

Gendered styles of linguistic peer interaction and equity of participation in a small group investigating mathematics

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In a teaching experiment with two Finnish upper secondary classes, the basics of calculus were studied using an investigative approach and a small-group setting. As part of the ethnographic teacher research, the different styles of talking of the girls and boys in four groups were analyzed through application of the concept of sociolinguistic subcultures. This paper focuses on the interactions in one of the groups where two girls and a boy discuss mathematics. We show how the linguistic strategies typical of these boys prohibited the full potential of the contributions of the girls to be utilized in the collective construction of meaning in the group. Promoting democratic discussions in small groups may need attention in terms of gendered ways of interacting.

Keywords: small groups, sociolinguistics, gender, mathematics education

Introduction

Small-group activities are widely used as a method of studying mathematics, especially in problem-solving and inquiry approaches. Normally, they are found to promote students' mathematical learning, although research on the use of small-group discussions in instruction has also revealed differentiated possibilities for student participation in the group activities (Good, Mulryan and McCaslin 1992, Bennett et al. 2010). If the democratic discussion of ideas constructed by all the students in a group is prohibited, much of the potential of the working method is lost.

The first author, Partanen, conducted a teaching experiment with two of her upper secondary classes in Finland, in which students investigated mathematics in friendship groups of three to four. Partanen (2007) analysed the different sociolinguistic subcultures (Maltz and Borker 1982) in four of the small groups and found differences in the styles of talking of the girls and boys. In this paper we use the earlier analysis to focus on the interactions within one of these groups containing two girls and a boy. The aim of this paper is to investigate how the styles of talking of the girls and boys were enacted in the discussions of this focus group.

Theoretical framework

Equity of participation in small-group discussions

Although research reviews on the use of small groups in instruction show that group discussions promote students' learning and acquisition of high order skills, they also point to the observation that the quality of collaboration and interaction varies from group to group, and that democratic and high quality interactions do not appear naturally (Good, Mulryan and McCaslin 1992, Bennett et al. 2010). Differentiated opportunities of participation for students in small groups in mathematics instruction have been observed, for example, as a function of achievement (Rozenholz 1985) and

gender (Lindow, Wilkinson and Peterson 1985). Esmond (2009) also showed how the type of tasks given to students influenced equity of participation in the small-group activity.

Bennet et al. (2010) reported differences in interactional styles according to gender in small-group discussions. All-male groups confronted differences in their individual predictions and explanations, whilst all-female groups searched for common features of their predictions and tried to avoid conflict. Mixed groups interacted in a more constrained way, and it can be argued that the best of all-male and all-female group interactions was lost in them (Bennet et al. 2010).

Sociolinguistic subcultures

Maltz and Borker (1982) write in their classic paper about different styles of talking of American women and men in friendly conversations. They argue that girls learn to do three things with words: 1) to create and maintain relationships of closeness and equality, 2) to criticize others in acceptable ways, and 3) to interpret, accurately, the speech of other girls. On the other hand, boys use speech in three major ways: 1) to assert one's position of dominance, 2) to attract and maintain an audience, and 3) to assert oneself when other speakers have the floor (Maltz and Borker, 1982).

Four small groups as a context

The focus group of this paper is one of the four small groups studied in a teaching experiment established by the first author (Partanen 2011). Partanen (2007) described the different styles of talking of the girls and boys in the four small groups.

In the peer interaction of the groups studied, the girls invited and encouraged others to speak, and they acknowledged what the others said more than the boys. For example, the girls expressed proactive utterances that required (and received) a response, and they used tag questions. They also gave more positive minimal responses. The girls gave more space for the others to express their ideas than boys, for example, by phrasing propositions that were meant to enhance the mathematical discussion as questions or in conditional form. These features of the girls' talk can be interpreted as trying to avoid giving the impression of mathematical authority and also recognizing the speech rights of others, which both contribute to building relationships of equality (Partanen 2007).

The boys in the four small groups were more assertive than the girls. They interrupted each other more often, and they had disputes, boasting, name calling, jeering, and mocking. They also gave more orders to each other than the girls. In line with Maltz and Borker (1982), the boys seemed to be very often in the process of posturing and counter-posturing (Partanen 2007).

