THE CONSTRUCTION OF WORD MEANING IN A MULTICULTURAL CLASSROOM TALK AND COLLABORATION DURING MATHEMATICS LESSONS

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Abstract. *This paper concerns the construction of word meaning by students during collaboration in a multicultural classroom at a Dutch primary school. The analysis is based on recordings of student talk in small groups of four or five students during mathematics lessons. The tasks which students had to solve consisted of realistic math problems. These tasks contained words that were unfamiliar to minority students for whom Dutch is their second language. In the groups with both Dutch and minority students, the Dutch children helped the minority children to overcome language problems. However, the Dutch students did not elucidate the meaning of the unfamiliar words but gave minimal information, often by gestures, which was just sufficient for minority students to solve the task. In the groups with only minority students, the students sometimes deduced the meaning from the text or from the accompanying picture. At other times, one of the minority students claimed to know the meaning of a word, but this claim was not always justified.*

Introduction

We do not know of any research in the field of mathematics education that deals with the question how children, who work in collaborating groups, handle language difficulties. Such research as there is on language problems in multicultural math classrooms examines interaction between students and teachers rather than interaction among students (Gibbons, 1998; Setati, 1998; Moschkovich, 1999). In the mathematics classroom, both the textbook and the teacher assume that children understand the words used in tasks and assignments -- an assumption that is clearly wrong. Van den Boer (2001) documented that during classroom interaction children rarely ask a teacher to clarify words they do not know (cf. Elbers, 1986). Our observations demonstrate that children working together in groups at solving mathematical problems do ask each other about the meaning of unfamiliar words. This is clearly an advantage of collaborative work in the classroom.

The study: school, participants and observations

We have been involved for some time in a project in a multi-ethnic primary school in Utrecht, the Netherlands. The objective of this project is to analyse interaction and collaboration among students during mathematics lessons (Elbers & De Haan, in press). 80% of the school population is from an ethnic minority background, with mainly Moroccan and Turkish children. Although the school is not part of any educational experiment, it has an educational philosophy in which particular value is attached to collaboration. The teachers have been specially trained to stimulate

collaboration among the students. The teachers focus the students on talking together and on helping each other to understand the subject matter.

In this presentation we will present observations from mathematics lessons in the seventh grade. There are 22 children in this classroom: 5 students are native Dutch (one of them has a Dutch father and a Czech mother), and 17 students have other backgrounds: 12 Moroccan, 3 Turkish, 1 from Yugoslavia, and 1 from Ghana. The Moroccan and Turkish students are second generation children: their parents are immigrants, but the children themselves were born in the Netherlands. The children from Yugoslavia and Ghana are from families that recently came to the Netherlands as refugees. The children are between ten and thirteen years of age, most of them are eleven (mean age 11,07). Some Moroccan children are older than usual in this grade, because they have spent a year in Morocco and therefore have lost a year in the Dutch school system.

In the classroom the children are seated in groups of four or five, and they each have their own place. The arrangement of the tables is such that children can talk and work together easily. According to the teacher's clarification, the groups have been put together in such a way that there is a combination of good collaboration and order and quiet. Table 1 shows the composition of the five groups (see Table 1).

Table 1. The composition of the groups

Group 1	Group 2	Group 3
Feliz (Turkish girl)	Ferit (Moroccan boy)	Annelies (Dutch girl)
Samira (Moroccan girl)	Fouzia (Moroccan girl)	Berend (Dutch boy)
Assad (Moroccan boy)	Ilham (Moroccan girl)	Goran (Yugoslavian boy)
Hassan (Moroccan boy)	Zakaria (Moroccan boy)	Maktoub (Moroccan boy)

Group 4	Group 5
Abdel (Moroccan boy)	Chantal (Dutch girl)
Fahd (Turkish boy)	Daniëlle (Dutch/Czech girl)
Ikram (Moroccan girl)	Farouk (Moroccan boy)
Françoise (Ghanaian girl)	Mimoun (Moroccan boy)
Lonneke (Dutch girl)	Yalcin (Turkish boy)

The common procedure in this classroom is that the teacher explains a subject to the whole class, and then tells the children to do their work, for instance to solve tasks from their textbook, and to do it in collaboration with the other students in their group. She tells the children to "think together" and "do it together". Moreover, the students are told to solve the problems in a logical way; that means in a way that is

mathematically adequate. Children who have understood the problem are supposed to help other children and to explain their solutions to them. It is not enough when one child tells others that their solution is not right. The teacher makes it clear that children should contribute to their classmates' understanding by listening to them, explaining their own solution, asking questions, discussing solutions. During the collaboration phase, the teacher walks around the classroom, occasionally helping students and asking them to explain to her what they are doing.

