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ABSTRACT

This paper describes the trademarked ScienceStart![TM] Curriculum--a science-based early childhood curriculum. The curriculum's major content goal is for children to develop a rich, interconnected knowledge base about the world about them. The curriculum's major process goal is to foster the types of intellectual development that characterize the preschool years, including children's receptive and expressive language skills, self-regulation of attention skills, and problem-solving skills. Following a discussion of the goals and assumptions of ScienceStart![TM], the paper describes the curriculum's characteristics, implementation, and effectiveness. (Contains 19 references and 10 endnotes.) (Author/HTH)

Using Science as the Hub of an Integrated Early Childhood Curriculum: The ScienceStart!™ Curriculum

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Abstract

This paper describes the ScienceStart™ Curriculum—a science-based early childhood curriculum. The curriculum's major content goal is for children to develop a rich, interconnected knowledge base about the world about them. The curriculum's major process goal is to foster the types of intellectual development that characterize the preschool years, including children's receptive and expressive language skills, self-regulation of attention skills, and problem-solving skills. The paper describes the characteristics of the curriculum, implementation of the curriculum, and the effectiveness of the curriculum.

For the past 7 years, we have been involved in creating, implementing, and refining a science-based preschool curriculum. There are both content and process goals associated with this curriculum. In terms of content, the major goal is for children to develop a rich, interconnected knowledge base about the world around them. In terms of process, the primary goal is to foster and support the types of ordinary intellectual development[1] that characterize the preschool years.[2] These include receptive and expressive language skills, problem-solving skills, skills in self-regulation—particularly attention regulation—and skills in problem identification, analysis, and solution.

Thus far, the curriculum has been used primarily with low-income 3-, 4-, and 5-year-olds who attend either Head Start or New York State Universal Pre-K programs. While the ScienceStart!™ Curriculum is highly effective in preparing low-income and second-language children for the demands they will eventually encounter in school, it is not designed as a compensatory or intervention program. Instead, it is very deliberately designed to be a holistic, developmentally appropriate program that can engage, support, and foster the development of all young children.

Goals and Assumptions Underlying the ScienceStart!™ Curriculum

The ScienceStart!™ Curriculum originates in an appreciation and concern for supporting the ordinary developmental achievements of the preschool years. In appropriate environments, intellectual development flourishes during early childhood. Unfortunately, however, many children find themselves in nonsupportive environments because of various family circumstances, particularly working parents' increased reliance on out-of-home care that is of poor or inconsistent quality. Appropriately implemented, the ScienceStart!™ Curriculum provides an out-of-home environment to foster ordinary development in the years between 3 and 6. This environment is beneficial to all preschool-age children.

The ScienceStart!™ Curriculum also originates in an assumption that primary school is the appropriate context for instruction in academic skills and that the preschool years are appropriately devoted to activities that provide opportunities to learn about the surrounding world and to acquire and practice the cognitive skills—expressive and receptive language, problem solving, self-regulation, and attention management—that are a part of ordinary development during the preschool years and that provide an essential foundation for later academic learning. This assumption also carries with it the following premises:

- Young children are active, self-motivated learners who learn best from personal experience rather than from decontextualized linguistic input (e.g., French, 1996; Nelson, 1996).
- Young children construct knowledge through participation with others in activities that foster experimentation, problem solving, and social interaction (Chaille & Britain, 1997).
- Young children should be allowed to exercise choice in the learning environment.
- Variability across children and the nature of preschoolers' general approach to learning mean that open-ended tasks are more appropriate in the classroom than are close-ended tasks.
- A classroom climate for young children that emphasizes achievement and evaluation can become highly punitive (e.g., Stipek, 1991) and thereby reduce or destroy children's inherent interest in learning.
- Children's social skills develop best when they have opportunities to learn and practice them in the context of meaningful activities (e.g., Katz & McClellan, 1997).
- Engaging and maintaining children's interest is a more effective means of supporting appropriate behavior than is emphasizing obedience.

