

(In)consistent? The mathematics teaching of a novice primary school teacher.

HANNA PALMÉR

This article focuses on the mathematics teaching of Helena, a Swedish novice teacher. Helena is one of seven teachers in a case study of primary school mathematics teachers' professional identity development. She is also an example of a teacher whose mathematics teaching, from an observer's perspective, may appear inconsistent with her talk about mathematics teaching. However, in this article a conceptual framework aimed at analysing professional identity development will be used making the process of her mathematics teaching visible and then her mathematics teaching appear as consistent.

This article is about Helena¹, a Swedish novice primary school mathematics teacher, whose mathematics teaching from an observer's perspective, may appear inconsistent with her talk about mathematics teaching. There are many studies regarding novice mathematics teachers, showing how they teach, or more often how they do not teach, as intended based on their teacher training. For example, several of the studies that Cooney (2001), Phillip (2007) and Sowder (2007) refer to in their research reviews show that teacher education has little effect on teacher students, and that what students learn in teacher education tends to decline when they start working as teachers.

One direction within research on mathematics teacher development and change is research on teachers' beliefs. According to Wilson and Cooney (2002), mathematics teachers often appear inconsistent towards their beliefs. Such inconsistency is given different explanations, for example that the investigated beliefs are not the dominant ones in the situation, or that the individual has unconscious beliefs. Other explanations are that the teachers, for some reason or other, do not act according to their beliefs, that concepts are interpreted differently by teachers

Hanna Palmér

Linnaeus University, Växjö

and researchers, or that the former actually act inconsistently with their beliefs (Phillip, 2007). Similar explanations have also been presented in beliefs research within other fields than mathematics education (Fives & Buehl, 2012). However, according to Phillip (2007) and Leatham (2006), the apparent inconsistency between beliefs and actions disappears when researchers better understand teachers' thinking in relation to the context. "[...] [I]nconsistencies exist only in our minds, not within the teachers, and [we] would strive to understand the teachers' perspectives to resolve the inconsistencies. Inconsistencies should still present problems, but for the researchers instead of teachers" (Phillip, 2007, p. 276).

Leatham (2006) writes that inconsistency between beliefs and practice in research "calls for deeper understanding of teachers' beliefs and reconsideration of our inferences as researchers" (Leatham, 2006, p. 92). Others suggest a shift of focus in beliefs research from objectified beliefs to individuals' patterns of participation in social practices (Skott, 2010; Skott, Moeskær Larsen & Østergaard, 2011). The approach used in this article is in line with the latter orientation. A situative conceptual framework will be used to analyse what may appear as inconsistency between how Helena, a novice primary school teacher, talks about and teaches mathematics. The goal is to offer a consistent explanation of the observed differences by making the process of her mathematics teaching visible.

To begin with, the conceptual framework to be used will be presented. After that, the case of Helena will be presented and analysed. The article ends with a conclusion and discussion.

Theoretical framework

Peressini et al. (2004) argue for using a situative perspective in studies of mathematics teachers' teaching. The term "situative" refers to a set of theoretical perspectives and lines of research which conceptualise learning as changes in participation in socially organised activities and individuals' use of knowledge as an aspect of their participation in social practices.

In the study presented here, two situative theoretical perspectives, communities of practice (Wenger, 1998) and patterns of participation (Skott, 2010; Skott et al., 2011), are coordinated in a conceptual framework aiming to capture both the individual and the social elements of professional identity development. Coordinating implies that well-fitting elements from the two theoretical perspectives are used together as they complement each other and thus support a more complete analysis (Prediger, Bikner & Arzarello, 2008). Communities of practice focus on *identity* and *identity development*, while patterns of participation focus

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on mathematics teaching as the *professional* part of professional identity development.

A conceptual framework is, according to Eisenhart (1991), a skeletal structure designed to support or enclose something. The framework presented in this article is aimed at enclosing the process of professional identity development as a primary mathematics school teacher. In this article, the aim of the framework is to analyse the process of mathematics teaching and, for this reason, the whole framework will not be presented, only those parts needed for that analysis.²

According to Skott (2010) and Skott et al. (2011) a teacher participates in multiple simultaneous practices in the classroom and there are patterns in the ways in which the teacher participates in these practices. The aim of doing research on *pattern of participation* is to understand how a teacher's interpretations of and contributions to immediate social interactions relate to prior engagement in a range of other social practices.