Our observations are part of a larger study we have conducted during mathematics lessons in a seventh and a eighth grade classroom. For the current presentation we have selected four lessons from a larger corpus of data collected in the seventh grade class. The analysis is based on video and audio recordings of children's conversations during the lessons. Since each mathematics lesson takes approximately one hour, our analysis covers twenty hours of recordings (five groups with four lessons of one hour). A video camera was placed in one corner of the classroom to give an overview of what happened during the lesson. The children's conversations were recorded with small tape recorders placed on one of the tables in each group. We transcribed the audio recordings of these lessons and used these transcripts as the main source for our analyses. We expect to present analyses of more lessons before long. The subjects in these mathematics lessons were the calculation of area and volume, the transformation of measures of area and volume, co-ordinates and working with a calculator. Mathematics teaching in the Netherlands has been influenced by Hans Freudenthal's idea of Realistic Mathematics Education (Freudenthal, 1991). Realistic contexts played an important role in the problems the students had to solve.

In another paper we analysed the modes of collaboration in the groups (Elbers & De Haan, in press). In the present paper we want to study language problems which children might have in working together at the assignments. We read the transcripts and selected all situations in which the children discussed the meaning of words or expressions or in which one or more children expressed unfamiliarity with a term or expression. We checked (and, if necessary, corrected) the transcripts of these passages by listening again to the sound recording made of the discussion in the group.

Results

Difficulties with specific terms and contexts frequently arose in the work of the groups. These language problems were the subject of discussion among the students. Sometimes, children explicitly told the others that they did not know a term or an expression; they even asked them to explain them the meaning of the term or expression. At other times, children, in their work, built on wrong assumptions about the meaning of a word, and were, in some cases, corrected by others. Table 2 gives an overview of the language difficulties in the groups. One of these difficulties concerned a specific mathematical term: volume.

Table 2. Problems with specific words in the five groups.

	Group 1	Group 2	Group 3	Group 4	Group 5
Pavement					X
Carpet tile	X	X		X	X
Telephone book		X	X	X	X
Slices of bread			X		
Rye bread		X	X	X	
Lot	X				X
Beech		X	X		
Volume				X	X

As an illustration we will discuss the students' discussions around 'rye bread'. The task demanded of students to make a spatial representation of a pile of packets of rye bread. The picture accompanying the task (see Figure 1) shows a shop assistant in a bakery. The illustrator has drawn various types of bread, French baguettes, and several loaves, rolls and buns. The task focuses on the number of packets of rye bread piled up in the right of the picture. In the Netherlands, one way of selling rye bread is sliced in packets. All Dutch children know what rye bread is and how it is sold. The task is, firstly, to calculate the number of packets in the pile (part A of the task) and, secondly, to calculate the value of the pile, if one packet costs Dfl. 1.98 (part B of the task). The difficulty for some of the minority children is that they do not know what rye bread is and are unfamiliar with the way it is sold. The term 'rye bread' poses problems in groups 2, 3 and 4.

Figure 1. "In a corner of the shop a shop assistant makes a pile of packets of rye bread. The pile is six packets high in the center. Downwards, the pile gets broader and broader. The pile looks like you see it in the picture. A. How many packets of rye bread are in the pile? B. If one packet costs one guilder ninety eight, what does the whole pile cost?" Reproduced (with permission) from De Wereld in Getallen, Rekenboek 5b. Den Bosch, Malmberg, (n.d.), page 164.

We will illustrate the difficulties and the way children dealt with them by presenting interaction episodes about the rye bread. The teacher introduced the task briefly in a whole class interaction. During her introduction she read the task aloud, held up the book showing the picture that belonged to the task and pointed to the pile of packets of rye bread in the picture. So, even the children who do not know the term 'rye bread' could basically know what part of the picture the task referred to.

The task did not pose problems in groups 1 and 5, however the term rye bread was discussed in groups 2, 3 and 4. We will present the relevant parts of the transcripts. Group 2 is a group with only minority children. Groups 3 and 4 have a mixed composition of minority and Dutch children. The Episodes concern parts of the transcripts which were translated by us from Dutch into English.

Episode 1: group 2 (6/6/00)

1) Fouzia: (reads). 'In a corner of the shop a shop assistant makes a pile of packets of rye bread. The pile is six packets in the centre. Downwards, the pile gets broader and broader. The pile looks like you see it on the picture.

a. How many packets of rye bread are in the pile?' This is what we have to do. 'If one packet costs one guilder ninety eight, what does the whole pile cost?' So, what do we do? We count the pile first.

2) Ferit: These?

3) Fouzia: And how many there are, that you must take times one guilder ninety eight.

4) Ferit: These?

5) Fouzia: These blocks

6) Ferit: But then..

7) Ilham: First we do a.

8) Fouzia: I know. How many packets of rye bread.

9) Ferit: How must we count?

10) Fouzia: I did not know that this was bread.

11) Ilham: These? These squares.