The ScienceStart!™ Curriculum differs from other published approaches to early childhood education in terms of both its explicit emphasis on fostering the age-appropriate development of the cognitive foundations needed for later success in the school environment and its choice of content—a focus on scientific exploration of the natural, everyday world that incorporates artistic expression, literature, mathematical reasoning, writing, and center-based play.[3]

Essential Cognitive Foundations Selection

In determining the Essential Cognitive Foundations that would comprise the underlying goals of the ScienceStart!™ Curriculum, we were guided by three questions:

- What is ordinary development during the preschool years, and how can this development best be supported and fostered in a classroom context?
- What are the areas about which teachers and policy makers express concern regarding incoming students' lack of preparedness for school success?
- What are the areas of intellectual development for which research suggests that different home and child care environments may offer differential access to the environmental factors that support development?

In considering these questions, we identified language skills, self-regulation of attention, and problem-solving skills as the areas of development to be explicitly targeted by the ScienceStart!™ Curriculum.[4]

Language Skills

Receptive language and expressive language are two related but essentially quite different processes. In receptive language, in order for comprehension to occur, the listener must receive linguistic input and translate it into a mental representation. In expressive language, in order to be understood, the speaker must translate a mental representation into linguistic output.[5] Those who study language acquisition by infants and second-language learners are well aware that receptive language precedes and provides a necessary foundation for expressive language—basically people cannot meaningfully and generatively produce words, syntax, or discourse forms that they cannot also comprehend when they hear them used by others.

Notwithstanding the fact that receptive language precedes and provides the basis for expressive language, there is very little emphasis in the literature of either ordinary or compensatory preschool curriculum on ways to foster and support children's development of skills associated with receptive language. For example, the guidelines for developmentally appropriate practice published by the National Association for the Education of Young Children (Bredekamp & Copple, 1996) include many suggestions to enhance the development of expressive language skills but very few that would enhance receptive language skills. In one of the earliest and best-known intervention programs for low-income preschoolers, Bereiter and Engelmann (1966) focused primarily on children's expressive language; drills in which the children were expected to repeat what the teacher said were the primary form of receptive language activity.

For the most part, formal schooling involves learning through verbal input. Thus, school success is critically dependent on skill in translating linguistic input into mental representations. By age 4, most children are sufficiently skilled in the fundamentals of language that they can begin to use language not only for ordinary social interaction but also for transfer of content-rich meanings. Learning to use language (both receptively and expressively) to transfer content-rich meanings through language is a crucial component of formal education; the ability to use language in this way (both expressively and receptively) can be supported and developed during preschool through the use of language that precisely describes activities the child is observing or experiencing.

Like listening, reading is a receptive language activity. We suspect that many of the children who have difficulty with reading comprehension—despite success in learning to decode—would have similar difficulties with listening comprehension. That is, we suspect that many children are asked to *read* text that they would have difficulty comprehending even if it were presented orally. Thus, preschool programs that support and foster the development of receptive language will almost certainly contribute to later success in reading comprehension.

Given an adequate basis in receptive language, children need ample opportunity to express themselves verbally. Although close-ended or "known-answer" questions may have a place in the classroom, they are not a good way of fostering children's expressive language skill. Children learn conversational skills by participating in conversations with more skilled language users, and they learn to express themselves verbally through attempts to describe their thoughts and ideas to a supportive listener.[6]

As will become apparent when the ScienceStart!™ Curriculum is described in more detail, extensive opportunities for children to acquire and practice receptive and expressive language skills are built into each day's activities. Language experiences differ across families in terms of how closely they match the types of language demands that will be encountered in primary school (e.g., Heath, 1983). However, virtually all children are capable language learners when they are immersed in an environment rich in opportunities to acquire and practice language skills. By the preschool years, virtually all children are capable of using language not only for basic social interactions but also to express and comprehend complex meanings. We reject the assumption that in order to succeed in school low-income children need a different type of preschool language environment than do middle-class children. Rather, we start with the assumption that a preschool environment rich with meaning and language will be beneficial to all children. Whether children are low- or middle-income, and whether or not they are below average in the language skills needed for school success, they will all find such a preschool environment a place to develop and practice their language skills while enhancing their knowledge base and developing related skills in attention regulation and problem solving.

