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Students' perceptions of Norms in a reformed classroom

Richard Wester[1], Anna Wernberg[1] and Tamsin Meaney[2]

1 Malmö University, Sweden, anna.wernberg@mah.se

2 Bergen University College, Norway

This paper explores tensions between the teacher's intention and the students' interpretation of a reformed classroom practice. Focus for this paper is particular on the social and socio-mathematical norms. The example presented in the paper is connected to the use of resources, such as manipulatives, to catch both explicit and implicit tensions between the students' perceptions of existing norms and teacher´s intention of supporting norms. These tensions could form and cause a barrier to students' opportunities to learn. Reform teaching is likely to fail if students do not share a similar understanding to that of their teacher in regards to their contribution to mathematics learning.

Keywords: Reformed teaching, tensions, social norms, socio-mathematical norms, students' perspective.

INTRODUCTION

School Inspection's quality review (Skolinspektionen, 2009) of Swedish mathematics teaching reveals that teaching in general is strongly connected to the use of textbooks. Students working individually in textbooks dominate Swedish mathematic teaching practice (Bergqvist et al., 2010; Kjellström, 2005). Alrø and Skovsmose (2002) term such teaching as the *exercise paradigm*. In the exercise paradigm, students are expected to learn how to master tasks by executing a series of procedures in order to gain the correct answer. According to Alrø and Skovsmose, an alternative to the exercise paradigm is *a landscape of investigation*. In that setting, students are encouraged to ask questions and to work together to investigate issues. The starting point is the students' previous understanding and that students are active seekers of learning.

In Sweden, a new syllabus (Skolverket, 2011) for mathematics education was implemented in 2011. It focuses on developing students' mathematical competences. The idea of mathematical competences in syllabus originates from the Adding Up report (Kilpatrick, 2001) and the KOM-project (Niss & Højgaard Jensen, 2002). Competencies provide another way to explain what it means to master mathematics. Both of these previous projects had the intention of changing teaching practice in schools (Boesen et al., 2014), by creating a broader view of what school mathematics means.

As a consequence of the introduction of the new curriculum and the reports such as the one by School Inspection, professional development in Sweden has concentrated on supporting mathematics teachers to adopt teaching practices which are less-textbook focused and require students to be more actively engaged. Although many teachers have been involved in extensive professional development of the kind advocated as best practice by mathematics education researchers (Rodgers et al., 2007), the impact on classrooms seems to be minimal. This follows a worldwide indication that changing mathematics teaching is challenging. For example, since the publications of NCTM's standards at the end of the 1980s, there has been a world-wide push to reform teacher-directed mathematics classrooms but this has met with limited success (Jacobs et al., 2006).

In trying to understand why this is the case, much research has focused on teacher change (see, for example, Clarke & Hollingsworth, 2002). There has been little research which investigates students' perspectives on reform teaching practices and whether their perspectives might contribute to the status quo remaining. One of the few studies is that of Graue and Smith's (1996), who investigated students and their parents' perceptions of reform mathematics classrooms. Graue and Smith showed that different students in the same class described the new teaching practices

in various ways, almost as if they had experienced different things. There were often strong similarities between the students and their parents' stories. Graue and Smith concluded that when the students interpreted the teaching practices, they related them to their previous experiences of mathematics, some of which were shared with their parents. The students' stories also showed links between their perceptions of the reform classrooms and how they succeeded with the earlier practices. Those who considered that they were successful with the previous practices seemed averse to accepting the new teaching practices whereas those who had previously performed poorly talked more positively about the possibilities with the new practices.

THEORETICAL FRAMEWORK

There are many rules and routines that guide and frame the classroom practice (Jablonka, 2011). Without these, teaching would not be possible. Some rules are explicit, while others are unspoken and thus hidden. The hidden rules, you learn by participating in the practice. The rules are not fixed, but are changing continuously by the participants. To succeed as a student in school mathematics, it is not enough to know the mathematics thought. You must also cope with what it means to be a student in a mathematics classroom. One must be able to follow the rules of the classroom, both explicit and hidden.

To successfully reform a teaching practice means that there is a change in the prevailing teaching culture available in the mathematics classroom. Old understandings about teaching of mathematics are shattered and needs to be renegotiated in different ways. Cobb and Yackel (1996) describe the agreed rules that operate in a mathematics classroom as norms; social norms and socio-mathematical norms.

Social norms operate in all classrooms to regulate and frame the social interaction between teachers and their students. These norms are established, often implicitly, as agreements in the group, rather than by a single individual. However, individuals may have their own ideas about how the norms operate. Examples of social norms are expectations about explaining and justifying solutions, listening and trying to understand others' thoughts, etc.

