Quality of talk between pre-school children solving subtracting problems

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ABSTRACT

This study focuses on pre-school children’s talk while they are solving subtracting problems with peers. In this study, a socio-cultural perspective is used. In a socio-cultural perspective, learning and knowing are situated at the intersection of individual and collective action, and learning is seen as an emergent property of involvement in cultural practices. To understand children's interaction and how they mediate their mathematical knowledge, important concepts used in this study are also collected from Bruner’s "Theory of representation". When the quality of talk between pre-school children could be related to disputational or cumulative talk the children do not exchange ideas and thereby do not develop their reasoning ability as much as they do when they are engaged in exploratory talk. Disputational talk and cumulative talk draw children's attention to procedural fluency or the concept of numbers. Depending on what representation forms are used by the children doing the explaining, the other children in the group are exposed to either the concept of numbers or procedural fluency.

Key words: Pre-school, collaborative work, mathematical competencies, quality of talk.

INTRODUCTION

Collaborative work with mathematical problems is a commonly used teaching method in several classrooms in Sweden. One of the difficulties for teachers is to observe the learning process of children who are working collaboratively. What do they discuss and how are they reasoning (Mercer, 2004)? Ross (1998) refers to the NCTM (National Council of Teachers of Mathematics) Commission on the Future of Standards questions concerning proof and mathematical reasoning: “One of the most important goals of mathematics courses is to teach children logical reasoning. This is a fundamental skill, not just a mathematical one. While science verifies through observation, mathematics verifies through logical reasoning. If reasoning ability is not developed in the children, then mathematics simply becomes a matter of following a set of procedures and mimicking examples without thought as to why they make sense.” Thus, reasoning seems to be a fundamental component of mathematics. The mathematics curriculum in pre-school and elementary school in Sweden has many components, but there is a strong emphasis on concepts of numbers and operations with numbers. From an international perspective, mathematics knowledge is defined as something more complex than concept of numbers and operations with numbers. Kilpatrick et al. (2001) argue for five strands which together build children's mathematical proficiency. In their report they discuss:

(i) Conceptual understanding: comprehension of mathematical concepts, operations, and relationships.
(ii) Procedural fluency: skill in carrying out procedures flexibly, accurately, efficiently, and appropriately.
(iii) Strategic competence: ability to formulate, represent, and solve mathematical problems.
(iv) Adaptive reasoning: capacity for logical thought, reflection, explanation, and justification.
(v) Productive disposition: habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy.

Looking at the curriculum in pre-school in Sweden, there are several goals related to mathematics that children should strive to. For instance, children are supposed to develop a rich and varied spoken language and the ability to communicate with others and to express their thoughts (Lpfö, 1998).

Develop their appreciation of the basic characteristics of the concept of number, measurement and form, as well as the ability to orient themselves in time and space, (Lpfö, 1998)

As can be seen, none of the objectives explicitly mentions children's adaptive reasoning although it is an important component in mathematical teaching and learning. The first goal focusing on communicative ability when expressing to others is similar to how adaptive reasoning is defined in Kilpatrick et al. (2001). Lithner (2000) discusses two aspects of reasoning (i) plausible reasoning, which is defined as reasoning based on mathematical properties of the involved components, (ii) reasoning based on established experiences from different learning environments such as everyday life and pre-school activities, which is mathematically superficial. It is an educational activity that enhances learning through active participation. Children discuss how to solve the problem and therefore they draw their attention to different mathematical skills such as logical thinking and communicative skills.

This study focuses on pre-school children's talk while they are solving subtracting problems with peers.