Self-regulation of Attention

The number and increasingly young age of children being diagnosed and medicated for attention problems worries many educators, physicians, and child advocates. The question is raised as to whether the children truly suffer from an attention disorder or whether the classrooms and other environments to which they are expected to adjust are inappropriate for young children.

The medical model of attention disorder assumes that the individual child is responsible for attending to the environment and that failure to do so reflects a disability within the individual. This perspective does not recognize the role that the environment may play in eliciting and supporting attention and does not recognize that skills in attending develop over time and, like many other cognitive skills, will most likely benefit from the support and involvement of other people in the environment.

On the one hand, developmental psychologists do not yet know very much about the ordinary developmental processes and stages of attention regulation. On the other hand, many skilled teachers have a variety of ways of engaging children's attention. This ability indicates that attention can be socially constructed and that the environment can affect the extent to which children will attend (French & Song, 1998). One hopes that identifying the development of attention regulation skills as a primary goal for the preschool years will allow us to draw on the expertise of these skilled teachers to outline techniques that all teachers can use to foster the development of children's facility in regulating their own attention and in turn to reduce the incidence of primary school children being diagnosed as having an attention disorder.

The foremost means of fostering attention in preschool is to have an interesting environment and meaningful activities. Major underlying premises of the ScienceStart!™ Curriculum are that (1) engaging children's interest and active participation is paramount and an essential prerequisite to learning, and (2) "wait time," during which children are expected to wait passively for a turn at an activity, should be minimized. The ScienceStart!™ Curriculum supports the development of attention regulation through activities that engage young children's interest for extended periods because these activities are hands-on, open-ended, and responsive to children's desire to explore and learn more about the everyday world around them.

Some of the ways that we have seen teachers in other programs foster the development of attention regulation among preschoolers include:

- *Reading aloud:* Virtually all children love to be read aloud to and to be invited to actively participate in reading. This activity fosters the development of both receptive language and attention regulation. Many children enjoy hearing the same story repeatedly; this enjoyment may be related to their emerging attention and linguistic skills—becoming more familiar with a particular text allows children to practice the attention-related skills of comprehension and prediction.
- *Extended and complex child-guided investigation:* The Project Approach (e.g., Katz & Chard, 1989; Edwards, Gandini, & Forman, 1993) is open-ended and can accommodate children with a variety of interests and a variety of skill levels. This approach allows children to set their own goals within the wider context of a group activity; their own goals are likely to be highly meaningful and motivating for them, thus leading to high levels of engagement and attention regulation.
- In the typical Korean preschool classroom, teachers frequently insert quick routines such as finger-plays into an ongoing lesson or activity; these finger-plays recall children's attention without the teacher disrupting the lesson to scold individuals (French & Song, 1998; French, 1995).
- The structure inherent in the High/Scope "plan, do, review" sequence provides a familiar routine to structure children's activity; this framework can then be drawn on to guide and self-regulate attention.

Problem-solving Skills

A simplified version of the cycle of scientific reasoning (reflect and ask, plan and predict, act and observe, report and reflect) permeates the daily activities of the ScienceStart!™ Curriculum. This cycle is initially introduced and guided by the teacher, but as the school year progresses, the children take increasing amounts of responsibility for its instantiation. The Vygotskian perspective (e.g., Bodrova & Leong, 1996; Vygotsky, 1978; Wertsch & Hickmann, 1987) that children learn higher-order thinking skills through watching others use them and co-participating in their use is widely accepted. It is not always easy for teachers to meet the challenge of making their almost automatic thinking processes apparent to children. Articulating the planning phase of the cycle is especially important because this is a phase that even the best teachers typically do "in their heads." Yet, the creation and evaluation of a plan are critical components for solving a problem, and the related skills are too important for us to hope that children discover them on their own.