In mathematics classrooms, there are ways of doing things that are specific to mathematics teaching and these Cobb and Yackel labelled socio-mathematical norms. Some examples of socio-mathematical norms are what is valued as an effective mathematical solution or what should be included in an acceptable mathematical solution. From participating in classroom practice the individual's perception are influenced by these socio-mathematical norms. The individual's perceptions will then affect the group's socio-mathematical norms.

In the examples scrutinised for this paper, Cobb and Yackel's (1996) framework provides as the analytical tool. Originally, this framework was used to analyse mathematics classroom interactions so that the taken-as-granted ways of behaving, *norms*, could be recognised and their role in determining what occurred in the classroom better understood (see, for example, Kazemi & Stipek, 2001). Cobb and Yackel found the framework had great potential for systematically structuring an examination of an otherwise complex and messy classroom. This framework therefore seemed relevant for exploring tensions between students and teachers.

DATA COLLECTION AND ANALYSIS

The data examined in this paper come from a larger study (Wester, 2015), investigating students' interpretation of their reformed classroom practice. The study was situated in a classroom where the teacher had made a major effort to change her teaching as suggested by the Swedish National Agency, defined earlier. Data from the students' perspective were gathered through semi-structured focus group interviews. These groups consisted of three or four students and were put together randomly. A round of interviews occurred during the spring semester of grade 8, the autumn semester of grade 9 and the spring semester of grade 9. The students were part of the first cohort to experience a new curriculum and a grading system which were implemented to support teacher change.

The extracts should be considered as illustrations, which exemplify how students from this classroom talked about their new teaching practice. Students' perceptions were compared with teacher's intensions. The different ways the issues were discussed were compared in order to identify tensions. These differences identified tensions operating. Three kinds

of tensions occurred: *explicit tension*, *tension inside a norm* and *tension between different kinds of norms*.

Explicit tension

The explicit tensions are easy to get hold off. When discussing classroom practice, students express that they have a different opinion than the teacher about the practice in the mathematical classroom. That is an explicit tension.

The students described how they experienced the mathematics teaching had changed from previous school years. Working in textbooks was no longer seen as the obvious activity connected to a mathematics lesson. Instead, using manipulatives had become increasingly prevalent.

> Student 1: Yes, it's *very practical subject* at the moment, which I think is wrong. So those blocks and so, even drawing and so, which I think is wrong. It's really very practical. And then it's too little, there is very little with books. It's *not so much calculating in books* nowadays. And then it's very much like visualizing the numbers in front of you (2012-05-31). [*Ja, det är väldigt praktiskt ämne just nu som jag tycker är fel då. Så de med klotsar och så, även rita och så tycker jag är fel. Det är väldigt mycket praktiskt. Och sen är det för lite, det är väldigt lite med böcker. Det är inte så mycket man räknar i böcker nu för tiden. Och sen är det väldigt mycket vi ska se talet framför oss.*]

Students stated that teaching was no longer just about calculating in textbooks. The student gave examples of various practical activities. The first sentence in the quote shows explicitly that there is an explicit tension between the student's view about mathematical teaching and the new practice. The student draws on his previous experiences about mathematical teaching, working individually in textbooks (Kjellström, 2005; Skolinspektionen, 2009) to criticise the new practices. The student was not convinced about the value of a new teaching practice towards learning mathematics.

Potential tensions

The hidden tensions that are not expressed explicitly by the students are more difficult to detect. Just because students do not express tensions, do not impose they do not exist. We call these, *potential tensions*. Two kinds of potential tensions were found in the data; *potential tensions inside a norm* and *potential tensions between different kinds of norms*.

Potential tensions inside a norm

In next extracts, students discussed a task where they could use manipulatives. The task instructions were:

> Student 4: *You get to understand exactly how big a cubic decimetre is.* And you realize it can have different shapes. [*Man förstår hur stor en kubikdecimeter är. Och att den kan se ut på olika sätt.*]
> Student 1: It is *rather basic in the beginning*. You start with number one. Do one thing. [*Det är en rätt grundläggande början. Alltså att man börjar med ettan. Gör en sak.*]
> Student 2: It will take some time to cut and paste. [*Det tar ju tid också att klippa och klistra.*]
> Student 4: Yes. It takes a lot of time to put the whole thing together. Folding and taping. [*Ja. Det tar mycket tid att hålla ihopa den. Vika och massa tejp.*]
> Student 3: I think this is rather good, when you are supposed to make different shapes, to get *to know which sizes are possible* to have making a cubic decimetre. You have to understand how big or small a cubic decimetre really is (2012-12-19). [Sen är det rätt bra tycker jag när man ska börja göra olika former på dem att man lär sig *vilka mått man måste ha* för att få just en kubikdecimeter. Så man förstår hur stort eller litet en kubikdecimeter är.]

