Preschool Teacher-Child Verbal Interactions in Science Teaching

Tsung-Hui Tu, Ph.D.
Kent State University

Wei-Ying Hsiao, Ed.D.
Southern Utah University

Abstract

This study examined verbal interactions between 20 preschool head teachers (N = 20) and their students in 13 Midwestern child care centers; preschool head teachers were videotaped for two consecutive days during morning free play time. By operationalizing Neuman's concept of "sciencing", this study used The Preschool Teacher Classroom/Sciencing Coding Form, The Preschool Teacher Verbal Interaction Coding Form, and The Preschool Classroom Teacher Interview Form to analyze preschool teachers' verbal interactions with children in science teaching and teachers' perspectives about science teaching. During the observation period, the most frequent verbal interaction entailed giving learning guidance. Teachers used more verbal statements than questioning statements; they tended to interact with children mostly in the art area. Comparing teacher verbalizations on Day 1 and Day 2 revealed that on Day 1 in typical activities teachers used more praise, acknowledge statements, and closed questions than on Day 2 when a science activity was provided for the head teachers. On Day 2 they used more learning guidance, information talk statements, and more attention-focusing questions. The study showed that preschool teachers tended to use more measuring and counting questions in the block and manipulative areas and used more reasoning questions in the dramatic play area.

Correspondence should be addressed to Tsung-Hui Tu, Ph.D., (Email: ttu@kent.edu), Department of Teaching, Leadership & Curriculum Studies, Kent State University, 2491 State Route 45 South, Salem, OH 44460, Telephone: (330) 337-4229, or Wei-Ying Hsiao, Ed.D., (Email: Hsiao@suu.edu), Department of Teacher Education and Family Development, Southern Utah University, 351 West University Boulevard, Cedar City, UT 84720, Telephone: (435) 865-8576.

Introduction

The traditional adage "I hear and I forget. I see and I remember. I do and I understand" indicates that children learn best through direct experiences (Croft, 2000, p. 219). Children have innate curiosity and as soon as children realize that they can discover things for themselves, their first encounter with science has occurred. Experiences in science provide opportunities for young children to develop an appreciation and awareness of the world around them and develop science inquiry skills, such as "wondering, questioning, exploring and investigating, discussing, reflecting, and formulating ideas and theories" (Chalufour & Worth, 2003, p. 4). Many professional

societies, such as the National Science Foundation, the U.S. Department of Education, the American Association for the Advancement of Science (AAAS), and the National Association for the Education of Young Children (NAEYC), emphasize the importance of science in the lives of young children and believe the early years are prime for active learning and that science can play a valuable role in a child's development.

Science-related Activities

Neuman (1972) believed that "sciencing involves children in full and active participation in a variety of experiences" (p. 6) and used the term "sciencing" to describe science-related activities for young children. He divided sciencing into three categories: formal sciencing, informal sciencing, and incidental sciencing. Table 1 describes the classification of Neuman's three science-related activities and examples are provided by the researcher. Kilmer and Hofman (1995) also used the term "sciencing" to emphasize children's active involvement in learning about science.

Table I
Categories of science-related activities

Type of science-related activity	Definition	Example
Formal sciencing (Neuman, 1972)	Teacher plans lessons, prepares materials, presents the activities to the children, and then encourages the children to do the activity, and as much as possible, to make discoveries.	-Providing a cooking activity -Introducing a pet -Setting up an incline -Providing a melting/freezing activity
Informal sciencing (Neuman, 1972)	Teacher sets up a corner or section of a room or outdoor area as the "sciencing center." The teacher selects materials and makes them available to the child who is interested in using them. The child freely chooses to use the materials and explore them in a variety of ways.	-Magnifying glasses with nature materials (e.g., bird's nests, feathers, nuts, and seeds) -Scales with a variety of objects (e.g., objects of different sizes and weights) -Magnets with different items (e.g., paper clips, markers, metal spoons)
Incidental sciencing (Neuman, 1972)	The incident is not planned by the teacher but is the result of an occurrence that is interesting to one or more children and is elaborated and expanded by the teacher.	-The class pet died over the weekend. -An animal is unexpectedly brought to the classroom. -A rabbit is seen hopping by the classroom window. -The weather suddenly changes.

