Inquiry in the kindergarten science:
Helping kindergarten teachers to implement inquiry-based teaching

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Abstract: Twenty kindergarten in-service teachers participated in a 25hr professional development program (PDP) supporting the development of abilities for identifying and responding to students’ in-class inquiry. Each teacher taught a science lesson at the beginning and at the end of the PDP. These were videotaped and analyzed in terms of the student inquiry the teachers responded to. Findings suggest that average student talk duration increased and students’ leads were increasingly used to guide lesson flow. Teachers increased responses to students’ reasoning and logic, offered more clarifications to students’ ideas and reasoning, and decreased evaluations of students’ ideas. However, teacher responses to knowledge claims increased and those to everyday experiences decreased.

Theoretical Framework
Scientific literacy includes more than just understanding the concepts of science. Current science education reform efforts, both in Europe and USA, emphasize promoting inquiry in science education (EC, 2007; NRC, 2007). Several studies (e.g., Boulter & Gilbert, 1996; Chin, 2006; Louca, Tzialli & Zacharia, in press), have emphasized the teacher’s role in promoting inquiry in the classroom when considering that inquiry-based teaching involves a complex process of adjusting teacher questioning based on the evaluation of the classroom discourse (e.g., van Zee & Minstrell, 1997). The ability to adapt instruction during teaching requires that teachers are able to notice and respond to aspects of classroom-based student inquiry (van Es & Sherin, 2002). To do so, teachers need to be able to listen to their students (van Zee & Minstrell, 1997), indentify elements of inquiry, and decide how best to proceed based on an evaluation of what they have identified (Louca, Tzialli & Zacharia, in press). We refer to these abilities as “teacher noticing and responding” (TNR). By “noticing” we refer to teachers’ abilities to attend to and reason about student inquiry as this takes place during instruction. “Responding” refers to teachers’ abilities to evaluate specific classroom exchanges and decide which teaching strategy is most appropriate for supporting each case of student inquiry (van Zee & Minstrel, 1997; Louca, Tzialli & Zacharia, in press). Developing TNR abilities depends largely on teachers’ initial preparation and subsequent professional development in teaching science, although, TNR abilities have not traditionally been part of teacher preparation programs for science teaching (e.g., Fleer & Hardy, 2001; Freese, 2006).

To address this need we developed a professional development program (PDP) aiming to help kindergarten teachers develop a range of teaching strategies to support students’ scientific inquiry. Our PDP had three distinctive parts. The first part introduced teachers to the aspects of scientific inquiry and inquiry-based teaching and learning in kindergarten science education. The second part focused on helping teachers develop and implement inquiry-based lesson plans in kindergarten science. The third part involved reflecting on video clips of each others’ lessons illustrating student inquiry and teachers’ responses. More information about our PDP can be found at http://prescience.co.uk/s-team/course/view.php?id=37. Our purpose in this paper was to investigate the possible impact of the PDP on the teaching of 20 in-service kindergarten teachers in Cyprus.

Methodology
Each of the 20 participating teachers taught two science lessons: one at the beginning of the seminar and another one at the end of the seminar. The first lesson was on a topic that none of the teachers had taught before, the phases of the moon. The topic of the second lesson was chosen by individual teachers and was part of the national curriculum for preschool science. Teachers collaborated with the first author to revise lessons, where necessary, to reflect more authentic inquiry practices for young learners. Transcripts of videotaped lessons served as the primary data source. We analyzed whole-classroom conversations in terms of (a) the time spent on teacher and student talking, (b) the student inquiry to which the teachers responded, and (c) how they responded to those elements. Analyses (b) and (c) were based on a coding scheme that we have developed elsewhere (Louca, Tzialli & Zacharia, in press).

Findings
During their first lesson teachers talked for a slightly larger portion of the lesson (average talk: 51.8%; average utterance duration 16 sec) compared to students (average talk: 48.2%; average utterance duration 5 sec). On
average teachers responded to (i) knowledge claims (67.9% average of the total utterances coded), (ii) scientific reasoning and logic (8%), (iii) everyday experiences (22.6%), (iv) epistemologies (0%), and (v) the direction of the conversation (1.5%). Teachers responded to their students’ ideas by prompts (35.3% of the total utterances coded), clarifications (36.9%), evaluations (12.4%) and restatements of students’ ideas (15.4%). In an average, 59.8% of the utterances coded, teachers seemed to follow the sequence of activities they had planned for their lessons, paying little attention to students’ responses which might guide their lesson in a different direction.

During the second lessons teachers spent a similar portion of the lesson talking (teacher average talk: 52.4%; student average talk: 47.6%) as in the first lesson. However, average teacher utterance duration increased (12s) and average student utterance duration increased (8 sec). Teachers responded to (i) knowledge claims (81.9%), (ii) scientific reasoning and logic (12.4%), (iii) everyday experiences (4.5%), (iv) epistemologies (0%), and (v) the direction of the conversation (1.2%). Moreover, in their second lesson teachers responded to their students’ inquiry using prompts (37.8%), restatements of student ideas (16.7%), clarifications (38%) and evaluations of students’ ideas (7.5%). In an average 42.2% of the utterances coded, teachers followed the sequence of activities they had planned for, paying little attention to students’ responses, whereas for 57.2% of the utterances coded, teachers allowed their students’ responses to guide their activities’ sequence.

Conclusions and implications
Overall, our findings suggest that by the end of the PDP teachers refrained from evaluating their students’ ideas and reasoning; rather they clarified student reasoning and ideas, possibly in an effort to make those ideas more accessible to the rest of the class, providing their students with more “space and time” to “talk” science. Also, the increase in teachers’ attention to knowledge claims in the second lessons (from 67.9% to 81.9%), and the subsequence decrease in their attention to students’ everyday experiences (from 22.6% to 4.5%), possibly seemed to be related to the fact that for the first lessons’ topic, teachers experienced the process of collecting, assessing and interpreting observations of the moon for themselves during the PDP, thus indicating that there is probably a need for the local teaching community to directly experience more authentic inquiry. Additionally, the fact that lesson 2 was part of the official curriculum and was chosen by teachers themselves, possibly suggests that they felt comfortable teaching the topic, probably due to the fact that they had taught it numerous times in the past. This might have guided teachers in placing more emphasis on the content and knowledge claims in terms of the canonical body of established knowledge in science. Lastly, findings suggest a wide need for detailed studies regarding teacher cognition, in particular for the development of TNR abilities. Research has shown that experienced teachers may engage in these practices already, while TNR abilities in classroom interactions is something that is perceived as developing over time. In order to better support this development, further studies are needed for investigating how teachers develop TNR abilities.

References


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