Methodology

The experimental courses in the term 2001/2002 were established for the dissertation of the first author (Partanen 2011). She aimed at developing her own practice of using the investigative small-group approach in teaching upper secondary mathematics in her school Lyseonpuiston lukio in Finland. The project can be seen as teacher research (Cochran-Smith and Lytle 1999). The research question for this paper is as follows: how did the different sociolinguistic subcultures of the girls and boys in the four small groups show up in the discussions of the focus group?

The experimental classes consisted of 31 and 28 second-year students, approximately 17 years old. They worked in friendship groups of three to four, and almost all of the groups were single-sex groups. The course was one of the compulsory courses for high level mathematics. Instead of teaching the important concepts of calculus, limits, and derivatives directly, the teacher gave the students questions and problems to be discussed and solved together. After the small-group sessions, the ideas of the students were discussed and summarized, and the teacher tried to connect her further teaching to the experiences of the students. The data for this paper consists of six recorded discussions in one focus group that consists of two girls, Anni and Jenni, and a boy, Veikko. The earlier analysis of the sociolinguistic subcultures in the four small groups (Partanen 2007) showed that Veikko used strategies of talking typical of both the boys and girls.

The way of analyzing data was close to that used in microethnographic analysis of interaction (Erickson 1992). Transcribed discussions in the small group were divided into episodes according to the themes. The episodes were then analyzed in chronological order. For each episode, the group participation structure was described. After this description, the teacher made conjectures of the typical participation structure in the group. When she was looking at the next episode, she revised and developed the conjectures. In this way, a holistic picture of the typical interactions in the group developed in her writings. She continued revising the conjectures until she felt certain satisfaction with the description. Finally, the typical interactions in the small group were examined in the context of the sociolinguistic subcultures analyzed in the interactions of the four small groups (Partanen 2007).

Results

Through the following two episodes, we are going to illustrate how the ways of talking typical of the boys that were also used by Veikko prohibited the full potential of the two girls to be utilized in the collective meaning-making processes of the small group. Prior to the episode, the class had measured some position-time values for a glider on an air track and fitted a simple quadratic function to the data. For the small-group session, the students were given questions about the meaning of the gradient of chord and the instantaneous velocity. In episode 1, the students are considering the meaning of the gradient of the chord $(f(z) - f(1))/(z - 1)$ to the position-time graph. Overlapping of speech is shown in the transcription.

Episode 1

- 31 Anni: So, what do they mean? (looks at the previous two pages of her notebook) Because this is time and that's distance (points to the axis in her calculator).
- 32 Jenni: So, how do we draw it?
(takes her calculator)
- 33 Veikko: What does the gradient of the chord mean, then? (looks at Anni triumphantly) Because it is time [indistinct].
- 34 Anni: (does not notice the expression on Veikko's face) Is it something like an average, something like that? ... I don't know.
- 35 Anni: (Jenni is following the discussion between Anni and Veikko) But, isn't it,
- 36 Veikko: When time goes on

- 37 Anni: isn't it average
38 Veikko: Look, here, because this is time (points to his notebook). Then, then, well x is, yes, here it meets that (points to the graph in Anni's calculator). The [indistinct] average value or something like that.
39 Anni: Um.
40 Veikko: Well, how was it, then?
41 Anni: (points with her pen to the screen of the calculator). So that if it is the average value, then the steeper it is, the longer the time is. For the average thing.

It seems that Anni was close to constructing an important idea: that the gradient of the chord is the average velocity. Yet, Veikko interrupts her and, by doing so, transforms the meaning of what Anni was saying. Anni gives up and returns to the previously discussed idea that the longer the time interval is the steeper the corresponding chord. Most probably, a learning opportunity for all the students was destroyed. A few times, it happened that Anni was expressing a promising idea, and Veikko prohibited it from being expressed so that a learning opportunity was lost. Normally, Anni did not persist with her idea, like the boys in the other groups sometimes did.

At the beginning of the data, it was typical of the participation structure in this group that Veikko and Anni collaborated, trying to achieve a consensus about the topic being discussed. Jenni either followed the discussions or worked alone with her calculator. When she rarely expressed herself, she spoke timidly with a low voice. Although the students listened to each other in their conversations, it was harder for Veikko than for the girls.