Lind (2000) believes that children learn concepts through three types of activities that are consistent with Neuman's three types of sciencing. In addition, "structured learning experiences are preplanned lessons or activities," "informal learning experiences are initiated by the adults as the child is engaged in naturalistic experiences," and "naturalistic experiences are those initiated spontaneously by children as they go about their daily activities" (Lind, 2000, p. 17-18). Therefore, teachers need to "take advantage of the unplanned experiences" which comprise incidental sciencing and "select planned activities from the children's daily experiences" which are formal and informal sciencing (Eliason & Jenkins, 2003, p. 278). It's teachers' responsibility to capitalize on teachable moments "when an opportunity for instruction presents itself by chance" (Lind, 2000, p. 17). Pedagogical responsibilities accompany children's sciencing: teachers play a very important role in expanding and supporting children's learning. For instance, teachers design an environment rich with science activities, equipment, materials, and "once the environment is in place, children's explorations lead them in many directions--and many ideas, questions, and challenges arise" (Worth & Grollman, 2003, p. 158).

Teachers' Roles

The role of teachers is crucial in expanding and supporting children's learning in science and it includes socializing with children, modeling the behavior they want to teach, encouraging children's play activities, monitoring children's behaviors for safety, and asking questions to promote critical thinking (Kontos & Wilcox-Herzog, 1997; Riley & Roach, 2006). Vygotsky (1962) believed that children are helped and influenced in their knowledge construction by the people around them and he also believed that teachers must take an active role in children's play to help them reach their learning potentials.

Teachers, like children, are learners and researchers. According to Hill, Stremmel, and Fu (2005), when teachers work with children, they "develop their own questions based on their curiosity about children's learning" (p. 45). While teachers investigate questions with children and guide them to document what happens, both teachers and children grow and learn together in that process. Teachers also learn through self-constructed knowledge, which means "knowledge is self-constructed by each individual, through reflection on their actions on the world around them" (Riley & Roach, 2006, p. 364). Teachers need to reflect their experiences in working with children on the regular basis and continue to seek any appropriate and possible learning opportunities for children.

Teacher–child Verbal Interaction

According to Bredekamp and Copple (1997), adult-child interactions promote trial-and-error learning, self-regulation through many opportunities to inquire questions, make decisions, and solve problems. The teacher verbalization statements are including learning guidance (McWilliam, Scarborough, Bagby, & Sweeney, 1998), Information talk, Praise (McWilliam, et al., 1998), Acknowledge statement (Abraham & Schlitt, 1973; McWilliam, et al., 1998), and Follow-up statement (Carman, 1990; McWilliam, et

al., 1998). Learning guidance is a teacher providing the information of activity procedures and expectations, such as "Today I am going to give each of you a piece of play dough, and I want both of you to…" Information talk is a teacher responding a child's comments by describing a child's exploration or answering a child's question with specific information. For instance, "I am rolling out my play dough so it is very flat." Praise is a teacher praising a child by conveying pleasure or admiration for the child, the child's behavior, or the child's work product; such as, "good job," "great," or "wonderful." Acknowledge statement is a teacher using statements that acknowledges the child's activity or approves the child's verbal behavior without elaboration, such as "you are working hard," "ok," or "all right," Follow-up statement is a teacher eliciting verbal or behavioral responses related to a child's activity. These statements are extensions related to previous specific statements stated by a child. For example, a child says, "Roll play dough." A teacher replies, "Oh, you want me to roll the play dough into a ball for you."

Kontos and Dunn (1993) examined teachers' verbal interactions with children and found that the most frequent teacher─child interaction was positive guidance (e.g., praise, nurturance, and redirection). The least frequent interactions involved divergent questions and elaboration of children's play activities. They suggested that teachers' interactions with children tended to give guidance instead of facilitating children's cognitive development.

Researchers have shown that teacher─child verbal interaction, especially asking questions, is the key component leading to positive outcomes for children (Trawick-Smith, 1994; Vandell, 1996). According to Eltgeest (1985) a productive question stimulates and provides scaffolding for children who are beginning to build their own understandings. His definition of productive questions is related to the learning cycle and sciencing processes described by Bredekamp and Rosegrant (1995). The comparison of the relationship between questioning and learning in the science process is showed in Table II.

