materials created specifically for the project. However, we attach in Appendix D accounts provided by the Oregon teachers reviewing their use of the Foundations for Learning materials. We know that individual components of the package are already in demand as demonstrated by requests to purchase them through our website, where materials are sold at very low cost. In the coming years we anticipate that we will receive further feedback on the entire package from users in the field. The package of materials is attached separately.

Results for Objective 1—DEMONSTRATION: Performance of Teachers and Students in Model Classrooms

Model Sites and Participants

Sites were recruited on a classroom-wide basis. That is, willing schools and teachers were recruited first. Then any students in participating classrooms who qualified for the project (by virtue of experiencing low-incidence disabilities (as defined by the U.S. Department of Education), severe communication disorders and cognitive limitations were recruited. Parents of all students who were offered the opportunity consented for their children to participate. There were three model classrooms for this project. Model Classrooms #1 and 2 were public pre-school classrooms located in Portland, Oregon. Model Classroom #1 participated in Years 1-3 and was dissolved by the school district in the following year. Model Classroom #2 participated in Years 1-2 of the project and then was dissolved by the school district. Model Classroom #3 was a public elementary school classroom located in Beaverton, Oregon that initially served as a replication classroom in Year 3. This classroom was converted to a model classroom for Years 4-5 of the project after the first two model classrooms had been discontinued. Three students moved abruptly out of Portland area schools during their second year of participation. In cases where a full year of data is not available for a subject, we do not include any data for that student for that year. Three students participated in model classrooms for two full years. In these cases, data are reported separately for each year of participation and these students are treated as two participants in any mean measures reported. Demographics for student participants in the three model classrooms are provided below. The last column indicates other impairments experienced by participants in addition to the communication and cognitive limitations that they all experienced. Most of the participants in the model classrooms (17 out of 21) were male.

Demographics of Model Classroom Student Participants
Foundations for Learning

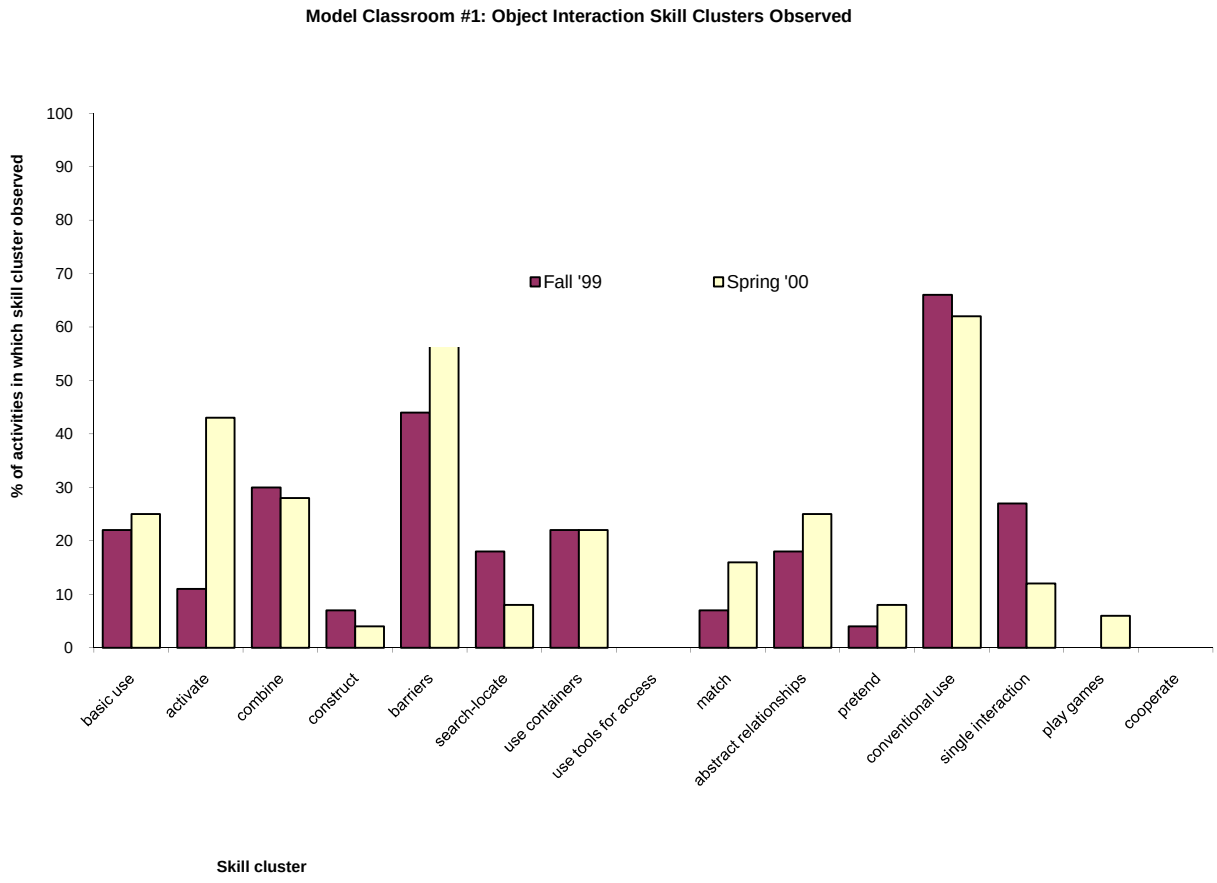
Classroom	Year	ID	Age	Gender	Ethnicity	Etiology	Specific Impairments*
Model #1	1	139	3.4	M	Caucasian	Prematurity	PDD
	1	140	4.5	M	Native American	Prematurity	OI
	1	141	4.1	M	Caucasian	Undiagnosed syndrome	OI, SD
	1	129	3.1	M	African-American	Traumatic brain injury	OI, VI, SD, MF
	1-2	130	3.6	M	Other	Cytomegalovirus	OI, VI, HI
	2	129	3.1	M	African-American	TBI	OI, VI, SD, MF
	2-3	131	3.3	M	Caucasian	Hydrocephaly	OI, VI, HI
	3	132	3.5	M	Caucasian	Cytomegalovirus	OI, VI, HI, SD
	3	133	4.5	M	Hispanic/Latino	Hemolytic-uremic syndrome, ecephalopathy	OI, VI, MF
	3	143	3.10	F	Hispanic/Latino	Tubercular meningitis	OI
Model #2	1	127	2.8	M	Caucasian	Unknown	PDD
	1	125	3.0	F	Caucasian	Inverted duplicated chromosome 15	PDD
	1	124	4.0	M	Caucasian	Pelizcaus Merzbacher Disease	PDD
	1-2	123	2.10	M	Caucasian	Unknown	PDD,
	1	126	3.5	F	African-American	Unknown	PDD, OI
	1	142	4.4	M	Other	Prenatal anoxia	OI, VI, SD
	2	128	4.0	M	Caucasian	Unknown	PDD, HI
	2	117	4.9	M	Caucasian	Cerebral palsy	PDD
Model # 3	4	145	9.5	M	Caucasian	Down Syndrome	HI, VI
	4	147	8.2	F	African American	Cerebral palsy	HI, MF, OI, VI
	5	150	6.8	M	Caucasian	Unknown	OI, VI