Students indicated that they knew what it was they were supposed to understand from participating in the activity; getting to visual the actual size of a shape which could hold a cubic decimetre. They also have to understand how the shape could vary. Seeing the different representations of a cubic decimetre is valued by the students, at least early in the group discussion. As the discussion continued, the interpretation of the task above changed. The given task was now discussed in relationship to its teaching context by the students.

> Student 1: That was what it was about in our *lesson before. How to do to make a correct*

calculation. How to get a cubic decimetre. All connected to this task. [*Det fick vi hela lektionen innan. Hur man skulle räkna ut det. Få fram en kubikcentimeter. Se vad det var till uppgiften.*]

Student 2: You have it all *in the textbook*. [*Och det stod ju i matteboken.*]

Student 4: Yes, but this is of course rather ... basic. [Ja men det här är ju väldigt ... grunden.]

Student 1: Actually. This task is connected to exactly what we were discussing in the lesson before. We had a whole lesson on how to calculate it. How to calculate volume of 1 cubic decimetre, and others. And the next lesson was about this task. [*Egentligen. Det här är en uppgift på det vi gick igenom på hela den lektionen. Så vi hade fått egentligen en hel lektion på hur vi skulle kunna räkna ut kubikdecimetern. Eller hur man skulle räkna ut kubikmetern, och massa sånt. Och sen efter det kom uppgiften.*]

Student 4: This task is typical at the beginning of a new chapter (2012-12-19). [*Den här uppgiften är vad man gör i början av ett område.*]

The students now connected the task to what they had done in the previous lesson, which had been about how to calculate volumes. The manipulative activity now shifted into a task about supporting to calculate volume of objects, even though calculations are not mentioned in the task instructions. Understanding the need to visualise the decimetre, discussed by the students in the first part, is now something you just need to do in order to do the calculation properly. The existing *socio-mathematical norm* expressed by the students is to be able to do the calculations (see Table 1). The students experience calculations are easier to do when they have produced representations of the different objects with manipulatives. They thus interpret the purpose of the manipulatives to support calculations and not the understanding of concept of volumes. The students´ beliefs about what school mathematics is about do not allow such an interpretation. In students´ beliefs and values, concepts have a secondary importance in relationship to mathematical procedures. Manipulatives are thus tools doing the mathematics (see Table 1).

The teacher's intentions with the specific task are not in the interviews with her. However, the teacher had expressed elsewhere how she considers manipulatives to support students´ understanding of mathematical concepts.

Teacher: I was teaching multiplication of fractions. The given task was 1/3 multiplied to 3/4. It is really handy if you know how to do it. 1/3 multiplied to 3/4 is just multiplication straight ahead and it will be 3/12. It is easy to rewrite as 1/4. That´s the way. Super easy. But I didn´t stop there. *Why does it works*? Then we used paper strips. (The teacher explained how the multiplication of fraction will be *represented* through the paper stripes). We *visualized*, made it *concrete* and explained. Yes it was not so smooth, if you compared it to the procedure (2013-02-01). [*Vi skulle köra multiplikation av bråk. Då ville jag att vi skulle titta på 1/3 gånger 3/4. Det är ju jättelätt att ställa upp ju. 1/3 gånger 3/4 är ju bara att gånga varandra. Det blir ju 3/12. Det kan man snabbt och enkelt göra om så blir det 1/4. Så gör man ju. Det var ju supersmidigt. Men så försökte jag liksom varför blir det så då? Och så tog vi pappersremsor. (Läraren förklarar hur man kan illustrera uppgiften med pappersremsor) Vi visualiserade, gjorde konkret det det var. Men det är klart lite krångligare. Det andra är bara att ta och gånger varandra.*]

In this quote, the teacher compared the learning of the procedure with explaining and understanding the concepts behind the multiplication of fractions. For the teacher the manipulatives is a tool helping students to gain mathematical understanding of concepts. Developing understanding requires more effort from the students than memorizing a procedure. As the teacher wanted to develop students' mathematical understandings, memorizing procedures was considered a contradiction to this. The *socio-mathematical norm* intended by the teacher is that mathematics is much more than calculating. School mathematics also aims to develop mathematical understanding and thinking (see Table 1).

The socio-mathematical norm suggested by the students and confirmed by the teacher, is that manipulatives are useful tools in mathematical teaching as they can represent and visualize mathematical concepts. But there is a tension in relationship to this norm. Students considered manipulatives useful as a primitive form for solving tasks, and thus less valuable than calculating. The teacher on the other hand, considered them to be a tool for gaining understandings. This is an example when both students and teacher talks about the same norm but give this norm different meaning. There is an example on a *potential tension inside a norm* (see Table 1; tension between students and teacher inside socio-mathematical norm).