Table II
Science-related questions identified to elicit children's science process skills

Eltgeest (1985)	Bredekamp and Rosegrant (1995)	
Productive questions	Learning Cycle	Sciencing Processes
Attention-focusing question	Awareness	Observing
Action question	Inquiry / experimentation	Relating
Problem-posing question	Inquiry / experimentation	Relating
Measuring and counting question	Exploration	Quantifying
Comparing question	Exploration, Inquiry / experimentation	Comparing, Organizing, Classifying, Inferring
Reasoning question	Utilization	Applying, Communicating

One particularly powerful format for verbal interaction involved engaging children with questions. Good questions promote children's observation skills, develop their problem-solving skills, and encourage them to share ideas (Branscombe, Castle, Dorsey, Surbeck, & Taylor, 2000). According to NAEYC's DAP guidelines, teachers pose problems, ask questions, and make comments and suggestions that stimulate children's thinking and extend their learning (Bredekamp & Copple, 1997).

However, in the early childhood settings, teachers seemed to spend considerable time facilitating children's play, but talk with rich and stimulating content seemed to be lacking (Massey, 2004). Jones (1990) also indicated that many teachers do not ask questions effectively. Teachers fail to reach children's potential by "early childhood error" (Bredekamp & Rosegrant, 1992, p. 3), which Kontos (1999) described as occurring "when early childhood educators prepare an appropriate, stimulating environment for young children but then stand back and fail to follow up with guidance 'scaffolding' or supportive, responsive interactions with the children as they play" (p. 364).

Research Questions

This study investigated teacher-child verbal interactions in preschool settings during morning free play time and proposes to address the following questions:

1) What types of verbal interactions do teachers have in the classroom with their preschoolers in light of children's "sciencing" experience?

2) What types of questions do teachers ask in different classroom areas?

3) What are teachers' perspectives about science teaching in preschool classroom settings?

Methods

Participants and Demographics

The participants were 20 (N = 20) head teachers of 3-to 5-year-old preschoolers from 13 child care centers in Midwest. These centers included children center, university-based lab school, community child care, nursery, children learning center…etc. Seven out of 13 child care centers were NAEYC accredited programs. The teachers had completed at least one year of teaching in their center and were selected for participation in this study by their child care director. All the participants were White/Caucasian females. The majority of the teachers had bachelor's degrees (60%); 15% had attended junior college or the equivalent; and 25% had a high school diploma. Thirty-five percent of preschool teachers had 1-3 years of teaching experience, 40% of the preschool teachers had 4-10 years of teaching experience, and 25% of the preschool teachers had more than 10 years of teaching experience. Seven preschool teachers had teaching certificate or licensure for birth through PreKindergarten/K or Early Childhood (birth to 8 years) while three preschool teachers had Elementary Education (K-8 grades) teaching licensure.

Instruments

The present study the researcher created three measurements: the Preschool Teacher Classroom/ Sciencing Coding Form, the Preschool Teacher Verbal Interaction Coding Form, and the Preschool Classroom Teacher Interview Form.

The Preschool Teacher Classroom/Sciencing Coding Form was developed for identifying the different areas of the classroom where teachers interact verbally with children and for indicating whether activities are related to science activities (see Appendix A). The nine typical areas identified were art, blocks, computer, manipulative, science, dramatic play, language and reading, sensory, and other. Two coders viewed the videotape to record where teachers stayed for 15 seconds or longer and what type of science activity was taking place. Based on Neuman's (1972) classification as illustrated in Table 1, the researcher provided examples on each classification. Activity not related to science was coded as: none of the above. The videotape was viewed by coders to record the classroom area during every 30-second interval. When more than one activity

area was observed, the activity was occurring 15 seconds or longer was coded (see Appendix A).

The Preschool Teacher Verbal Interaction Coding Form was developed to code the teachers' verbal interactions with children, specifically focusing on the preschool teachers' questioning statements (see Appendix B). Verbal interaction was coded for the type of verbal statement teachers used in five categories and these verbal statement categories were developed from several researchers, such as learning guidance (McWilliam, et al., 1998), information talk (Carman, 1990), Praise (McWilliam, et al., 1998), acknowledge statement (Abraham & Schlitt, 1973; McWilliam, at al., 1998), follow-up statement (Carman, 1990; McWilliam, et al., 1998) and other. When a teacher talks to a teaching assistant, parent, the child's siblings or herself/himself, it was coded as other. There were seven categories in question asking, such as closed questions (Carman, 1990) and Eltgeest's (1985) productive questions, such as attention-focusing, action, problem-posing, measuring and counting, comparison, and reasoning. The coding was done at every 15-second interval across the 10-minute videotaped segment. A mark was placed in one box next to each verbalization statement category as it occurred. This coding of behaviors was done as the verbal statement was observed and was repeated when the verbal statement observed again (see Appendix B).

