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Creating Participatory Discourse for Teaching and Research in Early Childhood Science

Christina Siry

and

Diane E. Lang

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Abstract

This paper presents the results of a study conducted with second grade students and pre-service teachers. This study examined the possibilities for engaging children in critical discourse about their classroom science experiences. At the heart of this discussion lies the desire to provide a space for teachers and children to develop relationships and to explore the learning of science together. Findings include: (1) on-going, focused, critical dialogue between children and teachers supported children in developing agency in the classroom, and (2) on-going conversations created the opportunity for children to reveal their ways of knowing and developing interpretations of the practice of science.

Key words: elementary science education, cogenerative dialogue, early childhood science education, critical discourse.

Creating Participatory Discourse for Teaching and Research in Early Childhood Science

This paper presents the results of a study conducted with second grade students and pre-service teachers. The purpose of this study was to examine the possibilities for engaging children in critical discourse about their classroom science experiences. At the heart of this discussion lies the desire to provide a space for teachers and children to develop relationships and explore the learning of science together.

This research was completed in the context of a field-based science methods course that took place in a second grade classroom. In this course, elementary pre-service teachers collaborated to develop and coteach science lessons to children on a weekly basis. Coteaching in this context was ongoing, as pre-service teachers shared responsibility for teaching a ten-week unit that they have developed. During the lessons, all pre-service teachers, the classroom teacher and the first author, Christina, were present, active teachers in the classroom. In this way, teachers learn to teach “at the elbow” of experienced teachers (Roth & Tobin, 2002). Further, sharing responsibility for teaching facilitates pre-service teachers developing sense of themselves as professionals (Siry & Martin, in press). This course has been intentionally structured so that all the pre-service teachers in the course work together with the explicit purpose of learning to teach by teaching science, in an effort to emphasize the benefits of teaching science at the elementary level. Numerous news articles and policy reports during the past several years have stressed the lack of basic science education for children (e.g. Dillon, 2006; Schemo, 2006). The field-based methods course has been structured to support new teachers in developing an understanding of science that ideally leads to proficiency and comfort

with developing learning activities for students. It is our hope that this knowledge enables them to see the importance of science in the elementary classroom.

Building upon the coteaching experiences for pre-service teachers, Christina sought to facilitate opportunities for children to provide their perspectives about the teaching and learning of science to these pre-service teachers. Thus, in order to critically approach the learning of science with a second grade class, we created discussion groups with children that were structured as a *cogenerative dialogue* (Tobin & Roth, 2006). Cogenerative dialogues are conversations between stakeholders in an educational setting; teachers, students, researchers, administrators, and any other people that might have an interest in participating in dialogue designed to support the teaching and learning that takes place in a classroom. The purpose of these dialogues is to listen to, and learn from, the members of the group. In these structured discussions, a key motive is to “enact forms of culture that expand the agency of all participants and produce agreements on how to enact curricula differently in a classroom so as to afford improvements in the quality of teaching and learning” (Tobin & Roth, 2006, p. 88).

Cogenerative dialogues have been implemented in a variety of settings, and have been shown to transform the teaching and learning of science in a wide diversity of situations, including high schools and teacher education. In particular, cogenerative dialogues have resulted in expanded students roles (Elmesky & Tobin, 2005), served to resolve conflicts in classrooms (Martin, 2005), and have been demonstrated to facilitate professional development of in-service teachers (Martin & Scantlebury, 2009). While there are relatively few studies that examine their implementation at the elementary and early childhood level, it has been demonstrated that the use of cogenerative dialogues in elementary classrooms can address ethical issues that are inherent in classroom research settings (Stith, 2007). Our research is informed by these and

other studies that have demonstrated the value of cogenerative dialogue, and builds upon existing research to provide a space for children, pre-service teachers, and researchers to navigate ways to interact with the purpose of facilitating collective responsibility and critical discussion around the teaching of science at the early childhood and elementary level.