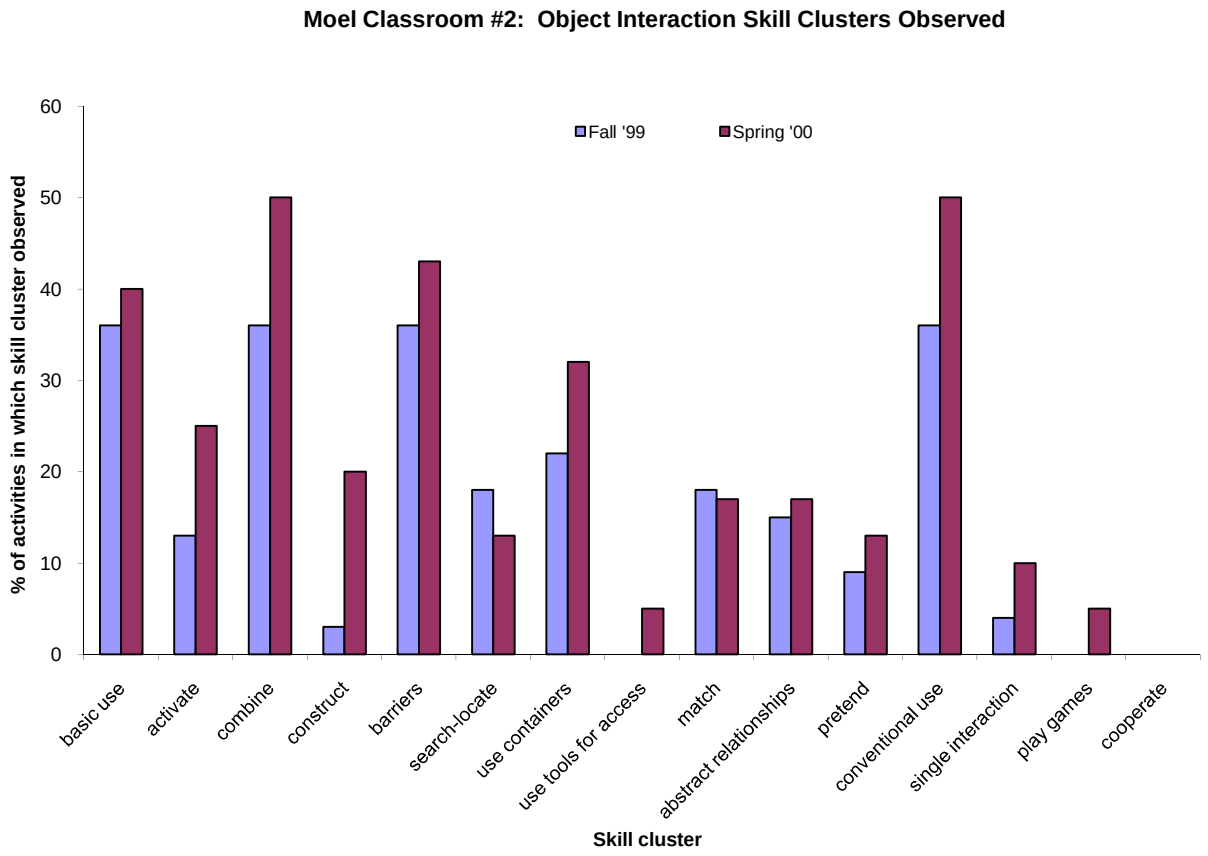
*Key to specific impairments (in addition to severe communication disorder and cognitive impairment)

PDD = Pervasive developmental disorder MF = Medically fragile SD = Seizure disorder
HI = Hearing impairment OI = Orthopedic impairment VI = Vision impairment

Evidence of Classroom-wide Effectiveness of the Instructional Model

In previous projects we had proven that using Design/*Time to Learn* to structure activities resulted in greater class wide opportunities for children to communicate for both target and nontarget students. However, the same hypothesis had not been tested for the concept development (object interaction) skills also targeted by this project. In Model Classrooms #1 and 2 that hypothesis was put to the test in Year 1. Project staff observed the entire classroom, recording the types of object interactions in which all children engaged using the items from *Hands-On Learning at School*. They recorded actions engaged in by both participating and nonparticipating students. These data were collected for one whole school day in the Fall of 1999 and then again in the Spring of 2000. The figures below show the data for each classroom collapsed into 15 clusters of highly related skills.