PEER COLLABORATION AND LEARNING MATHEMATICS

A teaching method discussed in the literature is peer collaboration work. The advantage of peer collaboration lies in the scaffolding process whereby children help each other advance. Giving and receiving help and explanations may widen their thinking skills, and verbalising can help children structure their thoughts (Leikin and Zaslavsky, 1997). This exchange may encourage children to engage in higher-order thinking (Becker and Selter, 1996). Children who work in small groups develop an understanding of themselves as well as others and learn that others have both strengths and weaknesses. Programmes that have attempted peer collaboration as a teaching method report good results, such as improved conceptual understanding and higher scores on problem-solving tasks (Goods and Gailbraith, 1996; Leikin and Zaslavsky, 1997). Research also shows that children working collaboratively achieve a combined higher performance output than children working individually (Samaha and De Lisi, 2000). However peer collaboration is not always associated with cognitive development (Doise and Mguny, 1984; Levin and Druyan, 1993; Tudge and Winterhoff, 1993). It was suggested that the peer collaborations' impact depend on a set of factors such as age (Hogan and Tudge, 1999), comparative ability level of partners (Garton and Pratt, 2001), motivation (Gabriele and Montecinos, 2001), confidence (Tudge et al., 1996), gender (Strough et al., 2001), and the task (Phelps and Damon, 1989). Several researchers (Rogoff, 1990; Samhan and De Lisi, 2000; Webb and Favier, 1999) argued that a key element of effective peer collaboration is the active exchange of ideas though verbal communication.

Theoretical perspective

In this study, a socio-cultural perspective is used. A socio-cultural perspective differs from many other established perspectives in its focus on broader activity systems or communities of practice (Lave, 1988). In a socio-cultural perspective, learning and knowing are situated at the intersection of individual and collective action, and learning is seen as an emergent property of involvement in cultural practices (Wenger, 1998). Studying situated knowing and understanding from a socio-cultural perspective, thus, implies that the learning outcome is dependent on the learning activities (Vygotsky, 1934, 1986; Wertsch, 1998). Forms of knowing are also embedded in, and mediated through language and the artefacts used in specific practices (Vygotsky, 1934, 1986; Volosinov, 1929, 1973; Wertsch, 1998). In this study, teachers and children use language in very different ways depending on their understanding of mathematics. Discursive contributions to group problems help children to advance, increasing their participation in mathematical speaking and thinking. Mercer (2004) found three distinctive ways of talking and thinking when children solve problems in a group:

(A) Disputational talk: Children's talk is characterized by disagreement and individual decision making. There are few attempts to offer constructive criticism and notably short exchanges consisting of assertions and counter-assertions.

(B) Cumulative talk: Children build positively but uncritically on what other children have said. It is characterized by repetitions, confirmations and elaboration.

(C) Exploratory talk: Children engage critically but constructively with each other's ideas. Statements and suggestions are presented for shared consideration.

Mercer (2004) argued that the actual talking that goes on in any collaborative educational activity can be analysed on different levels, a) a linguistic level (What kind of speech acts do the children perform?, What topics are discussed?), b) a psychological level (How do the children interact?,
What kinds of rules are they following?), and c) a cultural level (In what context is the talk accomplished?). The activities and the communities of practice build upon each other (Lave, 1988). The communities of practice or the context is the background against which mathematical activity is interpreted (Lerman, 2001; Wyndhamn, 2002). Thus, different activities create different contexts (Säljö, 2000). Interaction should therefore be seen as an activity system, a doorway into the mind that helps children to move forward in the zone of proximal development (Vygotsky, 1934, 1986). These activity systems are not distinguished from the cognitive processes that children produce within such a system (Säljö, 2000; Lerman, 2001; Mercer, 2004). Rojas-Drummond et al. (2001) argued that different types of interaction have different types of educational value for children (Samuelsson, 2008, 2010a, 2010b).

In the communication between children and teachers a ‘contract’ is established between the talkers, the teacher as the one asking questions and the children trying to respond (Hundeide, 2003). Together they established a framework for talking. In the sociocultural perspective, actions are mediated by the tools and resources children use. People are never in direct contact with the world, they are always mediating their action with tools or resources (Vygotsky, 1934, 1986). To understand children’s interaction and how they mediate their mathematical knowledge, important concepts used in this study is also collected from Bruner’s “Theory of representation”. Bruner’s (1966, 1978) theory is connected to cognitive development of the individual and described three modes of representing the world, via action (enactive), via internal or external pictures (iconic) or via symbols based on a code (symbolic).

Aim of the study

The aim of the study was to investigate how children in preschool interact, solving subtracting problems in small groups. The research questions were:

(a) What quality has the talk children use working together with subtracting problems in pre-school?
(b) How do pre-school children represent their mathematical knowledge working together with subtracting problems in pre-school?
(c) What mathematical knowledge can pre-school children learn working together with subtracting problems in pre-school?