Theoretical Frameworks

We believe that an imperative for education is to deeply explore and consider the lived experiences of children. It is in the acknowledgement and consideration of the contextuality of learning and teaching that we see the unwavering necessity of including critical discussions and reflection into discussions of teaching and learning. Henry Giroux reminds us that in order for critical educators to "... make a case for the context-specific nature of teaching – a teaching that not only negotiates difference but takes seriously the imperative to make knowledge meaningful so that it might become critical and transformative - they must expand curricula" (2000, p. 133). The major goal of this study is to improve the learning of all participants in a field-based course – children, pre-service teachers, the in-service teacher, and the course instructor.

Our work is guided by cultural sociology as a framework for thinking about learning and teaching, and thus we acknowledge teaching and learning as forms of culture (Sewell, 1999). A central tenet of cultural sociology is the dialectical relationship between agency and structure, which is a foundational perspective of this work. Dialectical relationships acknowledge that there are parts to social existence that constitute the whole, and they cannot be separated. "When we look at human actions, they cannot be understood without simultaneously considering *agency* and *structure*, which therefore are like two sides of a coin" (Roth, 2005, p. xxi). This dialectical relationship refers to the concept that structures (schema and resources) afford agency (the power

to enact social life) and that in turn, agencies produce structures. This enables us to identify structures that may create or hinder opportunities for children to gain agency, and in turn, to consider how their agency can impact the structures of the classroom. In particular, this study examines the ways in which children's agency is afforded by the resources available, including the actions of others.

In this study, the concept of curricula has been expanded to include cogenerative dialogue as both a classroom approach to reflection and transformation as well as a research methodology. Cogenerative dialogues are more than just a conversation (Martin & Scantlebury, 2009); they are a form of collaborative analysis with the purpose of generating “local theory *together* and with *equal* levels of input” (Roth, 2005, p.126). In the field-based methods course, they create opportunities for teacher participants* and young children to discuss events that have occurred in the teaching of science in an effort to allow children and teachers to articulate their understandings of what has happened in the classroom. Cogenerative dialogue further provides for participants to decide on future actions together. They have been implemented in this project to provide for a shared responsibility for learning science and an opportunity for collective sense-making of science phenomena, in order to ultimately attempt to create participatory discourses for teaching and research.

We are constructing a pedagogy that speaks in the voice of the child, the teacher, and the pre-service teachers (Dahlberg, Moss & Pence, 1999; 2006). These collective perspectives are the heart of our research project. We embrace the perspective that the child and the teachers each construct knowledge and identity, both individually as well as collectively. Echoing Dahlberg, Moss, and Pence, we believe that the central purpose of this early childhood education project should be “enabling children to have the courage to think and act for themselves” (1999; 2006, p.

* “Teacher participants” is used to denote all teachers that participated in the cogenerative dialogues; the pre-service

123). Creating a space for science to be situated and dynamic in the everyday lives of children helps assure that issues at the center of the cogenerative dialogues are meaningful and address concept formation and use (Fleer & Raban, 2006).

By creating a shared responsibility in the cogenerative group, we seek to change the structure of power in the classroom, and to provide "...a theoretical space for examining the commonsense assumptions, practices and contradictions that shape daily life" (Giroux, 2000, p. 34). This study engaged pre-service teachers into the dialogue in order to expand the possibilities for establishing relationships and facilitating more in-depth conversations. We borrow a question from Viruru and Cannella (2001) and have asked "How does one co-construct a new kind of research with children that reflects their perspectives?" (p. 168). We believe that conducting research and informing teaching through children's perspectives is a liberating and transformative approach for researchers, teachers and children alike.

Mode of Inquiry

In order to provide a view of participants' experiences, this research utilizes critical ethnography (Carspecken, 1996) combined with the cogenerative dialogue groups. Critical ethnography gives meaning to the lived experiences of the participants, supports the growth of participants' agency, and ultimately serves to catalyze structural changes. Cogenerative dialogues actively involve children and draw on their lived experiences with a need for intersubjectivity and a development of shared understandings. They present the opportunity to analyze how knowledge is formed, and how it can be transformed. As a methodology, they foster critical reflection and expand the role of students. The notion of children as mere subjects in the education process becomes swept aside as the power dynamics shift to ask children about

the ways in which they perceive classroom experiences and their self-concept as learners. Their voices become a main focus of the teaching process as well as the research process. The combination of critical ethnography and cogenerative dialogue can serve to give voice to all participants, provide for collective responsibility, and lead to the implementation of action (Roth, 2005, p. 147).