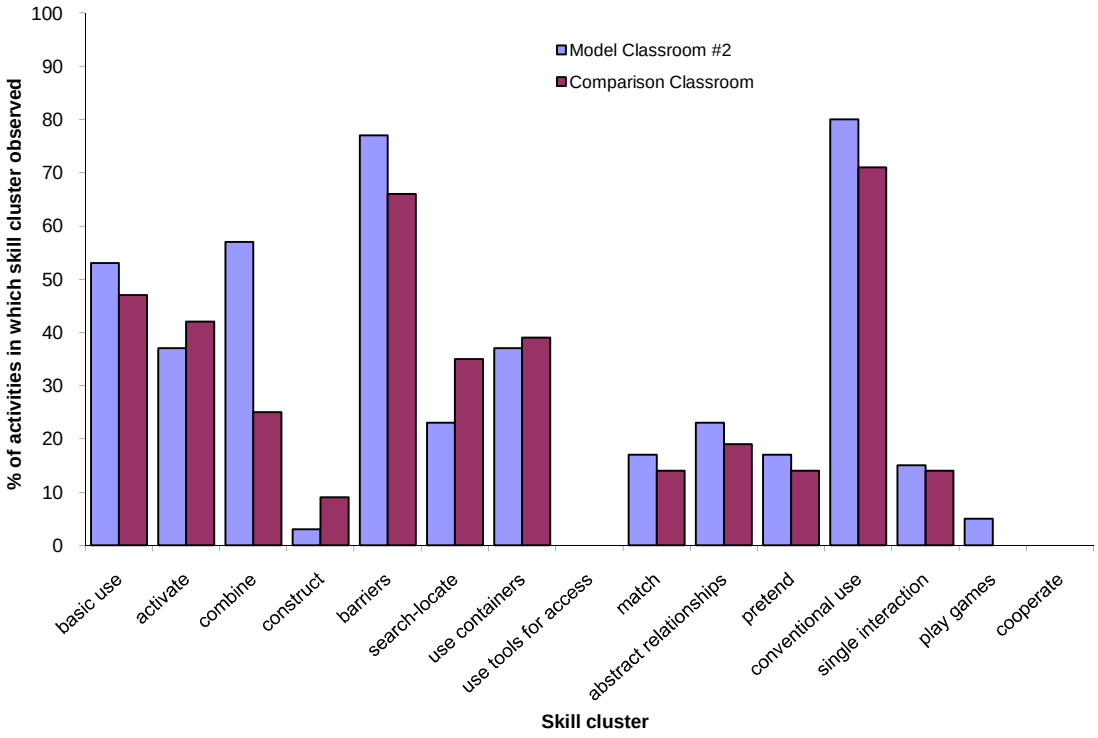




In Model Classroom #1, increases in the percent of activities in which object interaction skills were observed across all children were seen in seven of the 15 clusters. Skills in two clusters, Using Tool to Gain Access and Cooperating, did not appear at all in this classroom. Three skill clusters showed slight reductions in percent of activities and two showed no substantial change. This classroom included only one participating student who did not experience orthopedic impairment, so overall object interaction skills were substantially lower than for Model Classroom #2. In Model Classroom #2, eleven clusters showed increased percents of activities, one cluster, Cooperating, did not appear at all, one cluster (Searching & Locating) showed a slight reduction, and two showed no substantial change. These studies showed that attempts to introduce more opportunities for object interaction were impacting the entire classroom, although the effect was more pronounced for the classroom with students who did not experience orthopedic impairment.

A second study was conducted in Year 2 to compare Model Classroom #2 with a non-project classroom that included similar students. Project staff recorded actions engaged in by both participating and nonparticipating students, observing each classroom for one whole school day in the Fall of 2000. The figure below shows how Model Classroom # 2 compared to the comparison classroom in terms of the percent of activities targeting skills from *Hands-On Learning at Home,* clustered into 15 clusters.

Object Interaction Skill Clusters Observed in Model and Comparison Classrooms



This second study showed that neither classroom was providing opportunities to demonstrate skills in the Using Tools to Gain Access or Cooperating clusters. In nine of the remaining 13 clusters, the Model Classroom showed that skills were being targeted in more activities than in the comparison classroom, with an average of 14% more activities. In the comparison classroom, four of the 13 clusters were being targeted in more activities, by an average of 6%. Overall, it appeared that the project classroom was embedding opportunities to use a wider slate of object interaction/concept development skills than was the comparison classroom.

Data on Progress of Student Participants

There are two major data sources that speak to the effectiveness of the implementation activities conducted in the model classrooms. These are child performance data collected by personnel who conducted instructional programs and pre-post assessments of student skills conducted at the start and end of each school year. Child performance data varied widely depending upon the student, the targeted behavior, the type of measurements collected, the instructional activities and the teacher conducting the programs and taking the data. These data cannot be collapsed in any meaningful way. Their primary purpose was to inform consultations between project staff and participating teachers. Pre-post assessments were collected to demonstrate child progress across each school year of participation. The *Communication Matrix* and *Hands-On Learning at*

School or the *SIPSS* (depending on student characteristics) were administered at the beginning and end of each school year for each participant. These pre/post data are summarized below.

Communication Matrix (described in previous section). The *Matrix* data can be summarized numerically, with a score expressed as a percent equivalent to the total number of points out of a maximum possible of 148 points. The next table shows pre-post scores for *Matrix* data collected at school as well as Rate of Gain scores (calculated as gain/pre-score). The parent version of the *Matrix* was also given to parents for them to provide information about their child's communication at home and in the community. Parent assessments were completed by parents of five children at the start of a school year. For children whose parents provided this information, it was used in generating learning goals related to communication.

Communication Matrix Data:
Foundations for Learning Model Classrooms

Classroom	Year	ID	Pre-score	Post-score	Rate of Gain
Model 1	1	141	15%	27%	82%
		140	37%	44%	18%
		129	14%	17%	19%
	2	129	18%	19%	8%
	1	139	34%	46%	36%
	3	132	11%	14%	25%
		133	8%	13%	58%
		143	5%	19%	250%
	2	130	14%	18%	35%
		131	12%	14%	17%
	3	131	14%	24%	80%
Model 2	1	123	14%	42%	210%
	2	123	83%	84%	1%
	1	127	11%	18%	69%
		125	19%	41%	114%
		124	11%	21%	82%
		126	17%	36%	116%
		142	8%	15%	83%
	2	128	61%	66%	7%
		117	59%	60%	2%
Model 3	4	145	63%	75%	19%
	5	150	19%	24%	25%
	4	147	8%	20%	150%
MEANS			**24%**	**32%**	**66%**

Clearly there was a wide range of functional communication skills among the model classroom participants, with pre-scores ranging from 5% to 83%. The rate of gain across participants also varied widely, from 1% to 210%, with a mean of 66%. Of nine participants who began the year without any symbolic communication skills (Level V or above), five demonstrated some symbolic behavior by the end of the year. Of the two students who had no intentional communication (Level III) at the mastered level at the start of the year, both had mastered Level III by the end of the year. It is gains such as these that speak most clearly to the improvements made in communication skills over the course of the project.

Hands-On Learning at School (described in previous section). This instrument was used to assess object interaction skills that reflect an understanding of the physical environment, or concept development. This instrument was used for students who did not experience dual sensory impairments or sensory impairment combined with severe orthopedic impairment. *Hands-On Learning at Home* was also given to parents for them to provide information about the child's object interaction skills at home and in the community. Parent assessments were completed by parents of seven children at the start of a school year. For children whose parents provided this information, it was used in generating learning goals related to concept development. The next table shows pre and post scores as well as Rate of Gain scores (calculated as gain/pre-score) for *Hands-On Learning at School* as percents equivalent to the total number of points out of a maximum possible of 78.

Hands-On Learning at School Data:
Foundations for Learning Model Classrooms

Classroom	Year	ID	Pre-score	Post-score	Rate of Gain
Model 1	1	141	41%	49%	19%
		140	64%	73%	14%
		139	72%	85%	18%
Model 2	1	123	47%	68%	43%
	2	123	73%	87%	19%
	1	127	37%	60%	62%
		125	38%	53%	37%
		124	51%	69%	35%
		126	63%	76%	20%
	2	128	51%	83%	63%
		117	76%	90%	19%
Model 3	4	145	78%	90%	15%
MEAN			**58%**	**73%**	**30%**

Object interaction skills ranged from 37% to 78% at pre-test. Rate of Gain varied widely, ranging from 14% to 63%, with a mean of 30%.

SIPSS (described in the previous section). This instrument was used to assess object interaction skills that reflect an understanding of the physical environment, or concept development. This instrument was used with students who experienced dual sensory impairments or sensory impairments combined with severe orthopedic impairment. The *HIPSS* (home version) was also given to parents for them to provide information about the child's object interaction skills at home and in the community. Parent assessments were completed by parents of seven children at the start of a school year. For children whose parents provided this information, it was used in generating learning goals related to concept development. The next table shows pre and post scores as well as Rate of Gain scores (calculated as gain/pre-score) for the *SIPSS*. Total scores are expressed as percents equivalent to the total number of points out of a maximum possible of 66.