METHODS

Participant

The present study was conducted in two pre-schools with four teachers and 46 children; 22 girls and 24 boys (aged 4-5 years). This study is a part of a greater research program where the researchers try to describe analyses and understand the mathematical affordances in pre-school activities. These pre-schools recruit children from a part of Sweden with different nationalities and socioeconomic backgrounds. Fourteen of the children do not have Swedish as their first language. The teacher involved in this study had more than twenty years of professional experience as a pre-school teacher.

Empirical material

The empirical material in this study consists of twenty-two video recorded mathematical discussions between pre-school children and their teacher. Each of the recorded sessions lasted between 20 and 40 min. In total, the data amounts to 9 h and 14 min (where pre-school children collectively discuss how to solve a subtracting problem). The teachers in both pre-schools often use video cameras for documentation of activities. As a consequence, the children did not mind being filmed. The children were clustered into groups of three or four children and one teacher. The groups were organized by the teacher who knew all the children and therefore could cluster the children in sensible way.

Analysis

As has been said earlier, the interaction between the preschool children and the teacher was videotaped and later transcribed. The transcribed talk has been analyzed with a sociocultural discourse analysis. A sociocultural discourse analysis focuses on the language’s functions for the pursuit of joint activity (Mercer, 1996). The analyses have focused on the linguistic level (Mercer, 1996), the psychological level (Mercer, 1996), the representations used in the interaction (Bruner, 1966, 1978) and how the talk draw attention to learning that children later can demonstrate (Rojas-Drummond et al., 2001).

Ethical considerations

The ethical guidelines of the Swedish Research Council have been followed. All caregivers gave their permission to let us film their children. The teachers also gave their permission to be filmed.

RESULTS

In this study, the answers to the research questions are reported. Empirical excerpts are analyzed with respect to the research questions a) What quality has the talk children
Cooperative activity offers opportunities for learners practicing and developing ways of speaking and reasoning with language. Encouraging talk between learners may help the development of understanding. Different talk and collaboration also provides dissimilar opportunities to learn. Communication between learners focuses on different content as well as different cognitive processes and thereby provides learners with different educational values. When the material from the video observations was analyzed, six different types of talk dominated the conversation: Disputational talk and no representation, disputational talk and enactive representation, cumulative talk and enactive/ iconic representation, cumulative talk and iconic representation and exploratory talk and iconic representation. The conversation types are conceptualized with respect to the quality of talk and how children represent their mathematical thoughts. In relation to all presented types of talk, an interpretation of what mathematics competence, the different kinds of exchange draw the attention to.

**Disputational talk and no representation**

In this study, the teacher (Ewa) read a text presenting the problem to the children (John, Andy and Nick). The teacher (in turn 1) introduces the problem. The children respond by guessing. No one tries to understand why their peers give different answers.

1. Ewa: One day there are only five dwarfs working in the mine. The rest of the dwarfs are at home baking. How many dwarfs are at home?
2. John: Four
3. Andy: Two
4. John: Five
5. Ewa: How many dwarfs went to the mine?
6. Andy: Five
7. Ewa: Correct so how many dwarfs stayed at home baking?
8. John: It must be seven or eight
10. Ewa: How many dwarfs are there?
11. Nick: Seven
12. Ewa: If five went to the mine do you think it is reasonable that seven or eight stayed at home baking?
13. Andy: No six and seven stayed at home
14. John: Four
15. Ewa: No, two stayed at home baking

One of the children, Andy, gives the correct answer to the subtracting problem (in turn 3). Instead of following up Andy answer and asking all asking how they have solved the problem the teacher repeat the same question again (in turn 5). Once again the children start guessing; not listening or try to understand each other or the problem. John (turn 8) and Nick (turn 9) give answers that imply that they maybe do not know what they are doing. They guess that more than seven dwarfs stayed at home although five out of seven went to the mine. Maybe John and Andy have the same thinking procedure but John counts wrong. Andy who gave the correct answer in turn 3 argue that dwarf six and dwarf seven stayed at home. For Andy (and maybe for John) each dwarf got a number, he knows that two dwarfs stayed at home (turn 3) and the two who stayed at home are dwarf 6 and 7.