12) Fouzia: (laughs) Square bread. They sit down on it and it becomes square.

Three children participated in the conversation. Ferit and Ilham expressed their uncertainty about the task (lines 2 and 11). Fouzia showed the others what they were supposed to do. She did so in a self assured way, although later she made it clear that she did not know before that the packets on the picture refer to bread. That means that Fouzia deduced, either from the picture and the way the problem is formulated or

from the teacher's introduction, that it must be "these blocks" (line 5). From her expression of surprise that the packets are bread (line 10 and 12) we can conclude that she did not know the meaning of packets of rye bread before.

In group 3 the minority children asked the Dutch children to explain the meaning of rye bread.

Episode 2: group 3 (6/6/00)

1) Goran: (reading from the book). 'In a corner of the shop a shop assistant makes a pile of packets of rye bread. The pile is six packets in the centre. Downwards, the pile gets broader and broader. The pile looks like you see it on the picture.'

2) Annelies: Six packets

3) Maktoub: (reading). 'In a corner of the shop a shop assistant make a pile of packets of rye bread. The pile is six packets in the centre. Downwards, the pile gets broader and broader. The pile looks like you see it on the picture.'

4) Annelies: I don't understand. Pile? Downwards?

5) Maktoub: A. How many packets rye bread are there in the pile?

6) Annelies: (calculating) Seven

7) Maktoub: What is rye bread?

8) Annelies: That is ...

9) Goran: These?

10) Annelies: No.

11) Maktoub: It has been cut.

12) Annelies: No, rye bread can be brown.

13) Maktoub: Where are they?

14) Annelies: (calculating): 47, 25.

15) Maktoub: Here is ryebread, isn't that right?

16) Annelies: No, here, this pile, that is the rye bread.

17) Maktoub: These?

(...)

18) Maktoub: Berend, do you know where the bread is?

19) Annelies: Nine

20) Berend: Hey, you must have this large pile. Rye bread.

21) Maktoub: How many are in the pile?

22) Berend: Yes, that is what you must calculate.

This episode shows how the problem arose in group 3. The Moroccan student Maktoub and the Yugoslavian boy Goran did not know how to handle the task, because they were not familiar with rye bread. They turned to the Dutch students for an explanation. Maktoub (line 7) asked the other students to tell him what rye bread

is. Before Annelies could state her answer, Goran pointed to part of the picture (line 9). Annelies failed to make clear what rye bread is and Maktoub, pointing to a part of the picture, indicated the place where he assumed the rye bread is (line 15). Annelies told him that he is wrong and she showed him where the rye bread is (line 16). This was obviously not completely clear to Maktoub, for he asked for a confirmation (line 17), which Annelies did not give. Maktoub then turned to Berend and asked him if he knew where the rye bread is. Berend showed him the large pile (line 20). Maktoub asked him to confirm that this is what they have to calculate (line 21) and Berend did so (line 22).

Episode 3 shows a later part of the collaboration in the same group, when they started calculating the price of the packets of rye bread. Before doing, they repeated the answer of problem a, the number of packets (which is 286).

Episode 3: group 3 (6/6/00)

1) Annelies: At a we have ...

2) Goran: a, 286 slices rye bread

3) Annelies: No

4) Maktoub: No, 286 rye bread

5) Annelies: packets of rye bread

6) Goran(?): How many packets?

7) Berend: Hey and one packet of rye bread costs only one ninety eight.

8) Annelies: OK, it is fun what we are going to do.

9) Maktoub: b?

(...)

10) Annelies: is cheap, hey Berend. Wait a moment for them. (...) They have to understand it too, of course.

Although they had the right answer in mind, Maktoub and Goran did not succeed to formulate the solution in the correct way (lines 2 and 4). This can only mean that they were still uncertain about the meaning of 'packets of rye bread'. Annelies corrected these students and gave the right expression (lines 3 and 5).

In group 4, Francoise and Fahd expressed their unfamiliarity with rye bread. In this case the Moroccan girl Ikram and the Dutch girl Lonneke took the lead in working on the problem without explaining in an explicit way the meaning of rye bread. However, Ikram and Lonneke clarified the task to the other students by pointing to the picture, so that the others could join in the calculation. At the end, Ikram added that she has eaten rye bread only once and that she did not like it.

Discussion

The general trend of these observations is that, in the groups where rye bread is unfamiliar for some, children handle the difficulties with the packets of rye bread in a

purely pragmatic way. In group 3, the Dutch children do not elucidate the meaning of rye bread, nor do they give information that would make it possible for the minority children to grasp the context of the math problem. They only give the information that is strictly indispensible to solve the problem. They do so by pointing to the part of the picture where the packets of ryebread are to be found and by correcting incorrect formulations by Maktoub and Goran. In group 4, the language difficulties are solved in a comparable way.