School Inventory of Problem Solving Skills (SIPSS) Data
Foundations for Learning Model Classrooms

Classroom	Year	ID	Pre-score	Post-score	Rate of Gain
Model 1	2	129	26%	27%	6%
	3	132	8%	12%	60%
		133	6%	18%	300%
		143	27%	33%	22%
	2	130	24%	26%	6%
		131	9%	18%	100%
	3	131	23%	24%	7%
Model 2	1	142	11%	24%	129%
Model 3	5	150	53%	62%	17%
	4	147	35%	56%	61%
MEAN			**23%**	**30%**	**71%**

Object interaction skills were overall low, but varied widely for this group of more severely impaired students, ranging from 6% to 53% at pre-test. Exceptionally low pre-scores were demonstrated by subjects who had severe orthopedic impairment. Rate of Gain also varied widely, ranging from 6% to 300% with a mean of 71%. Subjects 150 and 147, who had the highest pre-scores, demonstrated the least orthopedic impairment and were semi-independent in terms of their mobility.

Results for Objective 2—REPLICATION: Performance of Teachers and Students in Replication Classrooms

Replication sites were established in Years 3 and 4 in public school classrooms in seven different sites: two classrooms in Beaverton, OR and one each in Lacey, WA, San Antonio and Lamesa, TX, Portland, OR and Santa Rosa, CA. Three subjects participated for 2 years. Demographics for participants in replication sites appear in the table below. The last column indicates other impairments experienced by participants in addition to the severe communication disorders and cognitive limitations that they all experienced. Across these classrooms there were 3 girls and 7 boys.

Demographics of Replication Classroom Student Participants
Foundations for Learning

Classroom	Year	ID	Age	Gender	Ethnicity	Etiology	Specific Impairments*
Replication 1	3-4	134	8.0	F	Caucasian	Cerebral palsy	HI, OI, VI, MF
	4	148	6.4	M	Asian	Unknown	PDD
Replication 2	3	145	8.5	M	Caucasian	Down Syndrome	HI, VI
Replication 3	4	135	6.5	M	Hispanic/ Latino	Unknown	HI, MF, OI, VI
Replication 4	4	136	8.8	F	Caucasian	Cerebral palsy	HI, OI, VI
Replication 5	4	146	8.2	M	Hispanic/ Latino	Unknown	HI, VI
Replication 6	4	151	9.3	M	Hispanic/ Latino	Unknown	HI, OI, VI
Replication 7	4	107	9.9	M	Caucasian	Williams Syndrome	PDD, OI
	4-5	109	9.0	F	Caucasian	Unknown	PDD
	5	149	5.0	M	Caucasian	Unknown	PDD

*Key to specific impairments (in addition to severe communication disorder and cognitive impairment)

PDD = Autism spectrum disorder MF = Medically fragile SD = Seizure disorder
HI = Hearing impairment OI = Orthopedic impairment VI = Vision impairment

As in the model classrooms, the *Communication Matrix* and *Hands-On Learning at School* or the *SIPSS* (depending on student characteristics) were administered at the beginning and end of each school year for each participant.

Communication Matrix. The next table shows pre-post and gain as well as Rate of Gain scores (calculated as gain/pre-score) scores for *Matrix* data collected at school. The parent version of the *Matrix* was also provided to parents for them to provide information about the child's communication at home and in the community. Parent assessments were completed by parents of nine children at the start of a school year. For children whose parents provided this information, it was used in generating learning goals related to communication.

Communication Matrix Data:

Foundations Replication **for Learning Classrooms**

Classroom	Year	ID	Pre-score	Post-score	Rate of Gain
	3	134	8%	12%	50%
Replication 1	4	148	9%	25%	164%
Replication 2	3	145	20%	41%	100%
Replication 3	4	135	7%	16%	109%
Replication 4	4	136	13%	15%	16%
Replication 5	4	146	16%	20%	25%
Replication 6	4	151	20%	32%	60%
Replication 7	5	149	32%	46%	45%
	4	109	64%	74%	16%
	5	109	52%	59%	14%
	4	107	39%	55%	41%
MEANS			**24%**	**34%**	**54%**

There was a slightly narrower range of functional communication skills among the replication participants than among the model classroom participants with pre-scores ranging from 8% to 64%. The Rate of Gain across participants varied from 14% to 164%, with a mean of 54%. Of the six participants who started the school year with no or only emerging symbolic communication skills (Level V or above), three were using symbolic communication by the end of the school year and one of these was using abstract symbolic behavior not demonstrated earlier. Two students began the year with no intentional communication at all (Level III). Both of these students had acquired intentional communication by the end of the year, and one of them was using Level VI behaviors to communicate. It is such gains as these that speak most clearly to the improvements made in communication skills over the course of the project.

Hands-On Learning at School (described in previous section). This instrument was used to assess object interaction skills that reflect an understanding of the physical environment, or concept development for the seven children without severe sensory and orthopedic impairment. *Hands-On Learning at Home* was also given to parents for them to provide information about the child's object interaction skills at home and in the community. Parent assessments were completed by parents of five children at the start of a school year. For children whose parents provided this information, it was used in generating learning goals related to concept development. The next table shows pre and post scores as well as Rate of Gain scores (calculated as gain/pre-score) for the *Hands-On Learning at School*. Total scores are expressed as percents equivalent to the total number of points out of a maximum possible of 78.

Hands-On Learning at School Data:
Foundations for Learning Replication Classrooms

Classroom	Year	ID	Pre-score	Post-score	Rate of Gain
Replication 7	5	149	63%	83%	33%
	4	109	58%	79%	38%
	5	109	81%	90%	11%
	4	107	44%	62%	41%
Replication 1	4	148	27%	65%	143%
Replication 2	3	145	50%	60%	20%
MEAN			**54%**	**73%**	**48%**

Object interaction skills did not vary as widely for this group as for the model classroom participants, ranging from 27% to 63% at pre-test. Rate of Gain ranged from 11% to 143%, with a mean of 48%.

SIPSS. This instrument was used to assess object interaction skills that reflect an understanding of the physical environment or concept development fro the five children with hearing, vision and orthopedic impairment. The *HIPSS* (parent version) was also provided to parents for them to provide information about the child's object interaction skills at home and in the community. Parent assessments were completed by parents of six children at the start of a school year. For children whose parents provided this information, it was used in generating learning goals related to concept development. The next table shows pre and post scores as well as Rate of Gain scores (calculated as gain/pre-score) for the *SIPSS*.