The educational value in the earlier presented exchange is not obvious. The exchange involves no arguing, description of their solution and no counting in public. Maybe the only thing this conversation support is that children learn that mathematics is a competitive subject. By guessing without any reflections they could learn that in mathematics it is important to give the correct answer quickly.

**Disputational talk and enactive representation**

In this study, the teacher discusses with another group of children. This excerpt starts with one child giving an answer, four, and show four fingers in the air. One of the other children (Elias) does not seem to be satisfied with the answer Eric gave and he looks around for reactions from someone else. The teacher repeats Eric’s answer with a puzzled look trying to get the children to think once again. Elias asks how many dwarfs there where, and when Ewa answers seven he starts count with his fingers. He says five and show one hands fingers. Before he finishes his counting Eric interrupts him (turn 21).

16. Eric: Four (Shows one, two, three, four fingers in the air. One of the children Elias with a puzzled look).
17. Ewa: Four?
18. Elias: Wait, how many where they?
19. Eva: Seven
20. Elias: One, two, three, four and five (Shows the left hand’s fingers, and tries to count on his right hand)
21. Eric: No, then it is six.
22. Elias: Then it is six (Shows one finger from his right hand in the air).
23. Ewa: Is there six dwarfs at home and five working in the mine?
24. Elias: Mmmmm
25. Eric: No they are five at home
26. Ewa: If five goes to the mine???
27. Eric: Yes, they are five at home
28. Elias: Five (Tries to count on his fingers again)  
29. Eric: No, it is four. Because they are only seven  
30. Ewa: Mmm, is it four then?  
31. Eric: Or five, it is four or five  
32. Ewa: Okey, what do you think (Looking at Elias)  
33. Elias: I don’t know  
34. Ewa: Let us do this. Show me both your hands.  
35. Eric: No, no, no, two hands are ten fingers.

This exchange between teacher and children is characterized by disagreement and individual decision making. Elias try to think (turn, 20, 28) but he is interrupted by Eric several times (turn, 21, 29, 31) and not fully supported by the teacher. He also tries to show his thinking by counting up with his fingers, an action interpreted as an enactive representation. By counting with his fingers he practices his procedural fluency. The conversation is not characterized by confirmation and trust in each other’s thinking. When the teacher tries to draw attention to Elias way of handling the problem (turn, 32), Elias is not interested to show how he thinks or maybe he is not sure if his thinking is correct. He has lost his motivation to contribute to the problem solving process.

Cumulative talk and enactive/iconic representation

In this, third excerpt, the teacher Ewa discusses the problem with two children André and Anna. The exchange starts with André’s thinking loud. The teacher clarifies that there were five dwarfs that went to the mine. André immediately gives the correct answer. Ewa provides him no attention or response, instead she asks what the other children think. Then Anna confirms André’s suggestion and shows a representation of how she thinks. She shows five fingers on one hand and two fingers on the other hand. This could be interpreted as an action, an enactive representation, but also as an iconic representation. Since Anna shows two distinctive groups, one five-group and one two-group it is possible to understand that representation as an iconic representation. The number seven is divided into two and five, numbers that are number friends with seven (In Sweden we call numbers that together are another number for number friends. Number friends to number seven are for instance 1 and 6, 2 and 5, 3 and 4).

36. André: Five …six, no four!  
37. Ewa: There five dwarfs that went to the mine.  
38. André: There were two dwarfs left. (André gets no response)  
39. Ewa: What do you think? (The teacher asks the other children)  
40. Anna: Same as André, there were two dwarfs at home (Shows five fingers on her left hand and two fingers on her right hand).  
41. André: Ahhh

42. Anna: I did like this. Five were in the mine (raise her left hand and show five fingers) and they were seven dwarfs and then there were two at home (show two fingers on her right hand), and then it became one, two, three, four, five, six, seven (counting when she is nodding at each finger she shows).  
43. Gustav: I did exactly the same but I used my other hand (Shows five fingers on his right hand and two fingers on his left hand).  
44. André: One, two, three, four, five, six, seven. (André counts his fingers and shows seven fingers in the air). I told you so!  
45. Ewa: Is that all dwarfs?  
46. André: Yes, look 5 plus 2.  
47. Anna: Yes it is seven  
48. André: Five plus two is seven (Waving with his fingers)

