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ROLE PLAYING: AN ENVIRONMENT FOR THE DEVELOPMENT OF STUDENTS' METADISCURSIVE REFLECTION IN MATHEMATICS

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ABSTRACT

Students' beliefs about their own role, the role of their classmates and the teacher's role influence the way that the members of a mathematics classroom interact among them. The stabilization of concrete behavior by the participants in a mathematics classroom obstacles the development of a productive cooperation in mathematics. In this paper we tried to investigate the opportunities that the role playing offers to the development of students' metadiscursive reflection in mathematics. Role playing allowed the focus of students' reflection on the evolution of their cooperation in mathematics. Also, it helped them to reflect on their beliefs concerning the role of cooperation in mathematics learning.

THEORETICAL BACKGROUND

If we consider the mathematical activity as a process that takes place in a community with identified sociocultural characteristics, then the classroom life must be interpreted not only from a psychological perspective but from a sociological perspective as well (Cobb & Bauersfeld, 1995). The way that the members of the classroom develop rules that guide their social behavior determine the evolution of their mathematical discourse. Especially, students' beliefs about their own role, the role of their classmates and the teacher's role influence the way that the members of a mathematics classroom interact among them. (Yackel et al., 2000). Sfard (2001) has mentioned that students' initiation to mathematical discourse depends on the "meta-discursive rules that regulate the communicative effort" (p.28). These rules are considered as the implicit regulators of interpersonal and intra-personal communication, as they determine the choices of the participants when they act and they embed their values and beliefs.

Nowadays it is accepted that in order to improve mathematics didactic situations have to create learning environments in which the classroom members actively participate toward this effort. The participants awareness of their own actions during their mathematical activity consists a main issue for this improvement. Recently, research in mathematics education focused on issues related to students' awareness through the investigation of the development of students' metacognition in mathematics (Kramarski et al., 2002). According to the above considerations, their awareness is related not only with the reflection on the cognitive aspects of their activity but on the social and emotional aspects of it too (Yackel et al., 2000- Moschkovich 2003). This kind of reflection could be named *metadiscursive* as it is related with the consciousness of relationships among cognitive, social and emotional components of mathematical discourse. The study of didactic situations that allow the development of students' metadiscursive reflection get into interest.

Furthermore, the stabilization of concrete behavior by the participants in a mathematics classroom (e.g. the student who helps and the student who is helped) obstacles the development of a productive cooperation in mathematics (Mulryan, 1989 in Good et al., 1992). This finding guides to the following question: How the students could become conscious of their own concrete roles in their sociomathematical interaction?

The purpose of this study is to investigate the opportunities that the role playing offers to the students to develop metadiscursive reflection in mathematics. Role playing is a form of dramatic play that has been



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born of Moreno’s psychodrama. According to Bolton (1995), role playing allows the individual and the collective reflection on an experience. Role playing has been used in education as training situation for the development of teachers’ and students’ reflection on their action (Andersen, 2002). Johnson(2002) studied the opportunities that this environment offered to students’ awareness about the consequences of an historical fact (the colonization of America in 18th century). In mathematics education, role playing has been used as context for mathematics’ educators reflection on different interpretations of mathematics classroom research findings (Breen & Hannula,2003).

METHOD

This research is a part of a broader research program realized in a fifth grade of a public school of Athens in 2003-2004 and it lasted six months. Participants were 18 students (9 boys and 9 girls). The students worked in small-groups (2 students in a group) 4 times per week during the mathematics teaching that the teacher of the classroom realized. The mathematical topic that they discussed during the research program concerned the concept and the operations of fractions.

Initially, in order to construct the students’ profile, the students were interviewed about their beliefs for their own role, others’ role, the general nature and the goals of mathematical activity. During their mathematical activity in the classroom, the students worked in groups and their cooperation was videotaped once a week. After a session of cooperation the members of each group participated in a meeting with the researcher. During this meeting, the students observed and discussed on issues concerning their videotaped cooperation. Moreover, the students in group were obliged to organize and to present drama role-plays in the classroom based on the experiences of their cooperation. These role-plays were videotaped. At the end of the program, the members of the group were interviewed about their own role and the others’ role in mathematics.