The Preschool Classroom Teacher Interview Form was designed to collect demographic information from the teachers, and to record their perspectives about science teaching in their classroom settings (see Appendix C). Specific questions regarding the experimental science activity provided by the researcher on the second day of observation were asked. The teachers were also asked to rank their preferences for subject areas, using a list of seven categories: language and literacy; mathematics; science; health, safety, and nutrition; social studies; aesthetic expression (art, music, drama, and movement); and gross motor and outdoors. The interview required about 15 minutes on the second day of the videotaping and the interviews were audiotaped.

Procedure

A pilot study was conducted with two multiage preschool head teachers in a Midwestern university based laboratory school. The pilot study videotapes were used later for interobserver agreement training prior to beginning the actual coding of the participants' videotapes.

The directors in Midwestern child care centers were contacted by telephone to seek their approval for the participation of their center in this study and to schedule an information meeting with the director and one or two teachers of 3 to 5-year-old preschoolers. All the teachers in the study were nominated for participation by the director of their respective centers. The teachers needed to have worked in the center for at least one year. Following verbal consent from the directors, information about the study and the letter of consent were distributed to each director and head teacher. In addition, written consent was obtained from the classroom teacher assistant and the parents since it was likely that the assistant teachers and preschoolers would inadvertently be included on the videotape. Each teacher was videotaped for 60 minutes for two

consecutive days during morning free play time. The videotape time was slightly different between 8 to 10 o'clock depends on each classroom's free play time schedule. Day 1 of videotaping began when at least half the children were present. The teacher engaged in her typical class routine and interactions with children. Day 2 followed the same procedure except that the teacher was asked to implement a pre-planned science activity that was provided by the researcher. The pre-planned science activity involved making green play dough without green food coloring. The purposes of using the pre-planned science activity were to investigate preschool teachers' verbal interactions with children, especially science-related questions. This activity was selected because it was a familiar activity involving scientific skills, such as measuring, counting, experimenting, and predicting. Following the activity, the teachers were interviewed for about 15 minutes to gather demographic information and their views of science for preschoolers in group settings.

Data Analysis

The data analysis including establishing interobserver reliability and interobserver reliability of videotapes, and analyzing interview questions. Interobserever reliability was established independently by the researcher and a graduate student specializing in Child Development. To establish interobserver reliability, the graduate student was trained in coding the data using videotapes from the pilot study. During the training phase, the interobsrever reliability was 86% for the Preschool Teacher Classroom measurement and 95% for the Preschool Teacher Sciencing measurement. The interobser reliability was 84.94% (verbal statement) and 95.32% (question) for the first day Preschool Teacher Verbal Interaction measurement. The interobsrever reliability for the second day of Preschool Teacher Verbal Interaction measurement was 81.25% (statement) and 92.50% (question). During the coder training phase, discrepancies in coding were discussed and solutions were mutually agreed upon. Interobserver reliability was 95.83% for the Preschool Teacher Classroom Coding and 100% for the Preschool Teacher Sciencing Coding. The Interobserver reliability was 97.81% (verbal statement) and 99.6% (question) for the Preschool Teacher Verbal Interaction measurement. The entire interviews were transcribed. There were minor differences in the interview transcriptions between the researcher and the other coder, such as in the use of prepositions, definite articles, and interjections. After the interview was transcribed, the researcher and the other coder searched for similar patterns and phrases to conclude the results.

Results

Finding 1: Preschool teachers used more praise statements, acknowledgement statements, and closed questions during free play on Day 1, and on Day 2 during formal science activity preschool teachers used more learning guidance statements, information talk statements, and attention-focusing questions.

The most frequent teachers' verbal interaction for Day 1 and Day 2 combined involved giving learning guidance (M = 2.07) followed by information talk (M= .92); they used more verbal statements than questioning statements (see Table 3). Some of the examples of statements in providing learning guidance were, "You need to stop and