In group 2, interestingly, the children deduce the meaning of the term rye bread. Because the task mentions a "pile", it can only refer to the right part of the picture and that part, Fouzia concludes, must be the rye bread. Possibly, the students also profit from the way the teacher introduced the task.

Even the teacher deals with this problem in a functional, pragmatic way, as the following observation (Episode 4) shows. She mistakenly refers to the pile as a pile of packets of butter (instead of packets of rye bread). By doing so, she shows that the precise nature of the context is not important. The context of Episode 4 is as follows. During the collaboration phase, the teacher was asked for help in group 1. In this group there were no problems in finding the pile of rye bread, but the children did not know how to approach the problem. Therefore, Zin asked the teacher for help.

Episode 4: group 1 (6/6/00)

(1) Samira: Miss, I don't know precisely how to do it.

(2) Teacher: This pile with packets of butter, how tall is the pile. (...) On top there is one packet of butter. And then they make a brim around it. Until you have six levels. In the first level, how many packets of butter are these?

The conclusion that these language difficulties are approached in a purely functional way is corroborated by the observations around the other unfamiliar words. For instance, in groups 1 and 2 some minority children have difficulty in estimating the area of a carpet tile, because they do not know what a carpet tile is. The children who do know show with their hands how big a carpet tile approximately is. However, they do not explain in words what kind of an object a carpet tile is. Fouzia, in group 2, does attempt to describe what a carpet tile is, but she clearly fails. She proceeds by indicating a carpet tile with a gesture of her hands. Once the other children have understood this, the solution of the problem is easy. We see that the children who asked about the meaning of a carpet tile, after this functional explanation, immediately participate in the discussion. For them, the problem has obviously been solved. They know enough to contribute to the group work, although they probably could not explain in words what a carpet tile is.

We showed how children make sense of the math tasks and how they help each other to understand words which are unfamiliar to some children. Children do not define words in a discursive way. Their explication of the meaning of unfamiliar words is given in a minimal way, using deixis rather than descriptions, and aimed at giving just sufficient information to do the task. From a broader perspective of

language learning in the multi-ethnic classroom, this purely functional of solving language problems may sound a bit disappointing. It is, however, provoked by the type of problems that the students have to solve. The mathematical tasks are embedded in contexts, but for solving these tasks the contexts do not have to be used. Looking at the observations from this perspective shows that children clarify the terms in a minimal but adequate way. With the minimum of information which is transmitted, the tasks can be solved.

The discussion around 'volume' in groups 4 and 5 concerns a mathematical term. This term is also addressed in a functional way, focusing on what should be done to calculate the volume, as is demanded of the children by the task.

Episode 5: group 4 (5/6/00)

Ikram: What do they mean by volume?

Fahd: Everything, Length, width and height.

Lonneke: You should add them up.

Abdel: That is very easy.

Episode 6: group 5 (5/6/00)

Faroek: What is volume?

Danielle: Look, length times width times height.

It would be interesting to see if, in other subject areas like biology or geography, children use the same strategy for clarifying terms, that is: adapt their descriptions to the argumentation demands of the lesson. One would expect that in biology and geography words cannot be stripped of their content and reduced to formal properties, in the same way as in mathematics.

The learning of mathematics in the multicultural classrooms brings along language difficulties. Therefore, math learning and language learning cannot be separated (cf. Gibbons, 2002). Teachers should see to it that children grasp the meaning of words, because if they do not, the students are handicapped in doing the tasks. The observations show that Dutch children were helping minority children. In order to improve the minority children's knowledge of the Dutch language, the Dutch children might be instructed and encouraged to explain the meaning of terms in a more discursive way, transcending the minimal approach we saw in the observations. It is encouraging that the minority children in the groups without Dutch children worked on figuring out the meaning of terms, using information given by the teacher, the text of the task and the accompanying picture. They often succeeded in constructing the meaning, like in episode 1. However, this approach is also susceptible to errors, as one example in group 2 shows where, after a discussion, a telephone book was considered to be a small notebook.

In the Netherlands, realistic mathematics has recently been criticised since its reliance on realistic situations assumes a high level of language competence, which minority children often do not posses. These critics (Tesser and Iedema, 2001;

Vedder and Kloprogge, 2001) plead for a return of traditional mathematics teaching with a focus on standard solutions, formulas, mechanical exercises and repetition. This traditional teaching would, according to these critics, also fit better with the patterns of learning and knowledge transmission in the home culture of minority children. We do not agree. Returning to mechanistic mathematics would rob children of the main advantage of realistic mathematics education: that they learn to 'mathematise', that is to turn everyday issues into mathematical problems and use the mathematics resulting from these activities to address other realistic problems. Moreover, Pels (2002) has emphasised the importance of the peer group in Moroccan and Turkish youth culture. The skills youngsters have learnt in the peer group could be used in forms of teaching and learning which put interaction and investigative learning at the centre.

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