Chapter 12
How to Understand Changes in Novice Mathematics Teachers' Talk About Good Mathematics Teaching?

Hanna Palmér

Abstract This paper focuses on how novice primary-school mathematics teachers talk about (good) mathematics teaching in general and mathematics textbooks in particular at the time of their graduation from university and a year later. The changes in their talk are discussed first in terms of beliefs research and second from a participatory perspective on identity formation. A comparison of findings with the two approaches shows that what beliefs research often explains as changes in belief, inconsistency, or hidden beliefs can be understood as identity formation in communities of practice from a participatory perspective.

12.1 Introduction

The shift from teacher education to actual teaching has long attracted interest from the community of mathematics educators. As an extension of that interest, studies on student teachers and novice teachers has been conducted from the perspectives of beliefs research (e.g., Phillip, 2007; Wilson & Cooney, 2002), mathematical knowledge for teaching (e.g., Hill, Sleep, Lewis, & Ball, 2007; Ponte & Chapman, 2008), and identity (e.g., Beijaard, Meijer, & Verloop, 2004; Skott, 2015). In beliefs research, several studies have reported that new methodological and pedagogical ideas learned in teacher education tend to regress when novice teachers begin working as teachers. Other studies have reported that novice teachers are inconsistent in their beliefs (Phillip, 2007; Wilson & Cooney, 2002).

In response to those findings, this paper focuses on how three novice mathematics teachers discuss (good) mathematics teaching in general and mathematics textbooks in particular at the time of their graduation from university and a year later. Experiences often explained in beliefs research as regression or inconsistencies are elaborated upon from a participatory perspective focusing on identity formation. The purpose of the study is to put novice teachers' talk in relation to their contexts

H. Palmér (✉)
Linnaeus University, Växjö, Sweden
e-mail: hanna.palmer@lnu.se

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and thereby be able to reconcile contradictions or inconsistencies found in earlier studies. The research questions considered are twofold:

- How do novice teachers talk about (good) mathematics teaching in general and mathematics textbooks in particular change during the year following their graduation from university?
- How can those changes, if any, be understood from a participatory perspective on identity formation?

As an introduction, some issues about the national (Swedish) context regarding mathematics teaching and textbooks will be described, however, such focus does not imply that the results are valid only within the Swedish context. Although a national evaluation in 2009 (Swedish Schools Inspectorate, 2009) indicated that most mathematics lessons in Sweden involved students' individual work with textbooks, Sweden has no national regulations regarding how or even whether to use textbooks, or which textbooks to use, if any. At the same time, textbooks are often discussed in negative terms by Swedish mathematics teachers, and having students work individually with textbooks is sometimes cited to explain students' declining performance in mathematics (Neuman, Hemmi, Ryve, & Wiberg, 2014). In many ways, the debate aligns with international reform proposals made in 1991 (NCTM, 1991) that advised spending less time on "paper-and-pencil drills" (p. 19) and more time on group work, discussions, and applications in real-world contexts to connect mathematics to other areas of the curriculum.

12.2 Becoming a Mathematics Teacher

Several studies have reported that teacher education has limited impact on student teachers, because, following graduation from university, they tend to exhibit regression in what they learned in teacher education once they start to teach. By contrast, their individualschooling prior to teacher education is often considered to be an important value in relation to how they think about teaching and how they teach, as the overview in Wang, Odell, and Schwille (2008) shows.

Several studies on the process of becoming a mathematics teacher have focused on the beliefs of student teachers or novice teachers, if not both, and thereby raised fundamental questions about whether beliefs change or remain static and, if the former, then how best to change beliefs. Several such studies have indicated that novice teachers appear to be inconsistent in their beliefs or act inconsistently in relation to their beliefs (Phillip, 2007; Speer, 2005). Such inconsistency has been explained in various ways—for example, by arguing that different beliefs dominate in different situations, that individuals have unconscious beliefs, that beliefs are situated, that individuals are actually being inconsistent, or that researchers and participating teachers have different interpretations of concepts (Phillip, 2007; Speer, 2005).