In all of this, patterns from the teacher's prior engagement in social practices are enacted and re-enacted, moulded, fused and sometimes changed beyond recognition as they confront, merge with, transform, substitute, subsume, are absorbed by, exist in parallel with and further develop those that are related to the more immediate situation. (Skott et al., 2011, p. 33)

What Skott (2010) and Skott et al. (2011) term *other social practices* will in the coordinated conceptual framework be treated as communities of practice. According to Wenger (1998), identity and identity development involve three simultaneous processes, one regarding communities of practice, another identification and negotiation, and the third memberships in communities of practice. These three processes are interwoven and focus on the same phenomenon, identity and identity development, but from three different perspectives.

Studies that use Wenger's theories from 1998 differ regarding which parts they focus on and how this is done. In the conceptual framework to be used in this article, identification and negotiation through memberships in communities of practice will be focused on. According to Wenger (1998), a community of practice is defined through the three dimensions of mutual engagement, joint enterprise and shared repertoire. Mutual engagement concerns relationships between the members, about them doing things together as well as negotiating the meaning within the community of practice. Joint enterprise regards the mutual accountability the members feel in relation to the community of practice, which is a

result of the mutual engagement. The shared repertoire in a community of practice regards its collective stories, artefacts, notions and actions as reifications of the mutual engagement. This shared repertoire proceeds from, and is a resource in, the negotiation of meaning within the community of practice.

According to Wenger (1998), identity formation is a complementary dualistic process in which one half is identification in communities of practice and the other half negotiation of the meaning (regarding mutual engagement, joint enterprise and shared repertoire) in these communities of practice. An individual can identify and negotiate in communities of practice through engagement, imagination and/or alignment. The three ways of identification and negotiation involve different approaches and conditions and they do not require or exclude each other. Membership through engagement implies active involvement in a community of practice and requires the possibility to participate in its activities. Membership through imagination implies going beyond time and space in a physical sense and creating images of the world, which enables us to feel connected with people we have never met who in some way match our own patterns of actions. Membership through alignment implies that the individual changes, aligns, with the community of practice the individual wants, or is forced, to be a member of. Since membership through imagination and alignment expands membership beyond time and space in a physical sense, individuals can be members of and feel belonging to communities of practices without a visible shared practice.

Skott et al. (2011) write that it is the responsibility of the researcher to disentangle whether and how a teacher's participation in *other social practices* influences the classroom. These *other social practices* can be considered as communities of practice in Wenger's (1998) sense. Coordination between pattern of participation and communities of practice implies that a teacher participates in immediate teaching situations and in communities of practice simultaneously. This double participation is illustrated below in figure 1. The teacher's participation is different (engagement, imagination and/or alignment) in different communities of practice, which implies that there are different possibilities for identification and negotiation. On the basis of an analysis of a teacher's different forms of participation interpretations can be made about communities of practice which the teacher seems to negotiate and/or identify in/with. As the teacher participates in immediate situations and multiple communities of practice simultaneously the merger of these participations is what gives significance to the teacher's actions, the patterns of participation regarding mathematics teaching, in the specific situation.

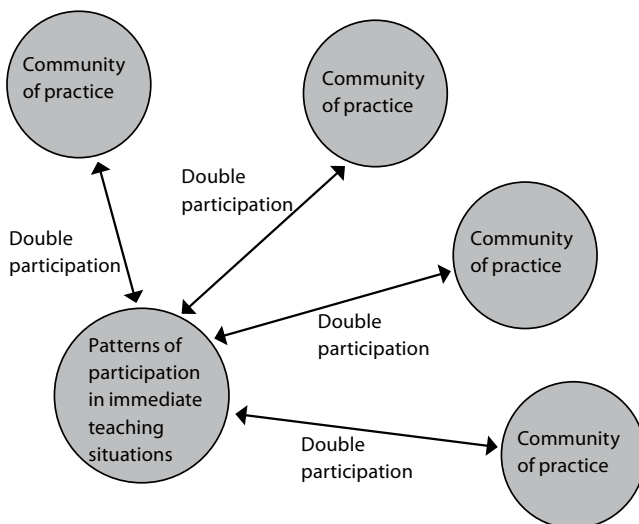


Figure 1. *A mathematics teacher participates in several communities of practice regarding mathematics teaching at the same time as participating in immediate teaching situations.*