listen." "You need to think about your choices." "Now what we need to do is to put food coloring, water, and oil." "Now we need to figure out how to make green play dough." "You can come over here and pour it in." "We are going to make play dough today." "We need 3 cups of flour." "It's your turn, Sally." The examples of information talk were "We don't want to put our finger in because it will make our finger red." "This is a measuring cup. These are also called measuring cups." "This is 1/3 cup so we put 2 of them in it; then, it makes 2/3 cups." "You put your hands like this, and this is called kneading." "We always need a recipe to tell us what to put in." The two most frequent questioning statements comprised closed questions (M = .88) and problem-posing questions (M = .34). The closed questions teachers used, for instance, were "Do you want to start with the snack?" "Are you going to swim?" "Do you want to make a picture?" "What color is our salt?" "Do I have green food coloring?" "Do you get your turn yet?" "Does everyone agree that is green?" The problem-posing questions teachers used were, for instance, "What do you think?" "What are you going to make?" "We don't have green food coloring, so what should we do?" "What should we do so we can make sure we have three cups of flour here?" "What do you think we need more of, Molly?" "What else do you think we need more of?" Teachers seldom used follow-up statements, action questions, comparison questions, and reasoning questions.

Analysis of teachers' verbal interactions showed significant differences ($p < .05$) between teachers' verbal statements during free play on Day 1 and the formal science activity on Day 2. Teachers used more praise statements and acknowledgement statements during free play on Day 1 and used more learning guidance statements and information talk statements during formal science activity on Day 2.

Table III
Frequency of teacher verbal interactions

	Day 1 & Day 2 Combined	Day 1	Day 2		
	M	*M*	*M*	*F*	*P*
Verbal statement					
Learning guidance	2.07	1.48	2.66	101.971	<.001**
Information talk	0.92	0.84	1.00	4.816	.028*
Praise	0.28	0.35	0.21	10.274	.001*
Acknowledge	0.58	0.66	0.50	10.000	.002*
Follow-up	0.06	0.07	0.05	.550	.459
Other statement	0.39	0.04	0.33	3.389	.066
Questioning					
Closed	1.00	1.11	0.88	9.019	.003**.
Attention-focusing	0.10	0.05	0.15	11.416	.001**
Action	0.02	0.02	0.02	.044	.834
Problem-posing	0.36	0.37	0.34	.377	.539
Measuring & counting	0.07	0.05	0.08	1.786	.182
Comparison	0.03	0.03	0.03	.000	1.000
Reasoning	0.03	0.04	0.02	3.750	.053
Other question	0.01	0.01	0.02	.828	.363

In addition, the findings indicated significant differences ($p < .05$) for teacher questioning statements. Teachers used more closed questions during free play on Day 1 and more attention-focusing questions during formal science activity on Day 2.

Finding 2: Preschool teachers used more measuring and counting questions in the block and manipulative areas.

There were significant differences ($p < .05$) for teachers' use of science-related questions among classroom areas. Teachers used more measuring and counting questions in the block and manipulative areas, where these activities are most likely occur and more reasoning questions in the dramatic play area (see Figure 1). The study found that teachers tended to interact with students most often in the art area (24.8%), and the sensory area (19.3%). They interacted least often in the science area (.3%).

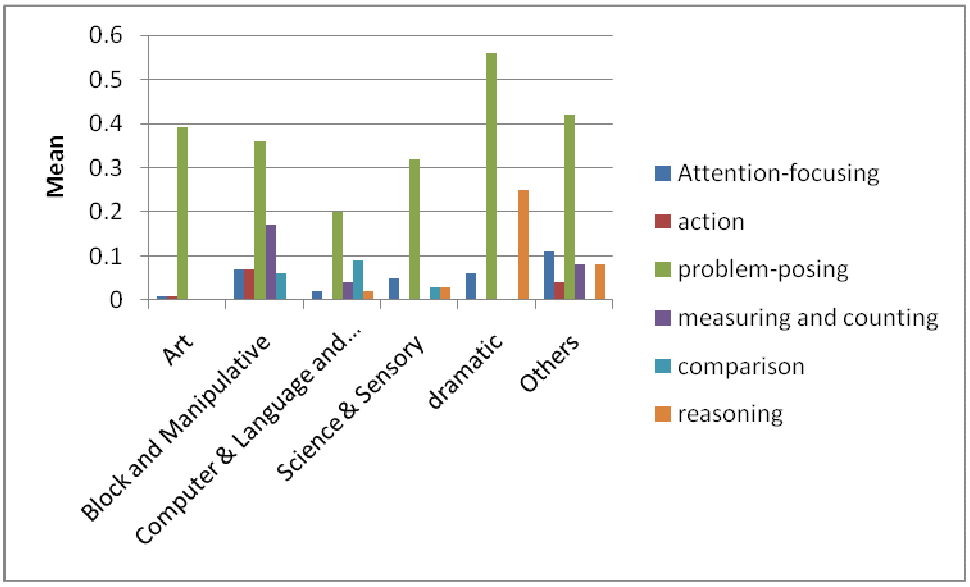

Figure 1. Differences in classroom areas on science-related questions

The study also investigated the science activities available to the children during morning free play time. The findings indicated that teachers spent most of their time engaged in activities not related to science (86.8%). Only 4.5% of the activities were related to formal sciencing. A total of 8.8% of the activities were related to informal sciencing, such as using sand box or a water table. No activities involved open-ended incidental science activities.

