Teachers’ Open-Ended Questions in Early Childhood Science Activities: How Often, When, and What Happens?

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Introduction
Questioning is an important part of teachers’ classroom practice. In particular, open-ended questions, which often start with ‘why’ or ‘how’, support students’ scientific reasoning skills (Harlen & Quater, 2004), and encourage them to reflect on the relationships they have discovered and to recognize (Jelly, 2001). Open-ended questions help develop children’s language and encourage them to extend and generalize. However, according to cognitive and social constructivist theories, open-ended questioning can encourage deeper reflections on the concept and enhance children’s understanding (Bransford, Brown, & Cocking, 1999).

Research Questions
1. What are the different situational conditions under which open-ended and closed-ended questioning occurs?
2. What are the cognitive levels evident in students’ responses to these two types of questions?
3. How does student language use differ when open-ended versus closed-ended questions are used?

Theoretical Frameworks
Vygotsky’s theory of social constructivism and scaffolding instruction provides a useful framework for understanding the function of teacher questioning practice (Vygotsky, 1978). In his view, children do not learn in isolation but through dialogue, and conversation is strongly influenced by social interaction (Bransford, Brown, & Cocking, 1999). The communication with more knowledgeable others (parents, teachers, peers...) helps children construct an understanding of the concept. Furthermore, the dialogues that accompanied shared experiences gradually become a part of the children’s thinking (Vygotsky, 1978).

As she scaffolds instruction, the teacher provides assistance to her students, to accomplish tasks that any given student could complete on his/her own (Vygotsky, 1978). Effective questions can be used to provide some of this scaffolding for student learning, for example by asking students to clarify, elaborate, or justify their ideas. Qualifying questions can encourage deeper reflections on the concept and enhance students’ critical thinking skills (Walis & Sattes, 2005).

Methods
1. Participants
   - Three Pre-K teachers in three different schools in a small mid-Atlantic city.
   - White females, with teaching experiences of 7, 18, 25 years respectively.
   - A total of 47 at risk students, 4-5 years of age.

2. Data Collection
   - Classroom observations: two science activities per week across three different weeks, resulting in six science activities facilitated by each of the three teachers (a total of 18 instructional sessions ranging from 15 to 30 minutes in length).
   - Teacher interviews: elicited each teacher’s perceptions of her instructional strategies involving open-ended and closed-ended questions, situational factors affecting her decisions on what type of questions to use, and her experiences with the students’ responses to open-ended and closed-ended questions.

3. Materials
   - MyTeachingPartner Math-Science (MTP-MS) curricula (Kinzie et al., 2009). The three weeks selected for analysis focused upon Wind (earth science), Seeds (life science), and Sliding Motion (physical science).

Results
1. 1. Teachers’ questions and classroom contexts
   - Teachers used substantially more closed-ended than open-ended opportunities in their science instruction. Their use of open-ended questions accounted for 67% of their total utterances and 36% of the total number of questions teachers posed.
   - In contrast, closed-ended questions were employed more frequently, representing 18% of the teachers’ total utterances and 65% of their total questions.

2. Frequency of open-ended and closed-ended questions by types of activities
   - 1.04.
   - 1.29.
   - 1.23.
   - 1.04.

3. Language use in students’ responses
   - Open-ended questions were more likely to elicit student responses employing a vocabulary and sentence structure more complex than close-ended questions. In contrast, closed-ended questions elicited shorter responses, often single words, expressing a limited range of vocabulary.

4. Discussions
   - Recommendations for Teaching Practice
     - There is a need for teacher support regarding the effective use of open-ended questions in science book reading and skills practice. Testing activities after starting off with closed-ended questions (e.g., How did you find out?)