The study

The study of primary school mathematics teachers' professional identity development is a case study with an ethnographic approach where seven novice teachers have been followed from their graduation and two years onwards. The ethnographic approach has been used to make visible the whole process of identity development, both the individual and the social part, in line with the conceptual framework above. The novice teachers in the study were selected because they chose to write their final teacher education bachelor theses on mathematics education and by that showed an interest in mathematics teaching.³

The main interest in ethnography is to understand the meaning activities have for individuals and how individuals understand themselves and others (Arvatson & Ehn, 2009; Aspens, 2007; Hammersley & Atkinson, 2007). According to Aspens (2007), reaching such an understanding requires interaction between the researcher and the respondents.

The empirical material in the study consists of self-recordings made by the respondents, observations, and interviews. Time has been used in a selective intermittent way (Jeffrey & Troman, 2004), meaning that the time from the start to the end of the fieldwork has been long (two

years) but with a flexible frequency of field visits. The observations have been whole day observations attending lessons, the teachers' staff room, meetings, etc. During observations, field notes were taken and written up later the same evening. Photos were taken and transcripts from lessons were occasionally e-mailed to the respondents for comment. Formal interviews were recorded and transcribed, as were the self-recordings made by the respondents on mp3-players. This empirical material is used as complete empiricism (Aspers, 2007), meaning that all of the transcribed material constitutes a whole, on which the analysis is based.

The empirical material has been analysed in two steps: first coding, applying grounded theory methods (Charmaz, 2006) and second, the conceptual framework. Coding the empirical material does not imply using pre-constructed codes, but labelling the empirical material, line-by-line, with as many codes as possible (Kelle, 2007). When coding the empirical material patterns were discovered regarding expressions (words and/or actions) within and between mathematics teaching situations and other situations in which the respondents participated. These patterns were then analysed by applying the conceptual framework.

The case of Helena

Helena is one of seven primary teachers in the present study. She has been chosen for this article as, from an observer's perspective; her mathematics teaching may appear inconsistent with how she talks about mathematics teaching. The study includes empirical material from two years starting at the time of Helena's graduation from teacher education. In this article only two different points of time during these two years will be focused on, first, the time of Helena's graduation and, second, her third semester as a novice teacher. However, the analysis of her mathematics teaching the third semester is based on the complete empiricism which implies that her mathematics teaching will be analysed with background in her different forms of participation in different communities of practice during the one and a half years after her graduation.

Directly after graduation Helena starts to work at *Aldro school* and continues to work there for two years. The school is located in a small town with 150 students divided into seven classes ranging from a pre-school class up to grade six. During the first semester, Helena works as a substitute class teacher in grade six. The next semester she becomes the class teacher of the new grade six. It is from Helena's work as a class teacher in this class that the empirical material to be presented further on is derived.

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Below, follows first, a description of how Helena talks about mathematics teaching at the time of her graduation. After that, her working situation during the third semester after graduation is described with focus on her mathematics teaching. Finally, an example from one of her mathematics lessons during that semester is given.

Helena at the time of graduation

Helena is 41 years old when she graduates from teacher education. Before she started teacher education she had worked at preschools and schools for children with intellectual disabilities. At the time of her graduation, Helena says it will be a challenge to make as many students as possible experience mathematics as fun. According to Helena, good mathematics teaching is varied, laboratory-based, reality-related and problem-orientated. The good thing about this way of teaching mathematics is that it is fun and leads to students cooperating, talking and developing a desire to learn and a knowledge about how to learn mathematics.