In this study we focus on students’ interaction during the role plays that they presented to their classmates and on the changes that seem to be happened in students’ beliefs concerning the role of cooperation in mathematics learning. The students’ interaction was developed in two levels: the metadiscursive level (as they designed their role play) and the collective level (as they discussed with their classmates on their role playing). The following table presents the elements of the students’ interaction analysis:

Metadiscursive level	• the roles that each student chose to play • the relationship between drama text and their cooperation in mathematics
Collective level	• their comments about role playing experience • their classmates’ comments

Table 1.

RESULTS

Before the research program the students’ beliefs about the role of cooperation in mathematics learning had the following characteristics:

- The development of students’ cooperation were influenced by their achievement in mathematics. Average and low achievers wished to cooperate with their classmates as they expected others help, while high achievers preferred to work alone or to cooperate with their teacher.

- Mathematical knowledge is acquired with personal effort (e.g. “*if someone doesn’t work on their own, they cannot understand mathematics*”).
- Different ideas in mathematics cause confusion and create difficulties in understanding (e.g. “*every-one can express their opinions and they might quarrel about which one is right as they are unable to make head or tail of it*”).
- The exposition of a student’s thinking to his/her classmates does not protect his/ her self-image (e.g. “*I have the impression that my classmates will think that I do not do well in mathematics and I don’t like this*”).

The role playing gave opportunities for the students’ reflection on their cooperation in mathematics in both levels of the students’ interaction that we described above.

A) In the metadiscursive level it gave to the students the following opportunities:

- *To experience their interlocutor’s difficulties and emotions that he/she felt during their cooperation in mathematics.*

For example, Stavroula was a capable student in mathematics and she cooperated with Alexia who usually needed help to complete her mathematical activity. In their role playing the two students chose to represent the opposite roles of these that they experienced during their cooperation in mathematics. Stavroula justified her choice as following: “*I want to know how one feels when she asks for help in mathematics*”.

- *To express their emotions provoked by his/her interlocutor’s actions.*

The students represented emotions like satisfaction or dissatisfaction for their interlocutors’ acceptance or indifference of their contribution in mathematical discussion.

- *To evaluate the evolution of their cooperation in mathematics.*

The following episode is representative of this opportunity. Paul and Nikos decided to represent in their role playing three different moments of the history of their cooperation:

1st scene

[1]N: *He is reading a mathematical problem.*

(The two boys are in silence looking at their books)

[2]P: Did you find the solution?

[3]N: I found it!

[4]P & N (together): Mister! Mister! (addressing to the teacher).

2nd scene

[5]P: *He is reading another mathematical problem.*

(after a few minutes)

[6]N: I think that it was left over $\frac{1}{6}$. What do you think?

[7]P: I think $\frac{2}{12}$, it is the same.

[8]P & N (together): Mister! Mister! (addressing to the teacher).

3rd scene

[9]N: *He is reading another mathematical problem.*

- [10]P: What do you think?
 [11]N: I am thinking to draw the walls and to divide them in 6 pieces and in 3 pieces.
 [12]P: The $\frac{5}{6}$ is larger. It is obvious.
 [13]N: Right. Is there another solution?
 [14]P: The $\frac{2}{3}$ is the same with the $\frac{4}{6}$.
 [15]N: The $\frac{4}{6}$ is smaller.
 [16]P: Lets talk about these solutions to the class!

- *To focus on elements of their mathematical discussion*

More specifically, they chose to incorporate in their drama texts issues concerning the treatment of their errors in mathematics as well as the significance of argumentation of a decision during their mathematical activity.

- *To relate the way of their interaction in mathematics with their parents' behavior.*

The following example is a part of Stavroulas' and Alexias' drama text.

