BELIEFS AND KNOWLEDGE FOR TEACHING MATHEMATICS IN SCHOOL IN THE NARRATIVES OF IDENTITY

Hanna Palmér
Växjö University, Sweden

This paper proceeds from a research project investigating the professional identity development of novice mathematics teachers. Both beliefs and mathematical knowledge for teaching are essential parts of mathematics teachers’ professional competence. The focus in the study is therefore beliefs and knowledge for teaching mathematics in school as building blocks in the identity process of becoming a mathematics teacher. Identity is man-made, and is constantly being created and re-created in collectively shaped interactions. The focus of this paper is how identity development is tackled methodologically in the research project. An example will illustrate how the identity development is made operational in the study in the narratives novice teachers tell about themselves as professional teachers:

INTRODUCTION

Hanna: When do you become a teacher?
Jenny: Graduation
Hanna: Is it the day of the graduation? […]
Jenny: I mean, you’re really not [reflecting about when she can call herself a mathematics teacher], before that you don’t feel accepted by society, so to speak. It’s that role that, yes. And then you also think about yourself, your competences, what you feel like you know and can do. Sometimes I don’t believe I’m a teacher. Because then I’m kind of, because I don’t have the competences that an English teacher has, for instance.

The transcript above is from an interview with Jenny, a prospective primary school teacher of mathematics and science. The interview was conducted immediately prior to her graduation, and is part of a research project investigating the professional identity development of novice mathematics teachers. The research project’s focus is on the structures of the new primary teachers’ identity building, that is the narratives they tell about themselves as professional teachers (Sfard & Prusak, 2005). This paper will focus on how identity development is tackled methodologically in the research project. The first section presents some of the key concepts of beliefs and of mathematical knowledge for teaching and outlines possible relationships between the two and their role in one’s identity development as a mathematics teacher. The aim of this first section is not to give an exhaustive account but to elucidate some of the essential concepts and relationships in the research project that are of importance for the methodological focus that follows in the second section.

THEORETICAL CONSIDERATIONS

The professional identity of a mathematics teacher develops throughout her pre-service education and into the first years of teaching. This identity development can be described as a learning process (Sfard & Prusak, 2005) that may involve theoretical knowledge from teacher education, school-based professional development, and a possible merger between the two. The content of the resulting professional competence and its relationship to classroom practices present a somewhat controversial question. In different studies, beliefs and mathematical knowledge for teaching are emphasized as being important for professional competence. However, there is little agreement about the contents of each of the two concepts or about the relationships between them. In some definitions, beliefs are described as unsure knowledge while in others knowledge is described as beliefs held with certainty (Randolph, 2007). Both definitions give a picture of one being a part of the other, but then, which is a part of the other? Other definitions emphasize the importance of separating beliefs and knowledge and treating them like two different parts of professional competence (Randolph, 2007). In some research, beliefs about how mathematics should be learned and taught are in many ways seen as being shaped by teachers’ knowledge (Hill, et al., 2008). The consequence of this approach is a focus on investigating teachers’ mathematical knowledge for teaching. In other research, beliefs are seen as the prime focus of investigation because teachers with similar mathematical knowledge for teaching can teach differently (Ernest, 1989; Thompson, 1992; Randolph, 2007).

The construct of beliefs has been defined in a variety of ways that are explanatory and illuminative in different situations (Mcleod & Mcleod, 2002). The definition in the research project in question proceeds from Randolph (2007), who states that beliefs can be thought of as lenses through which the individual views and interprets the world. The definition in the research project includes feelings, attitudes and values because they are parts of the individual’s experiences that shape these lenses. According to Pajares (1992), beliefs have two prime sources: emotional experiences and cultural transfer. The earlier beliefs have developed, the harder they are to change, and prospective teachers’ beliefs about mathematics and its teaching and learning are already well established when they enrol in teacher education. These beliefs are generally considered to be connected to each other and to other beliefs in comprehensive belief systems. On the one hand, such systems may be seen as idiosyncratic and highly individual; on the other, they refer to socially or culturally shared belief systems. According to Mcleod (1992), this gives rise to analysing mathematics teachers’ beliefs about mathematics and teaching mathematics as parts of larger belief systems.

Shulman suggests that knowledge for teaching includes content knowledge, curricular knowledge, pedagogical knowledge and pedagogical content knowledge (Shulman, 1986). Building on Shulman, Ball, Lubienski and Mewborn (2001) have compiled a “map” of mathematical knowledge for teaching, a special kind of
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professional knowledge of and skill in mathematics. There are differences between knowing mathematics and teaching it, and Shulman (1986), Bromme (1994) and Ball et al. (2001) make a distinction between content knowledge in the academic discipline and content knowledge of the subject as taught in school. Content knowledge for teaching mathematics is qualitatively different, and means more than knowing mathematics in the academic discipline. Pedagogical content knowledge is a special knowledge that concatenates content knowledge with pedagogy, that is pedagogical knowledge directly tied to a specific subject. For a mathematics teacher, pedagogical content knowledge can mean, for instance, knowledge about different ways of representing mathematical ideas and about what students often find difficult in the subject. Curricular knowledge is knowledge about syllabi in other subjects and other stages, which allows the teacher to know about experiences the students have had before and will have after they have been in her class.