A good mathematics teacher has, in Helena's opinion, "an ability to ensure that the students really understand". The teacher ought to be able to explain the same thing in many different ways with different learning materials and to adjust to the students. Helena says that she has discovered this way of teaching mathematics during her teacher education.

Less good mathematics teaching is, according to Helena, when the textbook controls the teaching. Then students do not cooperate, but instead they work alone in the textbook. In Helena's opinion, this kind of mathematics teaching ends up with students having poor self-esteem and a poor knowledge of mathematics – "It does not develop any mathematics thinking". However, when she starts to work as a teacher she says she will lean on the textbook since, as a new teacher, one cannot "cope with reforming the world". Later, when she feels secure, she intends to start testing new things in her mathematics teaching.

Helena – the third semester after graduation

As mentioned above, Helena is now a class teacher in grade six at Aldro school, where she has been working for over one year. There are many problems in the class with students acting out and with the noise level. Almost every mathematics lesson in the class starts with Helena demonstrating something on the board, and then the students work in their textbooks. Since the students have not had enough mathematics in grades four and five, they lag behind, according to Helena, and need to work a lot and fast with the textbooks. Helena has a plan for how the

students are to finish the textbooks before the end of the school year by dividing the chapters in relation to the number of school weeks available.

A basic course is around ten pages and then a red or blue course is about six pages. After every second chapter there is a test. Preferably two to two and a half weeks for every chapter. It is about that. Sadly, I feel we will have to cut the problem-solving part. In the textbooks. I would like to work more with discussions but we will not have time for that. (Interview with Helena)

Her motive for the time plan is to ensure that all students are confronted with all parts in the textbooks before the end of the school year. However, she feels "really stressed" by the tempo and says that she "would like to do this at a much slower pace" with more practical tasks and whole class discussions.

The working environment between Helena and the other teachers at the school is positive. The teachers talk about organisational matters, e.g. who is going to supervise the schoolyard during breaks and who is going to supply-teach for colleagues on sick leave. The teachers also talk about private matters but seldom about teaching.

Helena also works with teachers from other schools in the municipality, creating common goals in science. Since most of the teachers in the group also teach mathematics, they often discuss mathematics teaching. They talk about the importance of all children in the upper primary school being acquainted with the mathematics contents of grade six. The teachers from lower secondary school in the group complain that students who have not reached the goals of grade five have to spend the whole of grade six working to accomplish them and, as a consequence, miss the mathematics contents of grade six.⁴

When talking about good mathematics teaching, Helena uses the same words as before graduation, for example fun, varied, reality-related and problem-orientated. When talking about mathematics teaching she emphasizes the importance of students' understanding and of adjusting the mathematics teaching to the students. But when planning her mathematics teaching, the setting is another.

Not all students manage to do all tasks in time. [...] But we start on a new chapter anyhow and you simply have to skip what is left. And then we move on. [...] And you try to remind them that now there is only one more lesson. Now you have to focus during this lesson also. You need this time and we are here for you. (Interview with Helena)

A great deal of Helena's interaction with the students during the mathematics lessons regards their behaviour and them needing to put more energy into their school work. Helena emphasizes that students should

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work "neatly" in their textbooks and that all answers are to be written in units, since "it works like that in secondary school".

An example of a mathematics lesson: An introduction to statistics

The lesson to be presented in this section is when Helena is introducing a new chapter in the textbook on statistics.

It is not such a gigantic area, statistics. [...] They [the chapters in the textbook] are usually about ten pages [...] but there are quite a lot of pictures, fairly large pictures so there are not so many tasks. [...] This chapter is not really that big. (Interview with Helena)

The day before the introduction, Helena had asked the students to cut statistics out of magazines after completing another task. However, no students had done so, and therefore, Helena herself has cut examples of statistics from a newspaper during the break before the lesson.

At the start of the lesson, Helena asks the students where statistics are to be found in a newspaper. None of the students raise their hands. Helena repeats the question encouraging them to "think" about what statistics are needed for and why you "need to know". One student says "the weather pages" and Helena answers approvingly that statistics are good if, for example, you want to know the amount of snow.