- [4]Stavroula: Help me a little.
 [5]Alexia: What do you mean “a little”?
 [6]Stavroula: Just a little! (She shows with her fingers.)
 [7]Alexia: If I help you a little, the problem will be solved by me and not by you!
 [8]Stavroula: It doesn't matter at all!
 [9]Alexia: It doesn't matter at all? It matters a lot, because you will not learn it.
 [10]Stavroula: Oh! You talk like my mother! She tells me the same things.
 [11]Alexia: She is right! You should solve it alone....

B) In the collective level the role playing gave to the students the following opportunities:

- *To evaluate the behaviors of the students in role and to compare them with their own experiences of their cooperation in mathematics.*
 - *To relate concrete behaviors in mathematical discussion with the generation of concrete emotions*
- For example, the students related the acceptance of different ideas in mathematics with pleasure.

- *To non inculcate their behaviors during their cooperation in mathematics*

For example, during the discussion that took place among the students in the classroom, Paul said about his behavior in his role:

- [6]S1: The children played their roles very well. I would like to be Nikos in this role playing.
 [7]S2: Me too. If I was Paul I would discuss with Nikos about his difficulty.
 [8]P: (addressing to the student 2). I didn't like Paul behavior as he doesn't help his classmate, but all these happened in the theater(role playing).

After the research program the students' beliefs about the role of cooperation in mathematics learning had the following characteristics:

- Most of the students considered that the cooperation with their classmates in mathematics helps their mathematical activity.

- They considered that their classmates' different ideas were indispensable to the mathematical discussions.

CONCLUSIONS

The role playing is a learning environment that could support students' metadiscursive reflection in mathematics. Through this environment the students had the opportunity to reflect on issues concerning the social and emotional aspects of their cooperation. Moreover, the role playing allowed the focus of students' reflection on their discussions in mathematics as they tried to design and to construct their drama texts. These opportunities helped the students to change their negative beliefs about the role of cooperation in mathematics learning as it was obvious in their statements in the post-interviews after the research program. The way that role playing could embody in the daily teaching practices in mathematics classroom is an open question.

REFERENCES

- Andersen, C.(2002). Thinking as and thinking about: Cognition and metacognition in drama in education. In B. Rasmussen and A.L. Ostern (Eds.), *Playing betwixt and between: The IDEA dialogues 2001*, pp. 265-270, Landslaget, Drama i Skolen, Oslo.
- Bolton, G. (1995). Afterword: Drama as Research. In P. Taylor (Ed.), *Researching Drama and Arts Education*, pp. 187- 194. London : The Falmer Press.
- Breen, C, & Hannula, M.S. (2003). Exploring Alternative Interpretations of Classroom data. *Proceedings of the 27th Conference of the International Group for the Psychology of Mathematics Education*, Vol.1,174. Honolulu, USA.
- Cobb, P.& Bauersfeld, H.(1995). *The Emergence of Mathematical Meaning: Interaction in Classroom Cultures*. LEA.
- Johnson, C. (2002). Drama and metacognition, *Early Child Development and Care*, 172, 595-602.
- Good,T, Mulryan,C. & McCaslin,M.(1992). Grouping for instruction in Mathematics: A call for programmatic research on small-group processes. In D.A.Grows (Ed.), *Handbook of Research on Mathematics Teaching and Learning*, p.p.165-196, MacMillan.NY.
- Kramarski, B., Mevarech,Z.R. and Arami,M. (2002). The effects of metacognitive instruction on solving mathematical authentic tasks. *Educational Studies in Mathematics* 49, 225-250.
- Moschkovich, J. (2003). What count as mathematical discourse?, *Proceedings of the 27th Conference of the International Group for the Psychology of Mathematics Education*, Vol.3, pp.325-331, Honolulu, USA.
- Sfard, A. (2001). There is more to discourse than meets the ears: Looking at thinking as communicating to learn more about mathematical learning. *Educational Studies in Mathematics*, 46, 13-57.
- Yackel, E., Rasmusen,C and King, K. (2000). Social and sociomathematical norms in an advanced undergraduate mathematics course. *Journal of Mathematical Behavior* 19, 275-287.

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