The use of this approach emphasizes our regard for children as competent, capable, and effective reporters of their own experiences (Dockett & Perry, 2007, p. 60). These discussion groups emphasize the need to actively engage children in research and in the construction of their classroom experiences. The group works to share interpretations and co-construct meaning in ongoing weekly cogenerative dialogues. Cogenerative dialogues as a mode of inquiry illuminate different ontologies and the ways in which social life is enacted and perceived in classrooms (Tobin & Roth, 2006). While the focus of this study was on children's experiences and their growing understandings about learning science, the pre-service teachers were incorporated as part of the research design and as part of a parallel research focus on the use of coteaching and field-based science methods courses in elementary teacher education.

This research has been guided by Guba and Lincoln's authenticity criteria (1989), to ensure that the study is of high quality. Ensuring that our work meets these criteria means that it seeks to benefit those involved and leads to improvements in the future, and the criteria serve as central components in the data gathering, analysis, and interpretation. This is accomplished by ensuring a fair study that meets ontological, educative, catalytic and tactical authenticities. Ontological and educative authenticities raise the level of awareness by research participants and by those with whom they interact, and catalytic and tactical authenticities create the capacity for positive social change. In considering these criteria as they emerge through this study, our research seeks

to catalyze improvements in the experiences of the children and we are seeking to create research with human subjects that benefits those involved, and that leads to improvements as the research is enacted.

Setting and Participants

The study was conducted within the context of a field-based science methods course. The participants for this study included the 26 second-grade students, ages seven and eight years old, the ten pre-service teachers in the methods course who facilitated the science lessons as well as the cogenerative dialogue groups, and Christina, as the course instructor. The children attend an urban elementary school in the metropolitan New York area, and the pre-service teachers attend a small, private comprehensive college. Three of the pre-service teachers were enrolled in a BAT program in Childhood Education and the remaining seven were enrolled in a MAT program. The elementary school and the college are in a professional development school relationship, and it is through this partnership that the methods course has developed over the past five years.

The cogenerative dialogues occurred over ten weeks of the field-based science methods course. During this course, pre-service teachers developed and cotaught science lessons to the children with the support of the classroom teacher and the course instructor. This unit was developed to complement the teachers' existing curricula on plants, and our life cycle lessons focused on plant growth and decomposition. After each lesson, the adult participants worked in small groups with the children to enact cogenerative dialogue. There were five tables in the classroom, and in these discussion times there were generally five children seated with three adults. The children and adults shared discussion on a variety of topics related to the teaching and learning of science, and opening comments ranged from "You know what I liked today..."

to “I have an idea for next time”. Prior to the first cogenerative dialogue, the purpose of these conversations was explained to the children during a whole-class discussion, by the classroom teacher and Christina. The children were familiar with the structure of the methods course, as it had been a part of their classroom experience for a month by the time the dialogues began. It was explained to the children that teacher participants were interested in finding out how best to teach 2nd grade students science. Christina told the children, “You are the experts on being second grade students learning science. We want to hear all about what you think about what we are doing, and any thoughts or suggestions you have for us when we plan the future lessons we’ll be doing together”. The cogenerative dialogues began immediately after that conversation, and occurred weekly until the end of the semester.

Analysis

This study is an emergent qualitative study that utilized a design experiment approach (Brown, 1992). As such, the research evolved as the course unfolded and as changes were enacted from the cogenerative dialogues. The data sources include videotapes of all cogenerative dialogue sessions, transcripts, and student work samples. This study also draws on videotapes of classroom lessons to examine the possible relationships between cogenerative dialogues and children’s agency in the classroom. Conversation analysis was used to analyze the talk in the cogenerative dialogues and provides a focus on talk and gestures in order to examine the interactions of participants. Conversation analysis is used to focus on the semiotic resources that participants make available in an attempt to make sense of the ways in which interactions are put together in and through talk (Roth, 2005, p. 391).