Then she puts up the cuttings she has arranged during the break, one at the time. The first shows a line chart of changes in energy prices and Helena says that this is important information for everyone who owns a house. Then a discussion about energy prices and saving electricity starts and continues for about five minutes. Almost all students in the class and Helena are engaged in this discussion. The next cutting shows a bar chart of the number of people who are reported sick during different months of the year. The third cutting is another line chart, this time regarding mortgage interest rates. Since the students do not know what that is, a new fairly long discussion follows. Then the two last cuttings are put up, one of a bar chart of crimes and the other a sports chart. After the last cutting, Helena says: "This thing about statistics is not just something existing in your textbook but is all around us. Also on the TV news". Then she says that the students will have a little time to work in their textbooks. "Now, start at page 96, think of reading the examples very carefully. What do they say? Give yourself time to understand" (Observation of Helena). The students start to work in their textbooks, but after five minutes Helena interrupts them by saying that unfortunately they have to finish as the lesson has come to an end. In an interview after the lesson she says it was a pity the students did not have time to "get started working".

Analysis

Helena's descriptions of good, and less good, mathematics teaching at the time of her graduation from teacher education can be understood as her having membership in a community of reform⁵ mathematics teaching. In this community of practice, there is a joint enterprise and a shared repertoire regarding good and less good mathematics teaching.

The core of the community of reform mathematics teaching is located within teacher education. Helena says that she discovered this way of teaching mathematics during her teacher education. As such, her membership may not have been optional but mandatory for passing the exams required for her teacher education degree. However, she expresses no alignment with anything; rather, she speaks of her motivations in the first person, for example. "I believe good mathematics teaching is when students have access to learning materials. [...] I love these multiplication games we made. [...] I also like the games and the problem cards. I like them" (Interview with Helena).

As for engagement, Helena does not express being a part in the negotiation of the shared repertoire in the community of reform mathematics teaching, but she has been engaged in its teaching during her teacher education, for example when making the multiplication games and problem cards, as mentioned in the quotation above.

Then, the third semester, four communities of practice are visible in Helena's pattern of participation: the above described community of reform mathematics teaching, a community of teachers at Aldro school, one of teachers working with common goals in science, and a community of practice with the students in the class. As mentioned above, the analysis of these four communities of practice is based on the complete empiricism, the ethnographic data of her throughout the three semesters, of Helena as a teacher at Aldro school.

Most visible in Helena's mathematics teaching is the shared repertoire of the community of teachers working with common goals in science. Her emphasis on completing the textbook, on telling students to work "neatly" in their textbooks and write their answers in units, since "it works like that in secondary school" are examples of such visibilities. In this community of practice, Helena is a member through engagement and maybe also by alignment and imagination in a wish to receive positive feedback from the lower secondary school teachers. The central part of the shared repertoire in the community seems to be the students being confronted with all parts within the textbook, and not the learning of those parts. Completing the textbooks is central in Helena's teaching, and the mathematics lessons are planned on the basis of the number of pages in the textbook and not on the mathematics contents.

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The shared repertoire in the community of [mathematics teaching in] the class partly overlaps with the shared repertoire of the community of teachers working with common goals in science. All students are to be confronted with all of the contents of the math book. Based on how Helena plans her mathematics lessons, on what she emphasises when talking to the students and on what she says to other teachers and the researcher, the overriding aim of her mathematics teaching in grade six seems to be to prepare the students for grade seven; not primarily with regard to knowledge, but to study skills, writing units and reading the examples in the textbook. Helena is engaged in getting the students to align with this shared repertoire. Almost all of her interactions with the students focus on this or on their behaviour.

