From everyday contexts to institutionalised knowledge: Implicit initiation into school mathematics

Christine Knipping, Acadia University (Canada)
David A. Reid, Acadia University (Canada)
Uwe Gellert, Freie Universität Berlin (Germany)

One phenomenon that occurs in mathematics classrooms is the emergence of disparity in mathematical achievement. This is perceived by both teachers and students, often in a short time. As part of a larger research project on the emergence of disparity, we have become interested in the process of embedding school mathematics in so-called “real-life” contexts and of detaching it from those contexts. In this research report we will consider two cases and the ways in which the processes of embedding and detaching relate to the emergence of disparity in them.

Theoretical Framework

School mathematics can be described as an *activity*. Following Dowling (1998) we use *activity* to refer to a structure of relations and practices regulating who can legitimately say or do or mean what. Participants in an activity occupy asymmetric positions, and the regulation of participation varies. Thus school mathematics constructs hierarchies of positions, such as teacher and learners, students of different ages, or low-achievers and high-achievers.

A feature of the activity of school mathematics is making reference to contexts outside of school mathematics. This is often justified by reference to learning theories, theories of motivation, and promotion of transfer, but such external references are necessary in any activity that wants to create apprentices. The principal by which external references are used to construct official (i.e., curricular) school mathematics knowledge is often referred to as *recontextualisation* (Bernstein 1996, Dowling 1998, Gellert & Jablonka 2009): the subordination or partial subordination of one practice under the regulatory principles of another. Mathematical classroom practices, such as introduction into new mathematical procedures and concepts or elaboration of mathematical modelling tasks, are effected through recontextualisation. Particularly, but not exclusively, in primary and lower secondary education, a gaze is cast from abstract school mathematics onto students’ everyday experience, resulting in a subordination of this experience to the principles of school mathematics (Voigt 1985). In this way, recontextualisation creates a hierarchy of knowledge and experience favouring institutionalised knowledge over everyday knowledge.

Aim

It has been argued theoretically and empirically that the recontextualisation principle generally remains implicit in school mathematics activity and that as a consequence of the implicitness some students are systematically advantaged over others (Cooper & Dunne 2000, Theule Lubienski 2002) and a hierarchy of high-achievers and low-achievers is generated. However, not much research has been done in order to understand the interactional mechanisms by which this hierarchy is generated, that is, how recontextualisation is interactionally mediated in school mathematics practice (Mehan 1992). Thus, our aim here is to describe and analyse some interactional mechanisms of introducing students into the recontextualisation principle of school mathematics practice. We explore this in the larger context of our research on the emergence of disparity in mathematics classrooms (Knipping, Reid, Gellert & Jablonka 2008).

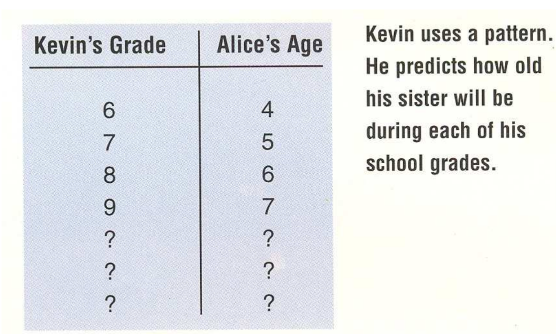
Research Strategy

Our research project is a cross-national investigation of school mathematics activity in secondary classrooms. The purpose of the cross-national character of our research project is to compare the emergence of disparity (including the role of recontextualisation) in a selective (Germany) and a rather inclusive (Canada) school system. As we are particularly interested in moments in which the students are *introduced* in school mathematics activity, we focus on an exceptional period within each student's school career: the transition from primary to secondary school, when the teacher does not know the students and the students do not know the regulatory principles of secondary school mathematics activity. Our analysis draws on video and audio supported classroom observation of the first 6 to 8 weeks of school mathematics activity in the starting school year (Germany: 5th grade, Canada: 6th grade). We suppose that during these weeks it is the aim of the teacher to accustom the students to the specific regularities of her or his teaching and learning strategy.