After the first four small group sessions, Veikko had to be absent from a few lessons. When he returned, the first topic was about constructing methods for finding the equations of a tangent and a normal to a curve at a particular x -value. It was a year ago when Veikko had studied the equations of lines, but the girls had attended the course during the previous period, just a few weeks before. Jenni had the notes from that course with her, and she seemed to have knowledge about the important methods and formulae. The typical participation structure of this group changed when Jenni had her chance to participate in the working of the small group.

The group had succeeded in finding out the equations of the tangent and normal to the graph of a third order polynomial function. They were beginning to write a summary about their investigation. Jenni asked Anni to write the summary on a transparency. After a short and friendly debate, Anni accepted the task.

Episode 2

- 20 Veikko: Let's first write that here. Firstly, we need to substitute this (points to his notebook). Don't write yet, but let's discuss this. (Anni and Jenni give a short laugh.) We should first substitute that x by minus one here in the original expression to get the y -value. Then, we need the x .
21 Jenni: No, but, that's the gradient, I mean. (points to Anni's notebook).
22 Veikko: Yeah, no, but, so, so that if we substitute that, and we'll get the gradient.
23 Jenni: No.
24 Veikko: No, but, well, here we don't need. (The girls laugh. Anni is holding her

- head by her hands.) Do we need to substitute this here? Yes.
- 25 Jenni: Yes. To get the y. But this is it (points to Anni's notebook).
- 26 Veikko: And then we need to find the x. Then we need to differentiate the original expression, to get the gradient of
- 27 Jenni: Yes.
- 28 Veikko: tangent.
- 29 Jenni: Exactly (gives a short laugh). And, after that.
- 30 Anni: So, we shall first put it (takes her pen). Shall I write that $x = -1$ is substituted in the equation, in that?
- 31 Jenni: Yes.
- 32 Veikko: Or, should we make it general? Or, just for this task?
- 33 Jenni: Can we make it general?
- 34 Veikko: So that if you first substitute x in this original equation (points to Anni's notebook).
- 35 Anni: No but, shall we write that
- 36 Veikko: we get
- 37 Anni: the equation of the, the tangent (points at a place in her notebook). And then, let's write that the gradient can be found by substituting the
- 38 Veikko: Differentiated.
- 39 Anni: Differentiated, yes.
- 40 Jenni: Yes.

In this episode, Jenni is playing a much more active role than earlier. She participates in organizing the group work (the debate before the episode). She discusses with Veikko about the meaning of their results and she supports Anni's suggestions. Although, at the end of the data, there were episodes where Jenni was not quite this active, she followed with attention the discussions between Anni and Veikko and, every now and then, participated in them. We interpret these occurrences so that Veikko's assertiveness and willingness to take and hold the floor in the discussions of the group excluded Jenni from participating in the collaboration.

Discussion

In the first episode discussed, Veikko interrupted Anni and thus prohibited her from expressing what seemed to be a very promising idea. Anni did not persist with her point of view. The second episode shows how Jenni participated in the small-group activity much more after Veikko's absence during his temporary confusion.

We see these episodes as examples of how the ways of talking typical of boys (Partanen 2007) produced obstacles for the two girls in the group to participate in the collective meaning-making processes when they were communicating in ways typical of the girls. For developing the use of small-group discussions in mathematics instruction, it is important to search for ways of establishing democratic participation. If multi-vocal contributions of all the participants can be utilized, the group activity will be enriched. One aspect that may lead to inequality in participation is the different sociolinguistic subcultures of girls and boys (Maltz and Borker 1982).

Some researchers in science education have identified notable differences in interactional styles according to gender (Bennet et al. 2010). Our analysis, furthermore, shows how the differences in the styles of talking may influence the

possibilities for students to participate in the small-group discussions. The two episodes also exemplify possible consequences of this influence for the collective processes of meaning construction. Training is recommended for students and teachers in the skills required for handling and participating in group discussions (Bennet et al. 2010). In mathematics education research, the work of Cobb and Yackel (1996) on social and sociomathematical norms has potential for contributing to resolving the problem. However, the challenge still remains for future research and developmental work, firstly, of identifying the important factors that contribute to inequalities in the possibilities for participation and, secondly, of developing ways of overcoming those problems.

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