We find that, with teacher support, children are able to transfer the reasoning cycle to resolve problems that arise during peer play. For example, one girl ran to the teacher to complain that the other girls in the housekeeping area would not let her play with the dolls. Rather than intervening with the other girls, the teacher asked the girl who felt left out what she thought she could do (plan) and what she thought would happen if she did take that course of action (predict). After discarding a couple of plans, the girl confidently walked into the housekeeping area, announced, "I'm the grandmother, and I have to give the baby a bath now," and was immediately given one of the dolls.

As teachers working with the ScienceStart!™ Curriculum support children in planning and predicting during the course of science explorations, they do not comment on the accuracy of the children's predictions, either before or after an activity is carried out. They welcome all predictions and emphasize that comparing outcomes to predictions is an excellent way of learning, regardless of whether or not the original prediction was correct. This approach is taken both because it accurately reflects the scientific attitude and because we feel it is extremely important during the preschool years to avoid making children overly concerned with getting the "right answer." Instead, teachers using the ScienceStart!™ Curriculum are urged to emphasize the open-ended nature of wondering and learning. Wondering leads to problem solving and feelings of competence and self-esteem in learning.

Knowledge Base

A fourth component of what we consider to be the essential cognitive foundations for school success is a rich, interconnected knowledge base about the surrounding world. Listening and reading comprehension involve relating the new input to what is already known. Children with a richer, more interconnected knowledge base will generally comprehend more than children without such a knowledge base. The knowledge base also plays a key role in supporting higher-order intellectual activities such as drawing inferences and making predictions (e.g., Bodrova & Leong, 1996).

Many preschool programs lack any sort of "instructional" content and are built around free play and art activities. Other preschool programs offer content that lacks coherence from day to day—on different days of a single week in February, the first author's 5-year-old studied presidents of the United States and their birthdays, Valentine's Day and St. Valentine, and dinosaurs. Many preschools use a theme approach that is intended to provide coherence and in-depth learning. However, as implemented, the theme approach is often not a topic that supports coherence and integration but a label that arbitrarily brings together unrelated items and concepts (for example, "Red Week" or "M Week").[7]

Just as they are biologically prepared to learn language and to learn to walk, children are biologically prepared to learn about the surrounding world. Without apparent effort, they process personal experiences to create rich mental representations that serve as a guide in understanding and interpreting subsequent experience (e.g., Nelson, 1986; Nelson & Gruendel, 1981). In the course of mundane, daily life, many children have rich opportunities to learn about the surrounding world. However, many children lack either a wealth of experiences or the language to talk about the experience.

To draw a strong distinction to illustrate this point, imagine the child who never visits a farm, the child who visits a farm in silence, and the child who visits a farm with an adult who is eager to talk about the purposes of farming, the animals and plants that appear on a farm, and the life cycle of these animals and plants—an adult who invites the child's questions and comments during the experience, and who then talks with the child after the visit and encourages the child to tell someone else (dad, another teacher) about the experience. The first child lacks the experience of visiting a farm; the second child has the experience and doubtless has mental representations of that experience; and the third child has the experience, mental representations created by both the experience itself and by the input/explanations offered by the adult, and the language to express and recall the experience and the adult input. Children who spend the preschool years in environments that offer a variety of experiences and provide the language to describe, interpret, and recall the experiences will be better prepared for school than will children who spend the preschool years in environments where little language is "wrapped around" daily experience.[8]

Once convinced of the importance of helping children develop a rich knowledge base, how would one decide the question of "about what?" At one level, daily life—especially if supplemented with extensive linguistic input—provides ample opportunity for learning a great deal. A variety of approaches used in successful preschool programs also offer a great deal for children to learn—projects, author studies, and emergent curriculum are all open-ended approaches that support the creation of a coherent knowledge base.