The community of reform mathematics teaching is not as visible in Helena's mathematics lessons as the community of teachers working with common goals in science. Instead, her membership in this community is mainly visible in her talk about good mathematics teaching and what she would like to do. Just as at the time of her graduation from teacher education, she says that good mathematics teaching is fun, varied, reality-related and problem-orientated. She says that she would like to teach like this, but when planning her mathematics teaching, the setting is another. As such, her membership in the community of reform mathematics teaching mainly takes the form of imagining what

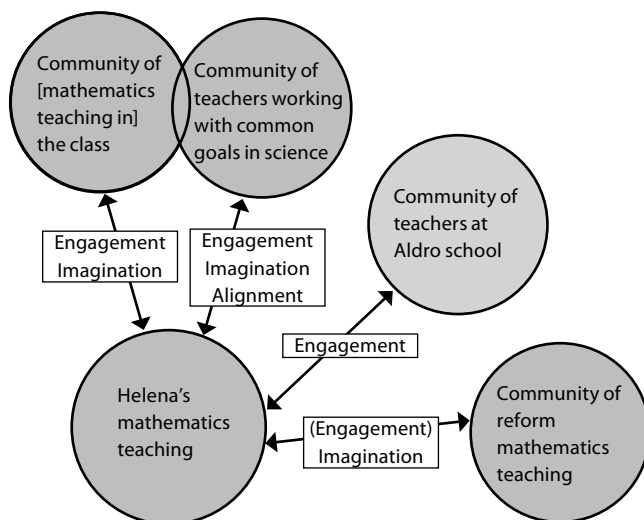


Figure 2. *Four communities of practice are visible in Helena's patterns of participation during the third semester*

she would want to do if she had more time. The mathematics teaching she performs is more in line with the teaching she described as less good before graduating.

Nor does the fourth community of practice, the community of teachers at Aldro school, influence Helena's mathematics teaching. She is a member by engagement but the shared repertoire in this community does not include [mathematics] teaching.

Helena's different memberships in the four communities of practice described above are illustrated in figure 2. However, only three of them influence her mathematics teaching. Helena's participation (engagement, imagination, alignment) in the four communities of practice differs. The shared repertoire in the community of [mathematics teaching in] the class and the community of teachers working with common goals in science partly overlap.

The lesson introducing statistics contains elements from the community of reform mathematics teaching, the community of teachers working with common goals in science, and the community of practice with the students in the class. The overall view of the area is based on the number of pages about statistics in the textbook. The textbook is central in the community of teachers working with common goals in science. The cuttings from the newspaper are a way of making the teaching reality-related and Helena also says to the students that statistics do not only exist in their textbook. Both these expressions are in line with the shared repertoire in the community of reform mathematics teaching. It is questionable whether energy prices and mortgage interest rates really shape the reality of twelve-year-olds, but the cuttings engage them in long discussions. Discussions in mathematics form part of the shared repertoire in the community of reform mathematics teaching. However, the discussions during the statistics lesson are not really about the mathematics contents and it is doubtful whether statistics are made visible in the introduction. For example, the different kinds of graphs are not discussed; nor is their role in the cuttings. After all the cuttings have been put up and the students start to work in their textbooks Helena tells them to read the examples carefully and, Helena says after the lesson, it is first when the students work in their textbooks that they start to "work".

As such, the lesson in statistics is an example of Helena's merged pattern of participation regarding mathematics teaching where the community of reform mathematics teaching (reality-related, discussions), the community of teachers working with common goals in science (the basis in and the focus on "work" in the textbook) and the community of [mathematics] in the class (students reading the examples very well, finishing the textbook) are visible (figure 3).

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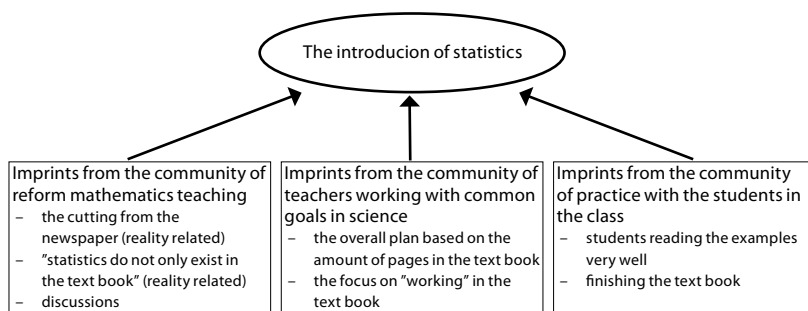