School Inventory of Problem Solving Skills (SIPSS) Data
Foundations for Replication Classrooms

Classroom	Year	ID	Pre-score	Post-score	Rate of Gain
Replication 1	3	134	23%	39%	73%
	4	134	32%	50%	57%
Replication 3	4	135	30%	41%	35%
Replication 4	4	136	12%	15%	25%
Replication 5	4	146	38%	58%	52%
Replication 6	4	151	61%	67%	10%
MEAN			**35%**	**45%**	**42%**

SIPSS pre-scores varied widely for this group, ranging from 12% to 61%. Rate of Gain ranging from 10% to 73%, with a mean of 42%.

Results from Analysis of Videotaped Instructional Programs in Model and Replication Classrooms

Project staff made videotapes of two major activities targeted for each model classroom participant in local classrooms (model and replication) at least three times per school year. Each videotaped activity lasted approximately 15 minutes. In replication sites in other states, teachers made videotapes themselves and mailed them to the project. In these sites, the mean number of videotapes was five per year per participant. A total of 170 videotapes were made of participants in model and replication classrooms over the course of the project.

Since the performance of individual children varied widely and the variables targeted to increase or decrease depended on the abilities and programs of each, it was not logical to conduct group analyses of these data. Instead, the coded data were used to shed light on the relationship between teacher strategies and between child and teacher behaviors. Teacher behavior was the primary target of project activities. Of interest was the degree to which teacher behavior could be shaped using *Design to Learn* as a catalyst, and the relationship between teacher behavior and child behavior. Also of interest was the question of whether teachers were able to target both communication and concept development skills within the same activity.

Project staff coded the videotapes in three ways. The *Expressive Communication* code was used to document the use of specific types of communicative behaviors by students (pre-symbolic and symbolic), communicative intents, the initiation of communication, and cues from teachers to elicit communication. The *Object Interaction* code was used to document the demonstration of the 39 generic object interaction skills related to concept development from *Hands-On Learning at School*, the initiation of object interaction and cues from teachers to elicit object interaction. For both of these codes, observations were made on a modified frequency basis, scoring the presence of each behavior category for each 60-second interval. The environmental inventory, *Design to Learn,* was also administered to the videotapes, providing a measure of strategies the teachers used to conduct instructional activities that would encourage communication and concept development. Reliability checks were conducted on all codes on at least 20% of videotapes for each subject and on 82 of the 170 videotaped sessions or 48% of all sessions. The three coding systems are described below.

The Expressive Communication Code

The *Expressive Communication Code* is an observational system that tracks the rate and type of pre-symbolic and symbolic communication by students; the communicative functions or intents expressed by students; and the rate of cues for communication from teachers or peers. Observations are made on a modified frequency basis, scoring the presence of each category of behavior during each one-minute interval. Reliability checks were conducted on at least 20% of the videotaped data for each participant. The statistics computed to assess inter-observer reliability for these data are the Mean

Occurrence Reliability--or the mean agreement on the occurrence (as opposed to the non-occurrence) of a behavior category (a score above .80 is preferred)--and the Mean Kappa Coefficient--an agreement statistic that takes into account the rate of occurrence and non-occurrence of the behavior category (a score greater than .60 is preferred). Reliability was computed on each behavior category. For this set of data, the Mean Occurrence Reliability was .90 and the Mean Kappa Coefficient was .84 (across behavior categories and across all 82 reliability sessions).

The major variables derived from the *Expressive Communication Code* were:

- P(Cues to Communicate): proportion of intervals in which the teacher provided at least one Cue for Communication that the student was capable of perceiving and to which the student was capable of responding
- P(Communication): proportion of intervals in which the student produced at least one intentional communicative behavior (either pre-symbolic or symbolic)
- P(Initiation of Communication): proportion of intervals in which the student Initiated Communication (communicative behavior that was not prompted by a Cue to Communicate from the teacher)
- # Intents: number of different communicative intents (out of four) demonstrated by the student

The first variable reflects teacher behavior, while the others reflect student behavior. With the exception of # Intents, these variables all reflect the rate at which each behavior category occurred. The table below shows the mean probabilities for each of the categories coded using this coding system. This offers an overview of the rates and types of communicative behaviors (and cues for such behavior by teachers) demonstrated across all 170 videotaped sessions coded).

Mean Expressive Communication Code Variables

Expressive Communication Code Variable	Mean
P(Cue to Communicate from Teacher)	.58
P(Communication by Student)	.53
P(Initiation of Communication by Student)	.20
# Intents (of 4) Demonstrated by Student	2

Object Interaction Code

This code tracks skills that are associated with concept development as demonstrated through interactions with the physical environment. It is based on the 39 skills included in *Hands-On Learning at School*. The *Object Interaction* code was used to document on a minute-by-minute basis the demonstration of these 39 object interaction skills, the initiation of such skills, and the provision of cues for object interaction by the teacher. Inter-observer agreement (# agreements /#agreements + # disagreements) computed for each category on a minimum of 20% of the data collected on each student yielded a mean agreement of 90% (across behavior categories and across all 82 reliability sessions).

For the *Object Interaction Code*, the major measures derived from the coding were:

- P(Cues for Object Interaction): proportion of intervals in which the teacher provided at least one Cue for Object Interaction that the student was capable of perceiving and to which the student was capable of responding
- P(Object Interaction): proportion of intervals in which the student intentionally engaged in at least one of the 39 object interactions included in the code.
- P(Initiation of Object Interaction): proportion of intervals in which the student initiated an object interaction included in the code and the behavior was not prompted by a Cue for Object Interaction from the teacher.
- % Clusters: % of different clusters (out of 14 clusters of related skills) represented by the object interaction skills demonstrated by student across the session
- % Complex Skills: % of different complex skills (out of 13) demonstrated by the student across the session.[1]
- % Different Skills: % of different skills demonstrated by student across the session (out of 39)

The first variable reflects teacher behavior, while the others reflect student behavior. The first three variables reflect rates of behavior, while the last three reflect the diversity of object interaction skills observed.

An overview of the performance of participants on the *Object Interaction* variables appears in the following table. We had divided the participants into two groups based on severity of impairment for the purpose of selecting the appropriate concept development assessment instrument to use. We divided the participants into these same two groups and computed means fro the *Object Interaction* Code data separately for the two groups. There were very clear differences between the two groups on these variables. We conducted a multivariate analysis of variance with one between-subjects factor of Group (*Hands-On Learning* versus *SIPSS*) and found that the difference between groups was highly significant ($p<.000$) for all of these variables.