Our data analysis was conducted individually as well as collaboratively. We approach this work through multiple lenses that overlap through our collaboration. The first author, Christina, was the instructor of the course and her research agenda includes a focus on the use of transformative pedagogies in pre-service elementary teacher education, particularly for the teaching of science. Her work examines the potentials for identity transformation and the development of group solidarity in collaborative, field-based science methods courses (Siry, 2009). The second author, Diane, is an instructor of similar field-based courses, visited the science field-based course as an observer, and has a research agenda that focuses on postmodern perspectives on early childhood and classroom discourse. We believe that our joint analysis of the project data brings two analytic frames and worldviews together. Ultimately, this provides critical perspectives of the role of cogenerative dialogues in providing opportunities for participatory discourse that sheds light on possibilities for increasing student agency and pre-service teachers' understandings of children's ways of knowing.

Two major findings have emerged through the analysis of the study data: (1) on-going, focused, critical dialogue between children and teachers supported children in developing agency in the classroom, and (2) on-going conversations created the opportunity for children to reveal their ways of knowing and developing interpretations of the practice of science. These findings are important for our work with preservice teachers and elementary students in that these experiences concretize children's discourse so that the preservice teachers can explore and address students' developing conceptions about the scientific world. Additionally, children are supported as valuable participants in their learning by being able to address the way that science is taught in their classrooms. The focus of this paper is on teaching children the skills of critical dialogue, and through this, supporting students in having the opportunity to explore and explain

how they know. However, this is not to say that content is not important – rather, simply that our focus in these conversations was on providing a space for student voice and to facilitate the practice of talking science.

In talking science with young children, we are not only engaging them as partners in conversation, but we are situating children as scientific investigators. Scientific explanations become co-constructed in the dynamic emergence of conversation. Through the reconceptualization of conversations between children and teachers as places of shared power, we are able to challenge “the notion of learning as an individual experience, and viewing learning as a group experience” (Iorio, 2006, p. 287). Thus, through this exploratory science talk, participants learn through social interaction and classrooms become places where young children are able to theorize about their observations of scientific phenomena.

Cogenerative Dialogue Expanded Students’ Agency

The children participating in the cogenerative dialogue demonstrated expanded agency throughout the semester. As discussions progressed over time, students presented questions and comments to the teachers that revealed students’ frustrations with classroom practices and suggestions for implementing changes in the teaching of science. The pre-service teachers worked together to plan a 10-week series of lessons that focused on a life science topic (the life cycle of pumpkin plant). In these lessons, it was a common occurrence for one pre-service teacher to facilitate a whole-class discussion prior to the children working with the remaining teachers in small groups. The pre-service teachers’ introductory discussions included a variety of open-ended questions, children’s books and games to engage the children in the topic they were to be exploring in the small groups. The following exchange took place after the third

lesson during a cogenerative dialogue. The participants in this discussion were the first author (Chris) one pre-service teacher (Terry¹) and three children (Juan, Marcos, and Teresa). They were seated around a table, and Terry asked the children to think about the teaching of science in the lessons thus far and give her advice on the teaching of science.

- Chris: ((turned toward the children)) You are the experts on being second graders...what do you think we should keep in mind when we are planning your lessons?
- Juan: We want lots of science.
- Chris: ((laughs)) ok.
- Juan: Yeah, but I don't know...maybe...we could do more time at the tables and not at the rug so much.
- Chris: Ok, so, we meet at the rug so that we can talk about the investigations we are going to do in science,
- Marcos: Yeah, I know.
- Chris: So, then how will we know when it is time to go to the tables? Because, once we go to the tables, it is hard sometimes to get everyone's attention again if we need to talk again as a group and it can be like an interruption.
- Marcos: Right. Well, you can look at me and you can know when I've got it.
- Chris: ((laughs)) Really?! That's very interesting. How will I know when you've got it?
- Marcos: Well, I make this face ((raises eyebrows and nods slowly))
- Chris: Oh...I see. So, that's how I'll know that Marcos is ready to move to the tables, but what about the rest of the kids?
- Juan: Well, I do this when I understand ((nods and smiles))
- Chris: ((turns to Teresa)) How about you? How will I know if I'm looking at 25 second graders when you are ready to move to the tables?
- Teresa: Well, I don't show it when I get something really...buuuut...when I have had enough, I get really wiggly.
- Chris: This is all very helpful. So, how can I put all this together to talk about with the rest of the teachers?
- Marcos: You can write down four words, Mrs. Professor, Write them down now. 'More tables. Less rug'. That's all you guys need to know really, we want more time at the tables with the science and less time at the rug listening about the science.