The decision to use science as the basis for our curriculum derives in large part from watching children themselves. As we began introducing activities such as color mixing, mapping, and exploring the properties of air into preschool classrooms, teachers began to express amazement at how focused and attentive the children became; the teachers were especially impressed by the engagement of children who often presented behavior problems or had difficulty in "settling down." As noted above, children are biologically prepared to learn about the everyday world; our observations indicate that they are also very excited about opportunities to do so.

Characteristics of the ScienceStart!™ Curriculum

As we have formulated the ScienceStart!™ Curriculum in greater detail over the past few years, we have established several guiding principles. First, we decided that the science content would involve only topics that children could personally experience or perceive. Second, we decided to build in coherence, such that each day's science activities would build on the activities of the day before and provide a foundation for the activities of the following day. Third, we decided to create a highly integrated program by making each day's science activity the core of the rest of the day's activities. For example, if mixing primary colors is the day's science activity, there might be:

- a selection of books about color in the reading area, with a book such as *Mouse Paint* or *Little Blue, Little Yellow* read aloud as a means of introducing the color mixing activity;
- only red and yellow paint at the easel, with a suggestion that children try to create a variety of shades of orange and some adult support for the mathematical concept of proportion;
- net aprons/capes made of primary colors in the housekeeping area, with a suggestion that children try layering them to create new colors; and
- flashlights, color paddles, and cellophane in primary colors at the science table.

Implementation

In practice, a classroom that is implementing the ScienceStart!™ Curriculum looks very similar to most high-quality American preschool classrooms. There is a large-group time that includes a period of "read aloud," choice time in the same sorts of activity centers found in most preschool programs, outdoor play/large motor activity, and mealtime or snacktime. We have operated the program with a lead teacher, assistant teacher, and 21 children, as well as working in smaller groups. Key features of the ScienceStart!™ Curriculum that are found in other high-quality programs include high levels of parent involvement and individualized planning and goal setting for students. What distinguishes the ScienceStart!™ classroom from others is the content of the curriculum, the interrelation between large-group activities and the rest of the day's activities, and the cycles that structure the implementation of the curriculum.

The curriculum is structured by two recursive cycles. The teacher guides the children through four phases as they experience an extended unit such as "air," "light," or "measuring ourselves." These phases are similar to those that would occur in a classroom that followed an emergent curriculum model. They include exploration, formulating questions, following the questions, and a culminating experience. The amount of time devoted to each of these phases is adjustable depending on children's and teachers' interests. A unit on air might last three weeks, with the first three days devoted to exploring air from a variety of perspectives, a couple of days devoted to supporting children in formulating observations and questions about their explorations of air, a week or more carrying out investigations that build on the observations and address the questions, and a few days planning and carrying out a culminating experience—perhaps having a party that included serving baked meringue and planting a wind garden, or perhaps making kites and taking a field trip to fly them. These complex culminating experiences can take on the characteristics of the familiar Project Approach. They have a variety of subcomponents that require planning and implementing; children can contribute to the efforts of the larger group as they find a part of the activity that fits their particular interests and skills.

The second recursive cycle is the simplified cycle of scientific reasoning that the teacher leads the children through during each activity. The four phases are "reflect and ask," "plan and predict," "act and observe," and "report and reflect." Reflections at the end of one activity may lead to another activity, thereby providing coherence from one day to the next.