Potential tension between different kinds of norms

Teacher's intentions of new socio-mathematical norms described above require a different teaching approach. The new socio-mathematical norms need supporting social norms containing teacher's role, students' role and general activity (Cobb & Yackel, 1996). The teacher wants students to be active seekers of learning through discovering and discussing while working with manipulatives in groups.

> Teacher: From there I put up different kinds of tasks that *used manipulatives*, we try to use the computers part because they actually have their own computers, *much discussion* and *group tasks* so they should learn to *communicate mathematics*, is also trying to get away so that math does not become a writing topic (2012-06-13). [*Och därifrån lägger jag upp olika sorters uppgifter med laborativa övningar, vi försöker använda datorerna en del eftersom de faktiskt har egna datorer, mycket diskussion och gruppuppgifter så dom ska lära sig att kommunicera matematik, försöker också komma ifrån så att matte inte blir ett skrivämne.*]

The students' own thinking challenged and developed through reasoning and discussion. The teacher wants *social norms* containing a student role, teacher's role and a role of activity adapted to a learning landscape (see Table 1; teacher's intensions of new social norms).

In the interviews, students easily express different ways of their new teaching practice. But they never talk about changes in their role as students or the teacher's new role. Instead they keep suggesting traditional roles to the teacher, which they believe make their learning more efficient.

> Student 3 It is better, I think, to work with exercises from the textbook instead of blocks and stuff like that. I think they are hard to learn from. Instead I *want somebody to show me how to do it. Then I have to practice on my own*. [*Det är bättre tycker jag att arbeta med uppgifter man får och inte hålla på med klossar och sådant. Jag lär mig heller ingenting utav det, utan jag vill ha någon som visar så här gör du så får jag träna själv.*]
>
> ...
>
> *Math should be something to calculate*. If you manage to do it in your head it is good. *It should not be necessary to lay it out*. (2012-06-06) [*Matte ska vara någonting du räknar ut. Tänker så blir det bra. Du ska inte behöva lägga ut det.*]

In these quotations, the student is talking about what mathematics is about (socio-mathematical norm). From their socio-mathematical norm the students suggest a supportive social norm; the role of the teacher is to show them how to calculate. Since they keep repeating the supportive social norm it could be seen as an indication of their awareness of the non established social norm.

In the same way have manipulatives has a role supposed to help students to calculate. Students believe using manipulatives is a good method if you do not know how to calculate. For instance, if you are on your way learning something new. But you are later supposed not to use manipulatives if you are able to calculate. This kind of value is an example on a socio-mathematical norm (see Table 1).

Students' suggestions of traditional social norms are heavily connected to their view of socio-mathematical norms. There is a *tension between students' view of*

	Students	*Teacher*
Socio-mathematical norms	School mathematics is about mastering calculations. Manipulatives are tools doing the math.	Math is more than calculating. School mathematics aims to develop mathematical understanding and thinking
Social norms		Creation of a learning landscape contains certain roles.

Table 1: Patterns of potential tensions

socio-mathematical norms and teachers intention of new social norms (see Table 1).

CONCLUSION

Changes in mathematics teaching from a traditional setting toward reform practices give rise to changes in social and socio-mathematical norms. However, it appeared hard for students to understand teacher's intentions of new classrooms norms. Hence a new curriculum and grading system, the change from mastering procedures to developing competences is not discerned by the students. They still believe that school mathematics is mainly about learning procedures. There is a tension between students' interpretation, and the teachers' intention of the reformed classroom practice. This teacher wanted her students to develop mathematical competences and not just learn the procedures. Nevertheless, for the students it is not yet a norm that conceptual understanding should be learned from teaching. This will affect what it is possible for students to learn from using different teaching resources. Students consider the use of manipulatives as interfering with their learning of mathematics. The resources are somehow able to do what the students are supposed to learn from activities. Thus, the students think it is better if they can do the mathematics without them. This is in contrast to the teacher, who is using these resources to support students developing mathematical thinking (Table 1, tension between socio-mathematical norm and social norm).

Students' interpretation of operating socio-mathematical norms interfere students' possibility to catch up teacher´s intention of new social norms. When students are not aware of new student roles and new teacher roles, they are hindered to participate in practise. Even if it looks like they are participating, tensions of this kind works as resistance. Without students are able to understand, there cannot be any agreement which provides new classroom's norms. This might be one explanation to limited success of reform teaching (Jacobs et al., 2006).

Understanding the inherent differences between viewing these resources as part of a social or a socio-mathematical norm, or conceptions of a socio-mathematical norm, provides an indication of why some students might resist reform teaching practices in their mathematics classroom and this will have an impact on the reality of their mathematics learning. This difference could be an explanation to why students do not learn from these resources what teachers aiming for.

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