According to Wilson and Cooney (2002), inconsistency observed in teachers' beliefs and actions could occur for several reasons. Researchers and participating teachers may have different interpretations of concepts, or a teacher might not intentionally act in line with his or her beliefs in certain situations due to practical or logistical circumstances. It is also possible that the specific beliefs studied are peripheral and that more central beliefs are the ones being expressed in the actions. Phillip (2007) and Speer (2005) have highlighted the problem among researchers of claiming that teachers are being inconsistent. According to Speer (2005), researchers attribute all beliefs, and therefore to say that teachers' actions do not align with their beliefs expresses an opinion of the researchers, not the participating teachers. In response to that problem, Phillip (2007) implies that inconsistency ceases to exist when researchers better understand teachers in relation to their social environments.

12.3 Theoretical Framing

To avoid attributing beliefs to teachers that later indicate false regression or inconsistency, Skott (2015) has advocated using participatory perspectives that focus on processes. Participatory perspectives imply theoretical perspectives and lines of research that conceptualize learning as changes in participation in social practices (Borko, 2004). To *participate* means both to absorb and to be absorbed in a community. From a participatory perspective, the physical and social context in which an activity occurs is integral to the activity, and, in turn, the activity is integral to the learning that takes place within it. Sfard (2006) has described this duality as the "individualization of the collective" and the "collectivization of the individual" (p. 158).

From a participatory perspective, becoming a teacher is a process of increased participation in the practice of teaching and, by way of that participation, becoming knowledgeable in and about teaching. To be understandable, teacher-learning needs to be studied in the multiple contexts in which teachers perform their jobs and by taking into account both individual teachers and the social systems in which they participate (Borko, 2004).

The participatory perspective used in this paper is Wenger's (1998) social theory of communities of practice. According to Wenger (1998), individuals are constantly involved in dual process of identity formation, in which one half involves identifying with communities of practice, whereas the other involves negotiating the meaning of mutual engagement, shared repertoire, and joint enterprise in the communities of practice. Mutual engagement encompasses the relationships among members in a community of practice, whose mutual engagement allows them to build a shared repertoire based on collective stories, artifacts, notions, and actions. By extension, mutual engagement fosters mutual accountability—a joint enterprise—that the members feel in relation to the community of practice.

Membership in communities of practice can be focused on regarding individual's identification and/or negotiation within or between communities of practice, based on the learning trajectories within and between communities of practice. Individuals can identify with and negotiate within communities of practice by way of engagement, imagination, and alignment, each of which involves different approaches and conditions and does not necessarily require or necessarily exclude the others. Since imagination and alignment expand participation in communities of practice beyond time and space, individuals can be members of and feel a sense of belonging to communities of practice despite the absence of visible shared practice. Within and between communities of practice, individuals' learning trajectories can be peripheral, inbound, inside, on the boundary, or outbound.

12.4 The Study

The study was a case study of seven novice primary-school teachers in Sweden that lasted from their graduation from university until 2 years later (Palmér, 2013). Their teacher education comprised 3½ years of university study, during which all seven participants specialized in mathematics, hence their inclusion in the study. In Sweden, teacher education integrates professional and subject-specific study at the same time. The structure of teacher education in Sweden at the present time allowed students to choose the number of courses—for at least 15 credits and 52.5 credits at most—in mathematics education that they completed during their teacher education. Participants were contacted during the last semester of their teacher education, and all requirements regarding information, approval, confidentiality, and appliance advocated by the Swedish Research Council (2008) were followed during their recruitment and participation.

Three of the participants, Barbro, Nina, and Helena, were selected for this paper because their cases illustrated the phenomenon under study. Barbro was 22 years old at graduation and had earned 22.5 course credits in mathematics education; Nina was 24 years old at graduation and had earned 37.5 course credits in mathematics education; and Helena was 41 years old at graduation and had earned 45 course credits in mathematics education. At the time of the study, Sweden did not offer any national or local teacher induction and because there were more qualified teachers than positions available, it was difficult for novice primary-school teachers to secure teaching jobs.