Comparison of Object Interaction Code Data for Participants Grouped According to Concept Development Assessment Instrument Used

Variables from Object Interaction Code	Hands-On Learning Group	SIPSS Group
P(Cues for Object Interaction from teacher)	.70	.45
P(Object interaction by Student)	.89	.59
P(Initiation of Object Interaction by Student)	.77	.43
% Clusters (of 14) Demonstrated by Student	.43	.16
% Complex Skills (of 13) Demonstrated by Student	.32	.00
% Different Skills (of 39) Demonstrated by Student	.21	.07

1 Complex skills were: Complex Search, Opens Complex Containers, Selects and Uses Tools to Gain Access, Operates Complex Objects, Complex Combinations, Constructs, Uses Tool to Assemble/Disassemble, Matches to Complex Visual Features, Uses Abstract Information, Pretends to be Something Else Using Props, Plays Game with Peer, Plays Game with Group, Cooperative Interaction

Design to Learn

Design to Learn is the environmental Inventory that was developed to help teachers determine to what extent a specific classroom activity encourages skill learning by a specific student (what constitutes an opportunity for one student included in an activity may not constitute an opportunity for another student). *Design to Learn* is administered to the learning environment, as opposed to the child, and the resulting scores are independent of child skill level. *Design to Learn* includes 67 items organized into eight sections: **Transitions, Activity, Adult's Interaction, Communication System, Peer Interaction, Opportunities to Communicate, Opportunities to Use Objects,** and **Materials**. The inventory was administered after viewing the entire videotaped session and was applied to the activity as a whole. The total *Design to Learn* score reflects the diversity of strategies used by the teacher to promote the production of communication and concept development skills for the specific student. This score does not reflect frequency or rate of behavior; it reflects the percent of the 67 strategies that the teacher was observed to implement during the activity. Inter-observer reliability was assessed between two project staff on at least 20% of the videotaped sessions for each participant. Two observers first scored the videotapes independently and then engaged in a consensus process to determine the final score. The mean percent agreement was 95% across the 82 reliability sessions. The table below shows mean *Design to Learn* scores across all 170 coded sessions for each section of the instrument as well as for the total score, expressed as percent of items in each section.

Mean Design to Learn Code Scores

Design to Learn Section	Mean % Items Observed
Transition	15%
Activity	78%
Adult Interaction	78%
Communication System	58%
Peer Interaction	19%
Opportunities to Communicate	29%
Opportunities to Use Objects	32%
Material	69%
Total Design to Learn	46%

Relationships between the Three Coding Systems

To examine the relationship between teacher behavior and student behavior, Pearson's correlations were run between total *Design to Learn* scores and summary scores derived from the two other observational codes. The purpose was to examine the relationship between *Design to Learn* scores and the actual performance of the child in terms of the frequency of various types of object interaction and communicative behaviors and the actual performance of the teacher in terms of the rate of cues provided. Strong correlations would suggest that environmental manipulations, as measured by *Design to Learn* scores, are indeed associated with rates of child performance. These analyses

were conducted on all 170 videotaped sessions from both model and replication classrooms.

Relationship between *Design to Learn* Scores and *Expressive Communication Code* Scores

Of the four *Expressive Communication* variables described above, all but the first (P[Cues to Communicate]) showed strong and positive Pearsons correlations (2-tailed p<.01) with the total *Design to Learn* score. Thus, higher *Design to Learn* scores were associated with higher rates of communication and initiation of communication by students and in their use of more of the four communicative intents tracked. However, the rate of cues to communicate from teachers (P[Cues to Communicate]) did not show a strong relationship with the environmental inventory score.

Relationship between *Design to Learn* Scores and *Object Interaction Code* Scores

Of the six *Object Interaction* variables described above, all showed strong positive correlations with the total *Design to Learn* score (2-tailed p<.01). Thus, higher *Design to Learn* scores were associated with higher rates of cues for object interaction from teachers, of object interaction by students, of initiations of object interaction by students and of the three measures of variety of object interaction--% clusters, % complex skills and % different skills.

A closer look at two *Design to Learn* Sections: Opportunities to Use Objects and Opportunities to Communicate

Additional correlations were run to examine the contribution of two specific sections of *Design to Learn* —**Opportunities to Use Objects** and **Opportunities to Communicate**. These two sections reflect the diversity of types of opportunities provided by teachers to target communicative intents and types of object interaction related to concept development. First we examined whether the scores from these two sections were associated with rates of behavior on the part of students and teachers. We found high and positive Pearson's correlations (two-tailed p<.01) between **Opportunities to Communicate** from *Design to Learn* and P(Communication), P(Initiation of Communication) and P(Cues to Communicate) from the *Expressive Communication* code. Similarly, we found high and positive Pearson's correlations (two-tailed p<. 01) between **Opportunities to Use Objects** from *Design to Learn* and P(Object Interaction), P(Initiation of Object Interaction) and P(Cues for Object Interaction). These results demonstrate conclusively that increased diversity of strategies for encouraging communication or object interaction, as measured by scores on the two "Opportunities" sections of *Design to Learn*, is associated with increased rates of communication or concept development behavior and initiation of such behavior on the part of students.

A Pearson's correlation was run between scores on the **Opportunities to Use Objects** section and the **Opportunities to Communicate** section to examine the degree to which teachers were able to target *both* communication and object interaction in the same

activity. This correlation yielded an extremely high and positive Pearson's correlation (two-tailed $p<.01$), demonstrating that, indeed, teachers did not have to sacrifice efforts to target a variety of communicative behaviors in order to target a variety of concept development skills. In fact, activities in which a more diverse slate of *communication* skills was targeted were those in which a more diverse slate of *concept development* skills was also targeted. However, the correlation between P(Cues to Communicate) and P(Cues for Object Interaction) from teachers, both of which measures speak to the rate of teacher behavior, did not yield a significant correlation. This suggests that there is a ceiling in terms of the total number of cues for behavior that can be embedded into any given activity.

V. Summary and Conclusions

The Foundations for Learning project was conducted in public school classrooms in four states. The participants varied widely in terms of entering skill level and ranged in age from 3 to 9 years. Nevertheless, all participants showed progress in terms of both communication skills and concept development skills. Rates of gain, which are relative to entering score levels, revealed that all participants made considerable progress, even those who entered with very low skill levels. That, in and of itself, is a striking accomplishment. Furthermore, gains were made even by children in replication sites in other states whose teachers did not have face-to-face interaction with project staff. This result speaks to the efficacy of the materials as they were revised over the years of the project and ultimately implemented as a total package in its final years.

As discussed earlier in this report, the merits of the individual assessment instruments and instructional strategies had already been demonstrated in previous research and demonstration projects. This project involved the integration of those materials into a cohesive package that would improve educational outcomes for children with low incidence disabilities. The key findings from the project are summarized below.

- Parent involvement is key to the Foundations for Learning approach. Parent input is solicited at the first step of the model (Assessment) where parents are asked to provide assessment information from home and community. Their input is given equal weight to that of professionals. Side-by-side comparison of child performance in the two environments presents a complete picture of the learner. This aspect of the model also encourages the collaboration of parents and teachers in setting individualized instructional goals and in determining exactly what form instruction should take. In project classrooms, parents were very willing to provide such input, demonstrating a high rate of compliance to such requests.
- The Foundations for Learning model represents a seamless instructional approach based on assessment instruments that lend themselves clearly to the development of individualized educational goals. The Foundations for Learning assessment instruments are pragmatic in terms of their immediate usefulness for generating instructional objectives. Skills are expressed in terminology that is meaningful to parents and teachers. Inspection of assessment data on a child's

communication or concept development skills suggests both emerging skills with which the child needs further practice and logical new skills to target.