Here we will discuss briefly the interactions between teachers and students in two first lessons, one in Canada and one in Germany. In both cases the teachers did not have much prior knowledge of the students. In the German classroom the teacher had been assigned the class at the last minute and so had not opportunity to research the students' backgrounds. In the Canadian classroom the students are in their first year in a new school. Their teacher, "Mr. White", may have met some at an orientation day and he had the opportunity to examine their records, but his personal "philosophy" is that he prefers not to have "preconceived ideas" of his students. However he set the first few classes testing the students on basic arithmetic skills, which might have provided him with some expectations before the first lesson. Mr. White also teaches other subjects to the same students. The German teacher, "Herr Schwartz", only teaches mathematics.

Findings

The topic of the Canadian first lesson was representing functions using tables of values, "T tables" and identifying the underlying relationship. For homework the students had been given a task from their textbook of completing a table showing the school grade of one child, Kevin, and the age of his sister Alice (see Figure 1a). This is a typical "real-world" context found in school mathematics textbooks, relating to an unlikely question (Kevin wondering how old his sister will be when he is in grade n) and an unlikely method of addressing it (using a table of values). But in recontextualisation this is typical, as the presentation of the "real" context is subordinate to the requirements of the school math context.



Kevin's Grade	Alice's Age
6	4
7	5
8	6
9	7
?	?
?	?
?	?

Kevin uses a pattern. He predicts how old his sister will be during each of his school grades.

Figure 1a: Task from the textbook (Mathquest 2000, p. 8)

Kevin	**Alice**
6	4
7	5
8	6
9	7

Figure 1b: The T-table as copied by the teacher on the blackboard

After having the students compare their answers in groups, Mr. White asks for a volunteer to complete the table on the board (see Figure 1b), and when that is done he asks the volunteer's group members to explain how they got their answers. The interaction between one of those students, "Max" and Mr. White is our focus here. Transcript 1 begins with Max's response to Mr. White's question "What did you do?"

61	**Max:**	Added one on each time.
62	**Mr White:**	Which side are we talking about? The left side or the right side?
63	**Nick:**	Both sides.
64	**Max:**	Either or both of them. Because Kevin, in one year he's in grade six and Alice is four years old. So the next year, he's going to be in grade seven and she is going to be five years old. So you add one on both groups.
65	**Mr White:**	So in other words, you're adding down, adding one. Is this what you mean? If you started, if you started here you just add one to get to ten.

Transcript 1: Max's response to "What did you do?"

In line 64 Max spontaneously offers a justification for what he did, making reference to the "real" context. Mr. White does not acknowledge this explanation, but instead refocuses attention on what Max did to find the numbers. Note that Max's answer in Transcript 1 is not what Mr. White might have wanted, as he looked at the two columns as separate sequences, not at the relationship between them. In Transcript 2, Max does refer to the relationship.

70	**Max:**	I had the number seven because I knew she was two-
71	**Mr White:**	This one here?
72	**Max:**	Yeah.
73	**Mr White:**	Yes.
74.1	**Max:**	Because I knew she was two years younger than the grade he was in.
74.2		So then I just added one on [the numbers?] from there.
75.1	**Mr White:**	I have a question. This can come, the answer may come from
75.2		any group. You may look at the T-Table here or you may look at the one
75.3		you've created in your notebook. Can anybody figure out or tell me the
75.4		relationship between the left side of this T-Table and the right side of the
75.5		T-Table.
76		*(Max is the only student who raises his hand.)*
77	**Mr White:**	OK.
78.1	**Max:**	The difference between the numbers, there's a difference of two
78.2		on each number.
79	**Mr White:**	A difference of two. How do you mean difference?
80	**Max:**	There is, one is two higher.
81	**Mr White:**	So in other words, this one is two higher.
82	**Max:**	Yes.