During large-group time, the teacher reads aloud a book that provides a context for introducing and discussing the daily science activity. After introducing the day's topic, the teacher invites children's input, and together they plan how to explore the topic. The science activity is carried out—with varying amounts of student participation—during large-group time, and it is then made available for revisiting during choice time, most likely with adult support. During both large-group and choice time, the teacher and children follow the cycle of scientific reasoning. Following large-group time, children choose which activity area to begin in, then move among areas. There is variation across teachers and days in terms of how much the teacher directs children toward specific activity areas. At some point during the day, a report about the day's investigations is prepared. Critical components of the report phase include reflecting on or talking about the activity and representing it in a way that can be shared with others. This representation may take many forms, including charts and graphs, lists and narrative descriptions, drawings, and performances. The report may be an intrinsic part of the large-group time (e.g., tasting three different types of apples and charting students' preferences), it may be an individual creation that results from the activity itself (e.g., a sun-catcher made with overlapping colored cellophane), it may be a compilation of individual creations (e.g., a class book for which each child contributes a page of dictation or drawing, a poster with handprints from each class member), or it may occur during a separate period of teacher-guided reflection and assume the traditional form of writing on chart paper that can be posted.

Effectiveness of the Curriculum

We are taking several approaches to documenting the effectiveness of the ScienceStart!™ Curriculum:

- Classroom teachers are interviewed/debriefed on a regular basis, and it is highly obvious to them that the curriculum is effective. Children are highly engaged. They make reasonable predictions and compare these to what actually happens.
- Classroom observations support the teachers' reports of students' high levels of engagement and participation, as well as their reports of few behavioral problems.
- Parents report satisfaction with the program, change their expectations for their children's learning in positive ways, and, once their children have moved on to primary school, frequently return to tell us about their success. Parents who have had older children in other preschool programs indicate a strong preference for the ScienceStart!™ Program.
- Pre- and post-tests[9] on the central concepts of units show two important types of learning: children are learning the "facts" of science (e.g., to make a large shadow bring an object close to the source of light; to make the shadow smaller, move the object away from the light), and their emerging theories of science concepts are increasingly well represented in, and therefore

accessible to, language. To assess children's science learning, we have created storybooks in which the protagonist, *Curi the Bear*, faces a problem that can be solved by the application of the concepts emphasized in the units. *Curi* solicits help from her "classmates" in a series of questions that differ in the degree of contextual support they offer the child. These questions permit us to distinguish between children whose knowledge is so well established in language that they can use it to think about situations (i.e., to interpret and reply to questions), and children who can access their knowledge to describe a picture but could not use it to support inference and prediction. Consistently, pre- and post-evaluations show that children know significantly more science facts following instruction, and significantly more children are able to use their knowledge to support thinking. Our children's progress is noteworthy because it supports the claim that the content is developmentally appropriate and because it shows how easily low-income children, frequently considered to be demographically at risk for school achievement, can learn complex, abstract concepts.

- Standardized measures of language show children making statistically significant gains in receptive and expressive grammar and vocabulary. Of the measures we use, the Peabody Picture Vocabulary Test is perhaps the best known.[10] This measure of receptive vocabulary correlates strongly with many achievement tests (Williams & Wang, 1997) and is a good predictor of school success. Our data, collected over 5 years, show that children entering the program, whose average chronological age was 4 years 4 months of age, had an average receptive vocabulary of children age 3 years 11 months. Six and a half months later, these children had the vocabulary of a child of 4 years 11 months. That is a 12-month gain in 6-1/2 months and shows the children performing at age level at the end of the program. We want to reiterate that this vocabulary was picked up incidentally, without direct teaching, in the course of participation in a language-rich classroom.

We are currently delineating an explicit match between the New York State Standards for PreK and the ScienceStart!™ Curriculum so that we can offer teachers insight into how to achieve these standards in a developmentally appropriate and engaging learning environment.