- The Foundations for Learning approach emphasizes a logical sequence of instructional targets and the harnessing of the learner's intrinsic motivation to learn. These concepts are compatible with Bailey's (2002) discussion of critical experiences and teachable moments. Bailey suggests a shift in thinking away from the notion of critical periods (which imply that the opportunity to learn may be permanently missed if not provided by a certain age) to "critical experiences". Critical experiences are ones that are essential for children to maximize development. Such experiences may adhere to certain sequences—that is, one sort of critical experience may necessarily have to follow a highly related one: but age *per se* is not considered as important as developmental status in relationship to readiness to learn. Teachable moments are related to critical experiences: teachable moments occur when the child is intrinsically motivated to learn something new. When the targeted skills are generic ones, teachable moments are likely to occur in many different contexts. The generic communication and concept development skills targeted by the Foundations for Learning approach might be conceived of as critical experiences that may be taught in a logical progression, always structuring learning around contexts and materials that are intrinsically motivating to the learner.
- *Design To Learn* proved to be an effective tool for teachers to organize their interventions. This environmental inventory was used to focus the teacher's attention on aspects of the social and physical environments that encourage learning. It seemed to serve as a useful heuristic, suggesting teaching strategies other than the typical heavily teacher-directed ones. It also proved useful for project staff to monitor interventions conducted in participating classrooms. The *Design to Learn* data generated from the videotaped programs showed strong correlations with teacher and student behavior. Although it would not be possible for classroom staff to conduct the detailed analyses of videotapes that project staff conducted, it *is* possible for teachers to administer *Design to Learn* to classroom activities as they observe or even conduct them. Project data show that *Design to Learn* scores are a good reflection of teacher and child performance.
- Participating teachers were heavily involved in the development of materials that knitted together the four model components: Assessment, Designing a Learning Plan, Teaching & Learning and Monitoring Performance to Promote Progress. Teachers were especially instrumental in creating *On the Same Page*, the form that integrates all four model components. We feel that the continuous input from participating teachers was key to the development of materials that educators were able to use without on-site support.
- Some of the project participants had severe orthopedic impairments and demonstrated neither intentional communication skills nor intentional object interaction skills at the start of the project. For these students, the distinction between communication and concept development skills seemed to blur because they were dependent on others to engage *both* the social and the physical environments. Intervention would target one or two motor behaviors that might be

used equally for communication or for interaction with the physical environment. For instance, a student might learn to activate a switch to gain someone's attention (a communicative behavior) using a swiping motion of the hand. That same motion might also be targeted as a way to activate a simple mechanical toy (a concept development skill). The critical learning involves the child's *understanding* that the specific movement can be used to gain control over the social environment (communication) and over the physical environment (concept development). Another student might achieve the same understanding by learning to approach someone to gain his or her attention (communication) or learning to approach a desired object to gain access to it (concept development). Another child might demonstrate understanding of the physical environment through his engagement with that object via his interactions with another person. At this very early stage of skill development, the distinction is less important than the significance of the child's *awareness* of the potential effect of his or her behavior on *either* the physical or the social environment.

- Students in model and replication classrooms achieved comparable outcomes. Consultation in model classrooms focused initially on child performance, while in the replication classrooms the focus was primarily on the learning environment. This suggests that teacher behavior could be shaped using *Design to Learn* as a catalyst and that the benefit of this environmental emphasis was reflected in student progress. A second implication is that teachers were able to understand the Foundations for Learning materials and that they were able to implement the strategies described by the materials without face-to-face support from the project.
- The analyses of the videotaped target activities for participating students showed conclusively that providing a variety of opportunities in one behavioral domain (communication) did not preclude providing opportunities in the other domain (object interaction). In fact, teachers who provided more types of opportunities for communication also provided more types of opportunities for object interaction.

Future Directions

The materials and strategies that form the Foundations for Learning package include alternate versions of concept development assessments for students with the most complex combinations of disabilities who have only the most basic of object interaction skills under their control. A comparison of the object interaction code data for the two groups of children defined on this basis showed significant differences in their object interaction skills. Further research into the differences between these two groups of children and how they differ in terms of both object interaction and communication skills might reveal information that would shed further light on appropriate intervention strategies. Children with such severe orthopedic limitations that only minimal movement is under their control continue to present great challenges that are not necessarily resolved by the materials developed through this project. However, it is heartening that even these children showed improvement over the course of their participation in this project. It is also significant that teachers were able to increase opportunities to learn

even for these students.

Future research directions might include a concerted effort to tease out the relationship between early concept development skills and early communication skills for children with the most complex needs. It is possible that contingency awareness is initially a generalized awareness that spans social and physical environments but that eventually diverges. Or perhaps at some point contingency awareness in one realm scaffolds the development of contingency awareness in the other realm. The blurring between these skill areas noted previously may well suggest an avenue for understanding the development of concept development and communication skills. Two quotes speak to the confluence of these skills:

> Knowledge about objects is at the center of most communicative exchanges (p. 29 Siebert & Hogan, 1982)
>
> Communication without exploration and subsequent experiential learning is meaningless, while exploration that is disconnected from communication in the child's preferred mode is yet another random experience that the children cannot organize mentally (p 207. Marks, 1998).

Another area that bears further investigation involves the relationship between *Design to Learn* scores and the rate of cues that teachers provide for their students to communicate versus to interact with objects. While there was a very strong and positive correlation between *Design to Learn* score and the rate of Cues for Object Interaction, the same did not hold true for the rate of Cues for Communication. This discrepancy warrants a closer look.

Another area for future research involves the *Design to Learn* inventory, around which interventions were successfully structured. This success raises the question of whether a future direction of inquiry should involve the development of a home-based version of the inventory. Combining environmental and more direct instructional approaches allowed classroom staff to expand their focus beyond the skills and deficits of individual students to consider the opportunities to learn offered by the environment. Perhaps such an expanded perspective would encourage parents in a similar way.

A home-based inventory could be used to help parents re-structure activities at home to better encourage learning. A home-based *Design to Learn* might be especially useful for pre-school students and their parents.