In this vignette, Juan, Marcos and Teresa clearly express their discomfort with spending long periods of time in whole class discussions ('on the rug'). This was a turning point for the pre-service teachers' understandings of how to facilitate the lessons they were developing for

¹ Pre-service teacher and students names are pseudonyms to protect participants' privacy.

learning about science. As the pre-service teachers were visitors to the class in many ways, they generally began their lessons by introducing the topic to the children ('on the rug') and then the children moved to the tables where they would participate in science investigations. Prior to this conversation, however, the pre-service teachers had been developing extensive activities to engage the children in the topic of the lesson. Motivating open-ended questions were combined with children's literature, whole-class discussion prompts, and games and songs. This conversation with Marcos, Teresa, and Juan, however, revealed the children's desires to spend more time interacting with the science investigations in small groups, and less time in whole class introductory activities. When the class regrouped as a whole again, Christina asked these three children to share with the others what they had discussed as a group, and then asked the rest of the class to share their opinions on the issue of time on the rug versus time at the tables. The class unanimously agreed that the time at the tables was more valuable, and as one girl stated "we always have to sit at the rug and talk when you aren't here. It's nice to do the good stuff at our tables when you're here".

This vignette is one example of the way in which the structure of the cogenerative dialogues provided the opportunity for students to increase their agency in the classroom. From this point on, preservice teachers ensured that time "on the rug" was brief and highly purposeful and regularly checked with the children about the balance of instructional experiences. Other examples range from more minor changes in the enacting of classroom routines and rituals, such as one group's decision to move all conversations to the rug, to students making suggestions for further inquiry, such as one groups' ideas for new ways to pursue learning the topics being presented outdoors.

Children Reveal their Ways of Interpreting Science

The children revealed to pre-service teachers their interpretations of science and their individual ways of knowing. These conversations provided the opportunity for pre-service teachers to listen to children as they made sense of their experiences in the science activities. The children commonly shared thoughts that were not what the pre-service teachers had anticipated, and this opened a space in later conversations between the pre-service teachers and Christina to explore what children say that reveals their understandings, and consider the ways in which we respond to children's comments that may not be aligned with adults' own conceptions of science.

The following interaction demonstrates an example of the different ways that children imagine knowledge and experience its creation that differs from the way many adults approach coming to know (Lang 2003). This exchange occurred after the seventh lesson in the classroom. In the previous lessons, students learned about seeds and seed growth. This included several lessons in which the students explored halved pumpkins and also watched change over time as the pumpkins began to decompose. During snack time, the children had eaten roasted pumpkin seeds and discussed the ways in which we use seeds for food. In this cogenerative dialogue, one of the students, Damian, was talking about a previous lesson with the people at his table. Diane was also at the table, and had not been present at the lesson he was discussing.

Diane: What did you learn about pumpkins during your science investigations?

Damian: Pumpkins have seeds.

Diane: How did you find that out?

Damian: They gave us the seeds, the pumpkin seeds, and we ate them. We got smarter about pumpkins from eating the seeds. That's how I learned about them.

In this conversation, Damian reveals his interpretation of how he has learned about pumpkins, and it is in this conversation that the pre-service teachers were later able to explore

the importance of being sensitive to young children's ways of knowing. Damian was supported through the cogenerative dialogues to verbalize his experiences as they related to the pumpkin seed, and through the participatory discourse that is supported in the cogenerative dialogues he was able to reveal his understandings and the pre-service teachers were able to analyze his contributions. In subsequent lessons we were able to talk to Damian directly and suggest more evidence-driven approaches to collecting data. In the following lesson, preservice teachers used graphic organizers, asked children to make specific observations, and revisited the prior lessons to discuss what the children had accomplished, and what they had learned about how pumpkins grow and change over time. Christina and pre-service teachers discussed in later conversations that while it may seem fantastic in many ways that his swallowing of a seed gave him knowledge, it could be one way in which he came to know something about the pumpkin. Multiple ways of meaning making for science phenomena can support students in further developing curiosity and serve as a segue to mainstream canonical concepts (Siry, Horowitz, Otulaja, Gillespie, Shady, & Augustin, 2008). Consequently as teachers of young children we need to be open to, and accepting of, these developing interpretations and prepared to support students in learning more canonical approaches and being able to draw from their own experiences and relate that to more conventional science vocabulary and concepts.