An ethnographic approach was followed to make the process of identity formation in communities of practice visible (Aspers, 2007; Hammersley & Atkinson, 2007). Empirical material was collected from self-recordings made by the participants on mp3 players, as well as from observations and interviews. For the self-recordings, participants were instructed to decide what was important for the researcher to know about starting to work as a primary-school teacher of mathematics and to therefore record whatever they wanted at any time and for as long as they wanted. In line with the ethnographic approach (Aspers, 2007), both formal (with template during lessons) and informal (between lessons) observations were made,

and the interviews included both spontaneous conversations during observations and formal interviews that followed thematic interview guides.

In the analysis, the ideas and thoughts expressed by participants in self-recordings, interviews, and observations were treated as narratives. According to Cortazzi (2001), collecting and analyzing several narratives makes it possible to distinguish participants' perspectives on particular themes and processes. The joint theme in focus during the study was how participants talked about (good) mathematics teaching in general and textbooks in particular. Coupled with observations, the narratives were interpreted in relation to communities of practice in which the participants seemed to negotiate or identify with, if not both, and examined for how they were influenced by those communities, if at all.

12.5 Results

The results are presented in three subsections: one addressing the participants at the time of their graduation from university, another that presents their individual experiences a year after their graduation, and the last that discusses the analysis of the three cases in terms of the theory of communities of practice.

12.5.1 The Time of Graduation

Interviewed individually at the time of their graduation, Barbro, Nina, and Helena said that they had discovered a "new approach" to mathematics teaching during their teacher education and expressed a clear desire to "reform mathematics teaching." When asked to give examples of the approach, they discussed lessons "outside the frame" of the textbook. In describing what constitutes good mathematics teaching, they emphasized teaching in which students do not realize that they are being taught mathematics, and the examples that they gave can be summarized as varied, laboratory-based, concrete, reality-related, and problem-oriented mathematics lessons.

Helena:	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.
Researcher:	What makes them good?
Helena:	The games are fun. Partly because many of them [the students] do not think of themselves doing math [while playing the game] at the same time as they actually get practice. Often, they do these things with someone else. There can be two or more [students working together]. Then they learn from each other. You hear their dialogues and they check on and inform each other. […] That also increases their understanding.

As Barbro, Nina, and Helena discussed the "new approach" to mathematics teaching, they referred to themselves and their fellow students from the teacher education program as "we." They also distinguished the "new approach" and their experiences as students in school from the teaching that they encountered during their preservice teaching.

> [I have] been at two different schools quite a long time and it feels like many teachers are very controlled by the textbook and that is what counts. (Nina)

The participants discussed experiences from their schooling and preservice teaching as "old-fashioned" and "traditional" and as mathematics lessons that followed a "patterned scheme" within the "frames" of the textbook.

> […] you are that closely tied to the text book that you don't dare leave it. But then maybe I had both the advantage and disadvantage of having a very experienced placement supervisor who had been at the same school for forty years and who probably had been teaching the same way these forty years. So, she was very controlled by the text book. (Barbro)

12.6 The First Year After Graduation

It was difficult for participants as novice primary-school teachers to secure teaching positions at the time of their graduation. Barbro began working as a substitute teacher, meaning that on a given day, if she were fortunate, she would receive a call in the morning and have a job as a substitute teacher for at least that day, if not the days that followed as well. Barbro combined those temporary teaching jobs with other kinds of temporary work. Because she worked at several schools, often for no more than a few days at a time, she did not develop any close relationships with other teachers during her first year after graduation. Working as a substitute teacher meant that she did not create lesson plans but taught mathematics lessons planned by the regular teachers and given to her as notes:

> It [the lessons] is so much the textbooks. It is the textbooks all the time. I have to adjust to that right now, I have to. […] it is mostly the textbooks and I feel like that is not really me. As I probably said the last time, it's more hands-on things, I want to pick and potter and get them to understand in that way. (Barbro)

Nina starts to work as a teaching assistant for a boy with attention deficit hyperactivity disorder. She likes the school where she works, although her work as a teaching assistant prevents her from developing any close relationships with other teachers at the school apart from Diana, the teacher whom she assists. Nina describes spending lessons, breaks, and afternoons with the boy. About Diana, Nina says that she is like a "tutor" to her and that they are "very close." When she talks about the mathematics lessons in the boy's class, Nina refers to them as "our mathematics teaching" and "our class." Since Nina has no time for planning, Diana is the one planning the mathematics lessons, based on a textbook that Nina reports "actually" liking, partly because it differs from "the ordinary ones she used when she was little." She stresses that every chapter of the textbook starts with the goals for that chapter, followed by a "math lab" in which students work with "practical material" in pairs.

Helena represents one of the few graduates to secure a full-time teaching position immediately after graduating from university. She works as a classroom teacher in an upper primary school (Grades 4–6) where she develops close relationships with several of the other teachers. Aside from her teaching colleagues at the school, she has also met with a group of teachers from other schools in the municipality several times each month to create common goals for teaching science. Since most of the teachers in the group also teach mathematics, they often discuss mathematics teaching as well. According to Helena, teachers in the group from lower secondary school (Grades 7–9) complain that students who have not reached the goals of Grade 5 spend all of Grade 6 working to accomplish them and consequently do not learn the mathematics content of Grade 6. In response, the group has often discussed the importance of acquainting all children in the upper primary school with the content in the mathematics text book for Grade 6. In the second term of that year, Helena buy copies of a new textbook for her class in Grade 6, a reform-inspired textbook that she evaluated as part of an assignment during her education as a teacher. She plans her mathematics teaching for the upcoming term around the goal of having students complete the textbook throughout the year, with the chapters in the textbook set to regulate what happens in her mathematics lessons and when.

12.6.1 How to Understand the Three Cases?

When comparing how the respondents talk about (good) mathematics teaching and textbooks at the time of their graduation and then one year later, there are both similarities and differences. Shortly before graduation, they all described mathematics teaching based on a textbook in negative terms and as "old-fashioned" and "traditional." A year later, Nina reported "actually" liking the textbook used in the class where she has worked as a teaching assistant, whereas Helena has bought copies of a new textbook for her class and based the plans of all of her mathematics teaching on the textbook. Conversely, Barbro showed no changes in her discussion of textbooks after a year's time. Thus, one could say that Barbro's beliefs about textbooks are consistent but that Nina's and Helena's beliefs have changed. Or, setting aside the question of changing beliefs, one could argue that Nina and Helena are inconsistent or that they, at the time of graduation, had other hidden or unconscious beliefs that became more influential once they started actually teaching mathematics. In any case, Barbro, who had earned the fewest course credits in mathematics education, did not change the beliefs that she expressed at the time of graduation, whereas Helena, who had taken twice as many credits as Barbro, changed the most.

As shown, schooling prior to attending teacher education often has important value in relation to how novice teachers conceive teaching and actually teach. In that sense, Nina's and Helena's "change" could have stemmed from their schooling and experiences as students. However, Nina says that the textbook that she has used differs from "the ordinary ones she used when she was little," and Helena bought copies of a reform-inspired textbook that she evaluated during her education as a teacher.

How can the cases be understood from the participatory perspective of identity formation in communities of practice? Barbro, Nina, and Helena expressed highly similar ideas about good mathematics teaching and textbooks at the time of graduation, which can be understood as they being members of a community of reform mathematics teaching. The core of that community seems to be within teacher education involving a shared repertoire and joint enterprise regarding textbooks and good mathematics teaching. At the time of graduation, all three respondents participate in this community through engagement and imagination, as they imagine themselves as teachers. As for engagement, they do not talk about being a part of the negotiation of the shared repertoire, but they have been engaged in its teaching during their teacher education. Since the core of the community of reform mathematics teaching seems to be within teacher education, their membership may have been mandatory to pass their exams; however, none of the participants discussed aligning themselves with anything against their wishes.