Looking Ahead

With support from the National Science Foundation, we are currently working to find ways to support teachers in adopting the ScienceStart!™ Curriculum. Development of the ScienceStart!™ Curriculum began during the 1996-1997 school year, and this year (2000-2001) is the first year that it is being piloted with teachers who did not play a major role in its development. We are finding that even teachers who volunteered to adopt the curriculum struggle with putting aside familiar approaches to the pre-kindergarten classroom and adopting instead the coherent, integrated ScienceStart!™ Curriculum. It appears that our efforts over the next few years will most likely be devoted to finding effective and efficient mechanisms for professional development. We are optimistic because our efforts at bringing about teacher change are helped considerably by the changes they see in their students as the curriculum brings hands-on investigations of the everyday world into the classroom.

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Notes

[1]By using the adjective "ordinary" we mean to emphasize that we are referring to intellectual abilities that emerge without direct instruction during the course of everyday life. At a basic level, virtually all children acquire these abilities. However, the abilities are also context sensitive in that their initial acquisition and the level to which they are eventually developed are affected by an individual child's opportunities, social interactions, and physical environment.

[2]It is our perspective that focusing on the development of intellectual skills is appropriate and possible only in environments that also meet children's physical and social needs. In our classrooms, we emphasize appropriate social interactions and community building, and we strive to create an environment that maximizes children's interest

and engagement. We find that when children are engaged with content they care about, they are much less likely to engage in inappropriate social behavior.

[3]We are sometimes asked how we can focus on "science" when "everyone knows" that language and literacy are the essentials for school readiness. We point out that language and literacy are aspects of the cognitive process of *making reference*. That is, they must be *about* something. Focusing on science content provides a meaningful, goal-directed context for enrichment of language and literacy skills, as children work with content-relevant texts and develop context-relevant reports.

[4]Some readers are likely to wonder why we do not target "learning to read" as an essential cognitive foundation. In order to learn to read, children must first have an opportunity to develop the appropriate foundations of receptive language skill in creating meaning from incoming language, a rich knowledge base to support comprehension, and the ability to self-monitor understanding and to take steps to correct the situation when understanding lapses. Without these foundations in place, it will be virtually impossible for children to move beyond simple decoding. With these foundations in place, they can easily learn to read in an appropriate primary school environment. Too early an emphasis on reading and phonics instruction can be not only developmentally inappropriate but also damaging to the child's sense of herself or himself as a competent, autonomous learner.

[5]Of course, this is a bare outline of what happens and ignores other components of both speaking and listening, including accessing the appropriate knowledge base to support comprehension, adhering to pragmatic expectations for speaking, and so forth.

[6]Here we would define a supportive listener as one who is genuinely attempting to understand what the speaker is saying and who asks questions to help the speaker express herself clearly. Preschool-age peers can certainly engage in conversations with one another, but supportive adults are also very important in helping children learn to express their thoughts through language (e.g., French & Pak, 1995).

[7]One Kodak scientist told us that she taught complex science topics in her son's preschool once a week. When asked how she decided what to teach, she said she had to find a topic that went with the "letter of the week" but that she sometimes "cheated" by using an adjective with the right letter to introduce the topic she wanted to introduce—e.g., "windy days" to introduce the concept of "weather" during "D-week."

[8]Unfortunately, our personal observations in day care and preschool programs suggest that the norm is using language primarily for control rather than for enriching and extending children's experience. Even teachers who are concerned about children's language development often translate this concern into concern about children's *expressive* abilities and may not themselves use a great deal of language to describe, explain, and simply converse about experiences.

[9]These pre- and post-tests are designed for each unit. The surface form consists of a narrative that is administered as a shared book reading, where children are asked to help answer questions raised by Curi, the main character in the narratives. The underlying structure of the assessments is a rubric that assesses children's level of understanding of the concepts that underlie the curriculum unit, ranging from no or very little understanding to sufficient understanding to express the concept in language without reliance on pictorial representation.

[10]The PPVT-R has recently been renormed to reflect the current U.S. population and the experience of ethnic minorities. For this discussion, PPVT-R raw scores were transformed into PPVT-IIIA scores.

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