Transcript 2: The relationship between the columns

In line 74.1 Max describes the relationship between the two columns, again making reference to the "real" context: "she was two years younger than the grade he was in". Mr. White's response is interesting: he asks the class if anyone can tell him the relationship. As Max has just done so, one might expect Max to interpret this as a signal that there was something wrong with what he said. In line 78 he reformulates the relationship in a way that is acceptable to Mr. White; a reformulation in which the "real" context has vanished, leaving only the relationship expressed in the language of school mathematics.

In this interaction Max has behaved in a way that suggests he is realizing that in school mathematics the external contexts that are referred to are subordinate to the requirements of school mathematics. In other words, he has seen that in the process of recontextualisation, it is important in the end to detach from the mundane context, to abandon the familiar and to focus on the school mathematics that the real-world situation was in aid of. It is doubtful whether the other students in the class saw this; in fact in the video many of them clearly lost interest at the beginning of the interaction between Mr. White and Max, not realizing that the task set by Mr. White (completing the table) was not an end in itself, but itself a recontextualisation leading to the identification of the relationship. Thus in this first lesson recontextualisations occurred that were occasions for disparities to emerge between Max and his classmates.

In the German classroom the teacher began by playing a game “race to twenty” which he claimed was a fun way for him to get to know the class. The playing of the game was also structured by the principle of recontextualisation, and it led quickly to the emergence of disparities in the class. Unlike the “real world” context of Mr. White’s problem, Herr Schwartz used an abstract number game to generate a playful and competitive situation that is reminiscent of the way number tricks are used at home for recreational purpose. In the course of the lesson however, Herr Schwarz gradually recontextualised the “race to twenty” as a school mathematics activity – a recontextualisation that passed unnoticed by many of the learners. In our presentation and final paper we will elaborate on this data and our findings.

Conclusion

In both lessons, the teachers referred to the students’ everyday experience. Both teachers used the reference to mundane contexts as a gate into school mathematics. There are substantial differences in the two first lessons, including the degree and modularity of “realness” of the external contexts, the presentation of school mathematics as applied or recreational, and the tightness of curriculum constraints on the focus of the lesson. However, in both lessons the familiar vanishes. In both classrooms this is realised in an implicit way, and there is evidence that only some students recognise that reference to everyday activities is no longer legitimate. As a result recontextualisation, as the structuring principle of school mathematics activity, leads to the emergence of disparity. Exactly who is positioned how in these processes, and why, remains a focus of our research.

References

Bernstein, B. (1996). *Pedagogy, symbolic control and identity: theory, research, critique*. London: Taylor & Francis.

Cooper, B., & Dunne, M. (2000). *Assessing children’s mathematical knowledge: social class, sex and problem solving*. Buckingham: Open University.

Dowling, P. (1998). *The sociology of mathematics education: Mathematical myth/pedagogical texts*. London: RoutledgeFalmer.

Gellert, U., & Jablonka, E. (2009, in press). I am not talking about reality: word problems and the intricacies of producing legitimate text. In L. Verschaffel et al. (Eds.), *Words and worlds: modelling verbal descriptions of situations*. Rotterdam: Sense.

Knipping, C., Reid, D.A., Gellert, U., & Jablonka, E. (2008). The emergence of disparity in performance in mathematics classrooms. In J.F. Matos, P. Valero & K. Yasukawa (Eds.), Proceedings of the Fifth International Mathematics Education and Society Conference (pp. 320-329). Lisbon: Centro de Investigação em Educação, Universidade de Lisboa.

Mehan, H. (1992). Understanding inequality in schools: The contribution of interpretive studies. *Sociology of Education, 65*, 1-20.

Theule Lubienski, S. (2002). Research, reform, and equity in U.S. mathematics education. *Mathematical Thinking and Learning, 4*(2&3), 103-125.

Voigt, J. (1985). Patterns and routines in classroom interaction. *Recherches en Didactique des Mathématiques, 6*(1), 69-118.