During the same lesson in which Damian revealed his thoughts on learning by eating pumpkin seeds, another group of students were investigating decomposing pumpkins. Small pumpkins had been halved two weeks earlier, and children had examine the pumpkins and learned about their different parts and purposes. These pumpkins were put into plastic baggies, and left outside to decompose. After two weeks they were brought back to the children for a lesson on decomposition, in which the following exchange occurred:

Brian: We are supposed to write down what we see, what we observe, on the chart.
 ((holding pencil)) So...what do you see?
 Ana: It's really squishy this time!
 Katherine: Yeah, there's lots of water in there...
 Brian: Where did the water come from?
 Diane: That's an interesting question.
 Katherine: ((nods head))
 Ana: Maybe it's like celery. You know, look at all these stringy pieces over here
 ((pointing to the bag)).When the structure was whole, it held the water in. Now,
 that the structure is falling apart, the water comes out. It's like celery, the stringy
 parts, when its all hanging together keeps the water inside. Now that it's been a
 while, it's all falling apart, and so the water and the stringy parts are separate,

In this vignette, the children are demonstrating their ability to relate the current investigation with personal knowledge (her knowledge of celery) and how it can help them to interpret the current situation. In considering the connections between this vignette and the ways that children revealed their ways of interpreting science, we see that Brian tries to use the tools of science. He focuses on structured note taking, and positions science as a way of asking questions. Ana in this vignette reveals developing structural thinking; her comments illustrate that she sees that structure and processes are related. Although she is not using the word decomposition, she is relating to a concept that had been taught at the introduction. Thus, these types of conversations around the learning of science, once laid out, allow the teacher to come back to the concepts and be able to come back and speak about their interpretations using scientific vocabulary.

Once this thinking is revealed, the teacher participants talked about what knowledge we hoped that they would gain through our lessons, and then planned lessons both that involved investigations to help children develop understandings and answer their questions, and develop questions. We believe that it is crucial to provide young children with a supported space to make public their "semi-scientific" understandings in order to be able to develop activities, both for and with them, to move towards more canonical science. If we do not create those spaces and

support the facilitation of this agency, children move forward with a closeted magical thinking at the same time that conventional science unfolds, and those two contradictory views create misconceptions that can last a lifetime.

The use of cogenerative dialogue in the early childhood / elementary classroom created a shared responsibility and a mutual focus for exploring the complexities of learning science. Critical conversations between children and teacher participants provided structures for children to be supported in developing their agency as valuable participants in the process of learning and exploring science phenomena. They provided opportunities for all participants to explore ways to co-develop future science activities and to examine the children's learning and the participants' growth and challenges in the classroom. Additionally, as voiced by the teacher participants in this class, being with others in the classroom with a shared goal provided mutual support and increased the teachers' feelings of confidence in themselves as teachers of science and supported new understandings about the ways in which young children learn and interpret science.

Educational Significance of the Study

There are three points of educational significance to be stressed from this study. The first point is the need to focus in early childhood and elementary education on facilitating a forum for young children to consider how they think about and learn science and to engage them in the ways of science and develop skills of inquiry. As children are provided with a space to talk about their own learning, they created meaningful learning experiences for the pre-service teachers who were participating with them in the cogenerative dialogues.

Second, we argue that teacher education programs need to deliberately provide such

opportunities for pre-service teachers to be able to engage in talk with children in authentic settings. A third implication of this study applies to the practice of teaching and the role of discussions of power and authority. This study emphasized the importance of a decentralization of power and the affirmation of student voices in the early childhood and elementary classroom. It helps us to develop classrooms that are more authentic in their approach and include the voice of the child as a serious driver of the curriculum.

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