In the presented excerpt, the children repeat and confirm other children’s suggestions (turn 40, 43, 44, 46, 47 and 48). All children contribute to construct a “common knowledge” by explaining how they are thinking. Ideas and information are shared and joint decisions are reached (turn 47, 48). There is little in the way of challenging each other. No constructive conflict occurs in the discussion where the children and the teacher try to construct a common knowledge. When the children try representing the number seven in an iconic way (five plus two fingers), they draw the attention to the concept of numbers. The educational value in that kind of exchange could be the opportunity to learn procedural fluency and concept of numbers.

Cumulative talk and iconic representation

In the earlier presented excerpt, the children use their fingers to represent their thinking when they describe how they solved the subtracting problem. In next excerpt, the children work with blocks as manipulative material. The exchange starts with Ben who suggests that there are three dwarfs at home. He takes four blocks and put them in one group and then he takes three blocks and put them in another group. The teacher can see that there is something wrong with Bens representation and ask again how many dwarfs that went to the mine. Ben says five and count the blocks in the first pile. He discovers that he has put too few blocks in the first pile and adds one block into the group. Bella confirms his changes (turn 55).

49. Ben: Five… Then it is three dwarfs baking (Splits a large group to two smaller groups with four and three blocks in each group).  
50. Eva: Okey. How many dwarfs went to the mine?  
51. Ben: Five! One, two, three, four (Ben counts the blocks in his first group and finds that one block is missing, so he adds one and got 5+3 blocks).
The exchanges seem to be aimed at the attainment of agreement. Ben and Bella try to solve the problem together, in a way that satisfies both of them. Ben tries to argue for his solution representing his thinking by splitting seven blocks into two smaller piles. The pile of blocks represents an external picture of his thinking. In turn 52 and 55, it is obvious that Bella is supported by Bens elaboration with the blocks when she argues against (turn 52) and confirms (turn 55) Bens suggestions. She sees that there are too many blocks and she points at the pile of blocks when she approves Bens answer. The external picture of how you could divide a number into two parts draws children’s attention to concept of numbers and in procedural fluency.

**Exploratory talk and iconic representation**

In the last excerpt, Sofie and Åsa begin the exchange with varied answers. Åsa is not satisfied with Sofies answer, and she wonders how Sofie found out her answer. Sofie pick up five blocks and says that there were five dwarfs that went to the mine. Then she picks up two blocks, counting six and seven loud to illustrate that two dwarfs stayed at home. Åsa also wants to show how she solved the subtraction and pick up four blocks to one pile and three blocks to a second pile. The teacher, who sees that Åsa does something wrong, when she splits the blocks into two piles, asks if the result of the procedure is correct and points at the piles. Before Åsa has a chance to answer, a boy, Anders says no. Åsa, who does not understand, wonders why it is not okay. Anders points at one pile and says that there are too few blocks in the pile that symbolize the dwarfs that went to the mine. Åsa tries to argue that her solution contains seven blocks which is equal with the number of dwarfs. Then Sofie shows how the blocks should be divided.

**Summary**

Different ways of talking and different ways of representing mathematics permit certain social modes of thinking. The earlier presented modes of thinking are developed in qualitatively different collaborative relationships. Table 1 summarize the results. The results will be summarized with respect to a linguistic level (L), a psychological level (P), a representation level (R) and the educational value of the exchange (E)

**DISCUSSION**

The aim of this study was to investigate how children in pre-school interact, solving subtracting problems in small groups. There was a hypothesis that the advantage of peer collaboration lies in the scaffolding process whereby children help each other advance. By verbalizing their opinions the children help each other to structure their thoughts (Leiken and Zasavsky, 1997). These exchanges inspire children to involve in higher-order thinking (Becker and Selter, 1996). In this study, it was shown that the qualities of exchanges were important to what the children were exposed to and thereby able to appropriate. It was found that pre-school children were involved in different types of talk with different educational value and used different representations solving subtraction problems in groups.