Figure 3. An illustration of imprints from the three different communities of practice in Helena's introduction of statistics

Conclusion and discussion

Before her graduation Helena had a clear vision regarding good and less good mathematics teaching. Three semesters later she still talks about good and less good mathematics teaching using the same terms as before graduation but this talk is not in line with her performed mathematics teaching. Before graduation, the focus was on students' understanding; whereas three semesters later her mathematics teaching focuses on students' doing. Before graduation, the textbook was associated with less good mathematics teaching; three semesters later the textbook is the exclusive core of her mathematics teaching. Before graduation, Helena talked about the importance of adjusting the mathematics teaching to the students; three semesters later the students have to adjust to the plan of completing the textbooks before the end of the semester.

If only looking at what Helena says and what she does, she appears to be inconsistent. Different explanations could be given for such inconsistency. For example, she herself says that she would need more time to be able to teach mathematics the way she would like to. However, if analysing the process of the mutual influence between her merged patterns of participation and her memberships in different communities of practice, her mathematics teaching appears consistent from the start without any inconsistency that needs explaining. By using the conceptual framework the process of her mathematics teaching becomes visible.

According to Wenger (1998), identity formation is a complementary dual process in which one half is the identification in communities of practice and the other half is negotiation of the meaning (negotiation about the mutual engagement, joint enterprise and shared repertoire) in those communities of practice. Identification can be made through engagement, imagination and/or alignment. Negotiation can only take

place through some kind of interaction. This could be one explanation why Helena's mathematics teaching is more visibly affected by the communities where she is a member through engagement (the community of [mathematics teaching in] the class and the community of teachers working with common goals in science). Those memberships offer both parts of the dual process of identity development: identification and negotiation. Three semesters after graduation Helena is a member in the community of reform mathematics teaching mainly by imagination and consequently she cannot negotiate. Therefore half of the dualistic process of identity development is missing. Helena is also a member by engagement in the community of teachers at Aldro school, but, as mentioned above, the shared repertoire in that community does not involve [mathematics] teaching.

According to Skott (2001, 2004), teachers have multiple and sometimes conflicting teaching priorities which are brought together in every teaching situation. Decision making with conflicting motives forces teachers to prioritise. If it is not possible to integrate the visions of mathematics teaching with other broader teaching goals, the teaching will not be in line with the reform. Even when believing in the reform, other demands and/or goals with the teaching can take priority, making the teaching look inconsistent to an observer. In the case of Helena, it seems as if she prioritises the demands and/or the goals of the communities of practice where she is a member by engagement. Sadly, however, Helena's merged patterns of participation regarding mathematics teaching really don't seem to focus on the learning of mathematics.

Through following Helena by applying an ethnographic approach and by analysing the empirical material within the conceptual framework, both the individual and the social aspects of professional identity development are visible, and teaching that may look inconsistent in the eyes of an observer becomes consistent. Besides, the decline often referred to, of teacher students' mathematics teaching when they start working as teachers can be explained as not a decline but as an onward process.

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Notes

- 1 Helena is a pseudonym as well as the name of the school where she starts to work.
- 2 For a complete presentation of the framework see Palmér (2013).
- 3 A primary school teacher in Sweden can teach several different subjects. Sometimes two teachers work together with two classes and then they do not teach all subjects.
- 4 During the time of this study there were goals and national tests in grade five and nine in Swedish schools. The students at Aldro school change school and teacher after grade six.
- 5 The term "reform" used for this community of practice is based on Helena's use of the word in relation to her description of good mathematics teaching. This community of practice has been visible in all the seven cases in the study of primary school mathematics teachers' professional identity development; as such, its "existence" is based on more than just Helena's expressions. *Reform* in the community of reform mathematics teaching is to be understood as reform from the perspective of the respondents. For a more thorough description see Palmér (2010) and/or Palmér (2013).

Hanna Palmér

Hanna Palmér is a postgraduate student in mathematics education at Linnaeus University, Sweden. Her main research interest is the professional identity development of mathematics teachers and the work with and learning of mathematics of children in pre-school, pre-school class and lower primary school.

hanna.palmer@lnu.se