Finding 3: After providing pre-planned science activity to preschool teachers on Day 2, their perspectives about science teaching were of three specific kinds. They believed that science must offer opportunities in which children a) can be involved, b) can see what is going on, or c) predict what is going to happen.

The teachers were interviewed individually following Day 2 of videotaping. Examples of their responses included that:

- "Science for young children definitely has to be hands-on activity."
- "Science for young children probably is exploring and using their five senses."
- "Science is experimenting and asking questions. The goal is to predict outcomes and to see what happens if."
- "Science is a lot of exploring, experimenting, thinking, and discussion."

For the pre-planned science activities on Day 2, many teachers reported they were anxious about the science activity the researcher would provide, yet the planned experience with play dough was unexpected. For instance, on teacher stated, "I was surprised that it was a simple activity." Many teachers mentioned that they had previously prepared play dough, usually without children's help. One teacher reported, "Since I was familiar with making play dough, it made it easier for me to take that and try to do more experiments." Similarly, another teacher stated, "I knew how to make play dough, so I could really focus on what the children's questions were rather than looking back to the recipe and making sure I was doing it right." Participants did not elaborate on their lack of confidence in having a science experience chosen for them. And yet they seemed to agree that simple, familiar activities could have merit due to the opportunities for scientific exploration embedded within them.

The teachers evaluated the play dough activity as an age-appropriate and hands-on activity because the children were actively involved in mixing, touching, sharing, turn-taking, practicing problem-solving skills (i.e., which colors make green), and feeling proud about the completed play dough. When asked what they might do differently the next time, the teachers reported that they would have only a small group of children involved; and they might choose a different color, add flavor, or use pictures instead of words for the recipe. Some teachers reported that they did more science activities with the children than they had previously realized.

The teachers were asked to rank their preferences for subject areas, and the activity teachers most preferred to teach was Language and Literacy (45%), Aesthetic Expression (20%), Health, Safety, and Nutrition (10%), Gross Motor and Outdoors (10%), Science (5%), and Social Studies (5%).

Discussion

Quality of Preschool Teachers' Verbal Interactions

The study examined the types of preschool teacher-child verbal interactions in the classrooms during morning free play time. The findings indicated that the most frequent teacher-child verbal interaction was involved learning guidance. This finding was

consistent with the study by Kontos and Dunn (1993) that the most frequent preschool teacher─child verbal interaction was providing positive guidance and few questioning statements. The present study shows that pre-planned formal science activity, by its very nature, was involved more learning guidance, information talk, acknowledge statements, and more attention-focusing questions, as observed on Day 2.

The findings also showed that teachers tended to interact most often in the art area. Preschool teachers used more measuring and counting questions when they were in the block and manipulative areas, where are relatively similar classroom areas. The present study also revealed that preschool teachers asked more reasoning questions in the dramatic play area, where children engaged in creative activity, allowing them "to hone their developing representational abilities through pretend actions and role enactments" (Kontos & Wilcox-Herzog, 1997, p. 251). Also, in the block area teachers might ask, "How many blocks will it take to build a tower?" to encourage children to use their estimation skills. Similar manipulative activities (e.g., stringing beads) could not only provide learning opportunities for measuring, counting, and pattern skills but also enhance a child's eye─hand coordination skills. Preschool teachers, therefore, tended to engage in more measuring and counting questions while interacting with children in the block and manipulative areas than in other areas. In the present study, the children did not sustain dramatic play when the teacher was uninvolved. This finding suggests that teachers' involvement and familiarity with the activity are important factors in teacher─child verbal interactions.

Teachers' Views of Science Activities for Young Children

The findings of the teacher interviews were consistent with Tu (1997) that preschool teachers prefer language and literacy activities. The preschool teachers agreed on the importance of science and provided definitions involving hands-on experiences and the five senses for free exploration, but only one teacher ranked science activity as her most preferred activity. The researcher of the study suggests that preschool teachers need to expand their knowledge of science in order to increase their familiarity and comfort level and to integrate science more rigorously into their classrooms.