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Appendix A

Generic Intervention record and accompanying glossaries

Intervention Record

Student	Date	Date	Date	Date	Date
Skill/Function					

Assessment					
Assessment of Skills					
Assessment of Preference					
Symbol Type Probe					
Assessment of Environment					

Teaching Routine					
Vocabulary / Materials					
Array Size					
Distractors					
Instructional Format					
Scanning					
Instructional Cues					
Targeted Behavior					
Time/Latency					
Level of Assistance					
Protest/Reject					
Consequence					

Environment					
Setting					
Position					
Partner					

Intervention Record Glossary for Pre-Symbolic

Assessment

- **Assessment of Communication Skills.** Indicate if you are conducting an assessment to determine the learner's communicative behaviors and intents.
- **Assessment of Preferences**. Indicate if you are investigating what is motivating to the learner at this time. Often times this is an on-going part of instruction.
- **Symbol Type Probe:** If applicable, indicate if you will be conducting an assessment to determine what type of symbol appears to be most meaningful to the learner at this time.
- **Assessment of Environment** Indicate if you are conducting an analysis of the child's environment to determine existing and new supports to learning.

Teaching Routine

- **Vocabulary/Materials.** List the specific materials used in this activity to teach or practice the target skills.
- **Array size.** Indicate the number of objects presented at one time
- **Distractors.** If appropriate, describe whether the objects other than the desired one in the array are "nothing", non-preferred or equally preferred items.
- **Instructional Format.** Describe the manner in which objects are presented to the learner (e.g. to his left, randomly, with contrasting backgrounds, one at a time, etc.). Describe how the learning opportunity is to be provided (e.g., duration and manner of interaction before pausing, alternating treatments, etc.).
- **Scanning.** Describe any assistance provided as needed to insure that the learner is aware of what is available.
- **Instructional Cues.** Describe what the teacher does to elicit a response from the learner.
- **Targeted Behavior.** Describe how the learner is to respond. This may include any mechanical adaptation
- **Time/Latency.** Indicate the amount of time to be allowed for the learner to respond.
- **Level of Assistance.** Describe any physical assistance, model/demonstration, or other assistance that is being provided to the learner to make his response.
- **Protest/Reject.** Describe the behavior, or absence of behavior, used by the learner to reject choices or further engagement with current activity.
- **Consequence.** Describe the manner in which the partner responds when the learner makes a correct and, (if possible/appropriate), an incorrect response.

Environment

- **Setting.** Describe the context in which the learning opportunity is being targeted.
- **Position.** Describe any unique positioning considerations that will be made to enable the learner to respond. This may include partner's position in relation to the learner.
- **Partner.** List the person(s) with whom the learner will be interacting in the target activity.

Intervention Record Glossary for Tangible Symbols Systems

Assessment

- **Assessment of Communication Skills.** Indicate if you are conducting an assessment to determine the learner's communicative behaviors and intents.
- **Assessment of Preferences**. Indicate if you are investigating what is motivating to the learner: often this is an on-going part of instruction.
- **Symbol Type Probe.** Indicate if you are assessing the most meaningful level of tangible symbol representation for the learner.
- **Assessment of Environment.** Indicate if you are conducting an analysis of the child's environment to determine existing and new supports to learning.

Teaching Routine

- **Vocabulary/Materials.** List the specific referents or topics that are being represented using tangible symbols.
- **Array size.** Describe the number of tangible symbols and referents presented to the learner at one time.
- **Distractors.** Describe whether the other symbols in the array are equally preferred, non-preferred or "nothing" symbols.
- **Instructional Format.** Describe the manner in which objects/symbols are presented to the learner (e.g. to his left, randomly, with contrasting backgrounds, etc.). Describe how the learning opportunity is to be provided (e.g., direct instruction or environmental engineering). Describe whether the learner will choose from an object array *then* symbols or from a symbol array *then* objects to demonstrate comprehension. Describe any tracking of object/symbol position to monitor for possible position bias. Describe any strategies (such as a book) for increasing symbol accessibility.
- **Scanning.** Describe any assistance provided to insure that the learner is aware of what is in the object and symbol arrays.
- **Instructional Cues.** Describe what the teacher does to elicit a response from the learner.
- **Targeted Behavior.** Describe how the learner will gain the attention of the partner and how the learner will indicate the symbol to the communication partner. List the type of symbol that is targeted.
- **Time/Latency.** Indicate the amount of time to be allowed for the learner to respond.
- **Level of Assistance.** Describe any physical assistance, model/demonstration, or other assistance that is being provided to the learner to make his response.
- **Protest/Reject.** Describe how the learner expresses no interest or loss of interest in activity or materials.
- **Consequence.** Describe the manner in which the partner responds when the learner makes a correct as well as an incorrect response.

Environment

- **Setting.** Describe the context in which the learning opportunity is being targeted.
- **Position.** Describe any unique positioning considerations that are needed to enable the learner to respond. This may include partner's position in relation to the learner.
- **Partner.** List the person(s) with whom the learner will be interacting in the target activity.

Intervention Record Glossary for Object Interaction

Assessment

- **Assessment of Skills.** Indicate if you are conducting a cognitive/object interaction assessment in the home and or school environment.
- **Assessment of Preferences**. Indicate if you are investigating what is motivating to the learner at this time. Often times this is an ongoing part of instruction.
- **Symbol Type Probe:** Not Applicable
- **Assessment of Environment.** Indicate if you are conducting an analysis of the child's environment to determine existing and new supports to learning. This may also include a Materials Checklist if you are conducting an inventory of the materials available in your classroom to determine those best suited to teach specific skills.

Teaching Routine: (cues, responses and consequences)

- **Materials/Vocabulary.** List the specific objects that are being used to teach or practice the target skills.
- **Array size.** If appropriate, describe the number of objects or pieces presented to the learner at one time. For example if the learner is doing puzzle assembly how many pieces are offered to him at one time to discriminate between.
- **Distractors.** If appropriate, describe how similar or dissimilar the materials presented are to allow the child successful selection and or manipulation of the correct materials.
- **Instructional Format.** Describe the manner in which objects are presented to the learner (e.g. to his left, randomly, with contrasting backgrounds etc.). Describe how the learning opportunity is to be provided (e.g. Direct Instruction or Environmental Engineering).
- **Scanning.** Describe any assistance provided to insure that the learner is aware of the materials relevant features (e.g. assist learner to tactually scan object to determine proper orientation).
- **Instructional Cues.** Describe what the teacher does to elicit a response from the learner.
- **Targeted Behavior.** Describe how the learner is to respond.
- **Time/Latency.** Indicate the amount of time to be allowed the learner to respond.
- **Level of Assistance.** Describe any physical assistance, model/demonstration, or other assistance that is being provided to the learner to make his response.
- **Protest/Reject.** Describe how learner expresses 'no' or loss of interest in activity or materials.
- **Consequence.** Describe the manner in which the partner responds when the learner makes a correct and an incorrect response.

Environment

- **Setting.** Describe the context in which the learning opportunity is being targeted.
- **Position.** Describe any unique positioning considerations that will be made to enable the learner to respond. This may include partner's position in relation to the learner.
- **Partner.** List the person(s) with whom the learner will be interacting in the target activity.