In the case of Barbro, no changes are visible the year after graduation; she talks similarly about her views on what constitutes good mathematics teaching and uses words such as "old-fashioned" and "traditional" when talking about textbooks. Even though she is not engaged in the community of reform mathematics teaching (not teaching in line with its shared repertoire), she imagines herself teaching in line with its shared repertoire in the future. Her work as a substitute teacher has prevented her from working closely with other teachers, and therefore she has not joined any new communities of practice with shared repertoires regarding mathematics teaching that could have influenced her ideas about good mathematics teaching and textbooks.

Nina uses the word "actually" when she says that she likes the textbook used in the class where she works, which indicates that she is aware that she is talking differently about textbooks now than before. However, the words she uses to describe why she likes the textbook are similar to the words she used to describe good mathematics teaching at the time of graduation. Then, she expressed good mathematics teaching as varied, laboratory-based, concrete, reality-related, and problem-oriented. One year later she describes the textbook as good because it includes the use of practical material, math labs, and students working in pairs and showing their different solutions. Thus, even though Nina has not had opportunities to participate by engagement in the community of reform mathematics teaching since she graduated from teacher education and started to work as a teacher assistant, she still seems to align with its shared repertoire. The choice to use a textbook in "our class" was made by the only teacher Nina cooperates with and she says "our mathematics teaching." Thus, her cooperation with the class teacher can be understood as an emergent community of practice where her talk about good mathematics teaching and textbooks 1 year after graduation seems to be a merger of the shared repertoires in these two communities.

Helena is the one of the three participants who has changed the most since graduation. During the year, she cooperates with teachers in what can be understood as a

community of teachers working with common goals for science teaching. These teachers have a mutual engagement in negotiating a shared repertoire regarding how best to teach mathematics and science. This shared repertoire involves the importance of all students in grade 6 getting through all of the content in the textbook. Her membership in this community through engagement changes how Helena talks about good mathematics teaching and textbooks. The goal of her mathematics teaching becomes to ensure that all of her students work through the entire textbook before the end of the school year. The textbook is reform-oriented, but the way she uses it indicates that she is an outbound member of the community of reform mathematics teaching (mainly participating by imagination) and an inbound member of the community of teachers working with common goals for science teaching (participating by engagement). This shift is understandable since the mutual engagement and negotiation in the community of teachers working with common goals for science teaching is much more intense than her imagined membership in the community of reform mathematics teaching.

12.7 Conclusion

The findings describe the talk of three novice primary-school teachers regarding (good) mathematics teaching in general and textbooks in particular at the time of their graduation from university and a year later. The aim of this paper was to illustrate how changes during a year's time can be understood from a participatory perspective on identity formation. As mentioned in the introduction, Speer (2005) as well as Wilson and Cooney (2002) has emphasized that observed inconsistency between teachers' beliefs and actions can have several explanations not connected to inconsistency. Similarly, Phillip (2007) has stressed that inconsistency ceases to exist when researchers better understand teachers in relation to their social environment. The analysis of the three cases represents an example of better understanding removing inconsistency. By using the participatory perspective of Wenger's (1998) social theory of communities of practice, what at first glance could have been understood as latent or unconscious beliefs, or even as inconsistency or regression, can be understood as changes in participation in social practices. The three cases illustrate how becoming a teacher is a process of increased participation in the practice of teaching and how novice teachers, via their different forms of participation (i.e., engagement, imagination, and alignment) in different communities of practice, develop their identities as teachers differently. Altogether, to understand the talk and teaching of (novice) mathematics teachers, a participatory perspective on identity formation has much to offer, and to make teacher learning understandable, the multiple contexts in which they participate and perform their jobs should be considered.

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