The DAP guidelines indicate that teacher preparation programs must provide teachers with information on how to construct appropriate curriculum for preschoolers. Therefore, preschool teacher preparation institutions need to make sure their early childhood education curriculum helps future preschool teachers be more knowledgeable, familiar, or even confident in teaching all subject areas, especially science. Also, it's helpful for preschooler teachers to know how to use community resources. For instance, the public library can help teachers find exactly the right books or teaching resources; the Public Health Service is a good resource to get health and nutrition aids; and farm organizations are helpful in scheduling field trips and providing information about farm animals (Holt, 1989). In addition, consulting with other teachers and children's family members and attending workshops or conferences are beneficial as a source of knowledge, artifacts, and expertise.

Conclusion

This study videotaped preschool teachers during morning free play time. To understand what part of the day teachers use more science-related questions and whether teachers change their verbal interactions with children throughout the school day, future studies need to videotape the entire preschool day. Future researchers also might ask preschool teachers to create their own science lesson as the basis for empirical study. This would permit them to think through their questions and procedures that would enhance children's scientific thinking.

Even though this study had some limitations, it provided empirical evidence of preschool teachers' verbal interactions with children during morning free play time with and without a formal science activity. The research findings suggest that teachers need to engage in science-related questions with children in all classroom areas. The science-related questions are very similar to Eltgeest's (1985) productive questions, such as attention-focusing, action, problem-posing, measuring and counting, comparing, and reasoning questions. By offering more science activities, teachers would increase the use of verbal interactions and science-related questions with children. Through operationalizing Neuman's (1972) concept of sciencing, the researcher of this study suggests that teachers need to plan formal sciencing activities, introduce informal science experiences in daily routines, and use teachable moments that promote incidental sciencing activities. Along with this improved specialized knowledge, teachers must shift from sharing knowledge to co-constructing understanding with learners. As Hill, Stremmel, and Fu (2005) advocate that teachers are researchers, so it is acceptable for teachers to say "I don't know, why don't we find out together". This study suggests that to improve science teaching in the preschool classrooms, teachers need to reflect more on their own practices and become aware of their verbal interactions with children, especially questioning statements.

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Appendix A

Preschool Teacher Classroom / Sciencing Coding Form

Teacher ID #_____
Coder Name _____

Classroom area
A= Art area
B = Block area
C = Computer area
M = Manipulative
S = Science
DR = Dramatic play area
LR = Language and reading area
SN = Sensory area
O = Other

Sciencing
F = Formal sciencing
IF = Informal sciencing
IN = Incidental sciencing
N = None of the above

	0:00-0:30	0:31-1:00	1:01-1:30	1:31-2:00	2:01-2:30	2:31-3:00	3:01-3:30	3:31-4:00	4:01-4:30	4:31-5:00
Area	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O
Sciencing	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N
	5:01-5:30	5:31-6:00	6:01-6:30	6:31-7:00	7:01-7:30	7:31-8:00	8:01-8:30	8:31-9:00	9:01-9:30	9:31-10:00
Area	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O	A B C M S DR LR SN O
Sciencing	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N	F IF IN N

Classroom area

Code	Score	
	Frequency	%
A		
B		
C		
M		
S		
DR		
LR		
SN		
O		
Number of Agreement		
Number of Disagreement		
Reliability (Pt-Pd) /Pt		

Sciencing

Code	Score	
	Frequency	%
Formal		
Informal		
Incidental		
None of the above		
Number of Agreement		
Number of Disagreement		
Reliability (Pt-Pd) / Pt		

Pt: the total number of agreement and disagreement
Pd: the number of observed disagreement

Appendix B

Preschool Teacher Verbal Interaction Coding Form

Teacher ID #_____
Coder Name _____

	0:00-0:15	0:16-0:30	0:31-0:45	0:46-1:00	1:01-1:15	1:16-1:30	1:31-1:45	1:46-2:00	2:01-2:15	2:16-2:30	2:31-2:45	2:46-3:00	Total
Statement													
Give learning guidance (G)													
Information talk (I)													
Praises (P)													
Acknowledges (A)													
Follow-up (F)													
Other (O)													
Question													
Closed (C)													
Attention-focusing (AT)													
Action (AC)													
Problem-posing (PP)													
Measuring and counting (MC)													
Comparison (CP)													
Reasoning (RS)													
Other (O)													