**The quality of talk and educational value**

Working in small groups is a commonly used teaching method where children can develop a fundamental
Five went to the mine

Two stayed at home, dwarf 6 and 7

**Figure 1.** Illustration of subtracting 7-5=6 and 7.

**Table 1.** Quality of talk between pre-school children solving subtracting problems.

<table>
<thead>
<tr>
<th>Representation</th>
<th>Disputational talk</th>
<th>Cumulative talk</th>
<th>Exploratory talk</th>
</tr>
</thead>
<tbody>
<tr>
<td>No representation</td>
<td>(L) Assertions and counter-assertion without any foundation</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>(P) Competitive, information is flaunted</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(R) No representations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(E) Learn to compete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enactive representation</td>
<td>(L) Assertions and counter-assertion</td>
<td>(L) Repetition and elaboration</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>(P) Competitive, information is flaunted</td>
<td>(P) Solidarity, trust, repetition and trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(R) Count fingers</td>
<td>(R) Count fingers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(E) Learn to compete, use fingers when counting, procedural fluency</td>
<td>(E) Listen and contribute, use fingers when counting, procedural fluency</td>
<td></td>
</tr>
<tr>
<td>Iconic representation</td>
<td>(L) Assertions and counter-assertion</td>
<td>(L) Repetition and elaboration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(P) Competitive, information is flaunted</td>
<td>(P) Solidarity, trust, repetition and trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(R) Show external pictures of numbers with the fingers</td>
<td>(R) Show external pictures of numbers with the fingers or blocks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(E) Learn to compete, use fingers when illustrating numbers, concept of numbers, procedural fluency</td>
<td>(E) Listen and contribute, use external material illustrating numbers concept of numbers, procedural fluency</td>
<td></td>
</tr>
<tr>
<td>Symbolic representation</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

component of mathematical knowledge as for instance adaptive reasoning (Ross, 1998; Kilpatrick et al., 2001). Thus, the peer collaborations impact on mathematics learning depends on several factors such as age (Hogan and Tudge, 1999) and task (Phelps and Damon, 1989). In this study, the children were the same age and worked with the same task, despite that, the quality of talk and thereby the educational value turned out to vary in the groups. One
The quality of talk and representation forms

The communities of practice is the background against which mathematical activity is understood (Lerman, 2001; Wyndhamn, 2002). Interaction should therefore be seen as an activity system, a doorway into the mind that helps children to move forward in the zone of proximal development (Vygotsky, 1934, 1986). Words and symbols used to communicate do not refer directly to reality but represent entities: objects, properties, relationships, processes, actions, and constructs, about which there is no automatic agreement between two persons. In this study, the children used different representation forms (enactive and iconic) to show their ways of thinking (Bruner, 1966; 1978). By counting up with their fingers, an action interpreted as an enactive representation (Bruner, 1966) the children try to explain practices procedural fluency and the other children are exposed to that mathematical competence. When the children used an iconic representation, pile of blocks or fingers representing different numbers, they expose the group of children to the knowledge that the number seven could be divided into two groups for instance two and five. Using iconic representation helps children to understand that numbers can be divided into smaller groups \(7=5+2\) and that the two numbers equals another number \(2+5=7\).

Didactical implications

The results in this study show how different quality of talk affects pre-school children’s mathematics achievement. Earlier research has shown that programmes that endeavoured peer collaboration as a teaching method reported good results (Goods and Gailbraith, 1996; Leiken and Zaslavsky, 1997). The specific contribution of this study is to clarify how different quality of talk affects different mathematical competencies. From a pre-school teacher’s perspective, when mathematics work is complex (Kilpatrick et al., 2001), it is essential to know how different quality of talk affect children’s different learning outcomes. Talks were children’s are able to exchange ideas seem to have an impact on children’s adaptive reasoning. This study gives evidence that collaborative work with mathematical problems in pre-school could be different activity systems exposing different cognitive processes (Säljö, 2000; Lerman, 2001; Mercer, 2004). This was also shown by Rojas-Drummond et al. (2001) who argued that different types of interaction have different types of educational value for children. The results in this study show that teachers’ settings of the problem and how they manage the interaction processes in the group are important to what competencies children are exposed to and what they thereby are able to learn.

REFERENCES