	3:01-3:15	3:16-3:30	3:31-3:45	3:46-4:00	4:01-4:15	4:16-4:30	4:31-4:45	4:46-5:00	5:01-5:15	5:16-5:30	5:31-5:45	5:46-6:00	Total
Statement													
Give learning guidance (G)													
Information talk (I)													
Praises (P)													
Acknowledges (A)													
Follow-up (F)													
Other (O)													
Question													
Closed (C)													
Attention-focusing (AT)													
Action (AC)													
Problem-posing (PP)													
Measuring and counting (MC)													
Comparison (CP)													
Reasoning (RS)													
Other (O)													

Preschool Teacher Verbal Interaction Coding Form

Teacher ID #_____
Coder Name _____

	6:01-6:15	6:16-6:30	6:31-6:45	6:46-7:00	7:01-7:15	7:16-7:30	7:31-7:45	7:46-8:00	8:01-8:15	8:16-8:30	8:31-8:45	8:46-9:00	Total
Statement													
Give learning guidance (G)													
Information talk (I)													
Praises (P)													
Acknowledges (A)													
Follow-up (F)													
Other (O)													
Question													
Closed (C)													
Attention-focusing (AT)													
Action (AC)													
Problem-posing (PP)													
Measuring and counting (MC)													
Comparison (CP)													
Reasoning (RS)													
Other (O)													

	9:01-9:15	9:16-9:30	9:31-9:45	9:46-10:00	Total
Statement					
Give learning guidance (G)					
Information talk (I)					
Praises (P)					
Acknowledges (A)					
Follow-up (F)					
Other (O)					
Question					
Closed (C)					
Attention-focusing (AT)					
Action (AC)					
Problem-posing (PP)					
Measuring and counting (MC)					
Comparison (CP)					
Reasoning (RS)					
Other (O)					

Appendix C

Preschool Classroom Teacher Interview Form

ID # _____
Name of the Program _____
Name of the Classroom _____
Date _____

NAECP accredited Yes _____ No _____
-or-
In self-study Yes _____ No _____

Age group_____ Total number Boys_____ Girls_____

Head teacher's sex: 1 = Female _____ 2 = Male_____

Highest level of educational completed:

1. High school diploma
2. CDA
3. Junior college or equivalent
4. B.A./B.S. degree
   (Specify major_____)
5. M.A./M.S. or professional degree
   (Specify major_____)
6. Other
   (Please specify major_____)

Teacher licensure(s):

1. None
2. Elementary Ed (K-8 grades)
3. Prekindergarten/K
4. Early Childhood (birth-8 years)
5. Early Childhood special Ed (Birth-6 years)
6. Other

Racial/Ethnic identification:

1. White/Caucasian
2. Black/African-American
3. Hispanic/Latino
4. Asian or Pacific Islander
5. Native American/American Indian
6. Other (Specify)

Years of teaching experience completed (include this year):

	1 = Head Teacher (years)	2 = Teacher Assistant (years)
Day care (Full day)		
(a) Infant/toddler (birth-36 month)		
(b) Preschool (36 month to kindergarten enrollment)		
(c) Kindergarten		
(d) School-age		
2. Preschool (1/2 day)		
3. Kindergarten (1/2 day)		
Total numbers of years taught		

Interview questions:

1. How would you describe this day? (schedule, children behaviors, interactions)

2. Is this a typical day or are there parts of it that are different in some way? If it has been different, what aspects have been different?

3. What has been the best part of self-selection time today? (Children, curriculum, programming, learning)

4. What is your definition of science for young children?

5. Please describe today's science activities?

6. How would you evaluate today's science activity? (interest level, level of suitability for the children, familiarity)

7. What were your expectations today for the children and the prepared science activity?

8. What would you do differently next time that you use this specific science activity with the children?

9. Please rank the activities that you prefer to teach from most preferred to least preferred.
(A) Language and literacy (B) Mathematics (C) Science (D) Health, safety, and nutrition (E) Social studies (F) Aesthetic expression (G) Gross motor and outdoors

10. Was the number of science activities today about the same as most days? More? Fewer?

11. Which of the activities available during self-selection time today was the most cognitively challenging for the children?

12. How many of the storybooks in your classroom today are related to science? Total? (Provide a specific number)

13. How many science resource books for children are in your classroom today? (Provide a specific number)