Bromme (1994) further expands the meaning of knowledge for teaching with the addition of philosophy of content knowledge, which he describes as being synonymous to beliefs. According to Bromme (1994), all parts within beliefs and knowledge for teaching must be observed if the purpose is to illuminate the complexity of professional competence.

In line with Bromme, the present study views both beliefs and mathematical knowledge for teaching as essential parts of the professional competence of mathematics teachers. Content knowledge, curricular knowledge, pedagogical knowledge, pedagogical content knowledge and beliefs should be taken into consideration. In the project, as a group they are called beliefs and knowledge for teaching mathematics in school. The role of beliefs and knowledge for teaching mathematics in school in the research project are as building blocks in the identity process of becoming a mathematics teacher.

Mathematics education research, regarding both teachers’ beliefs and their knowledge for teaching, has moved into the classroom (Skott, 2009). In the current project the words situation, setting and context are used with different meanings. Situation means events, conversations and activities that take place. These situations take place in different settings. A setting is a condition or position in which you find yourself, the combination of circumstances at a given time. Context is the individual’s experience of a certain situation in a certain setting. According to Lerman (2001), an individual becomes a part of a setting and the setting becomes a part of the individual. Teachers’ beliefs and knowledge for teaching mathematics in school is a part of what happens (situation) in a classroom (setting), which becomes a part of what happens in school (another setting). The actions of the new teachers in the project do not only reproduce the context around them, but also affect and change the settings they occur in, that is the context of the teachers’ experience. In these settings, professional competence develops gradually in a process of enculturation (Bromme & Tillema, 1995) at the same time as the individual’s professional competence affects the setting. This reflexive relationship between setting and
individual means that beliefs and knowledge for teaching mathematics in school are related to practice, but that the two are not easily connected one to one. The exact relation between teachers’ beliefs about learning and teaching and practice is unclear (Thompson, 1992). Practice in the project not only involves what teachers do when they teach; it also involves their thoughts about and motivations for their actions.

Learning is about becoming, as well as participating in practices. In the current project identity development is seen as learning, and identity cannot be separated from setting and meaning because it develops in the connection between the social and the individual. Identity is man-made and is constantly being created and re-created in collectively shaped interactions (Wenger, 1998; Lerman, 2002; Sfard & Prusak, 2005). Identity is the embodiment of an individual’s knowledge, beliefs, values, commitments, intentions and affect as they relate to her participation within a particular community of practice (Randolph, 2007). Identity is shaped through participation in these communities of practice, but with the identity of the individual as a starting point, which conveys that identity is neither individual nor collective. Instead, the focus ought to be on the process of their mutual influence. An individual belongs to several communities of practice, and identity development also involves coming to terms with these different memberships (Wenger, 1998). According to Wenger (1998), doing this can be the greatest challenge for a person moving from one community of practice to another. A movement between communities of practice is being made by the primary school teachers in the current project, a movement from the university to different schools. These movements are not always mellow and they are not done at once; instead, different communities of practice constitute sources of learning.

IDENTITY AS NARRATIVES, THE METHODOLOGICAL TOOL

The focus in the rest of this paper is how identity and identity development are tackled methodologically in the research project. Investigating identity development in context leads to two demands on the collection of data: One, making setting perceptible from the perspective of the responders; and two, making identity development operational. Sfard and Prusak (2005) make the concept of identity operational by defining it as “a set of reifying, significant, endorsable stories about a person” (p. 14). The reifying parts in the narratives infer that we, when we talk, have a tendency to replace the talk about actions with talk about states. In doing this we overcome the fluidity of change by “freezing the picture” of actions in different communities of practice into a gathered narrative regarding properties of the actor. The narratives that Sfard and Prusak (2005) define as identity also have to be significant and endorsable. They emphasize that the identifying narratives do not

1 Sfard and Prusak (2005) use both the words stories and narrative. For instance: “[...] identity may be defined as collections of stories about persons or, more specifically, as those narratives about individuals that are reifying, endorsable, and significant (p. 16).” In the rest of this paper I will use the term identifying narrative for these “reifying, significant, endorsable stories about a person (p.
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express the identity, but rather are the identity. In the research project, the narratives
the primary teachers tell about themselves as teachers and teachers of mathematics
with their professional identity in relation to their context are used as their identity.

Identifying narratives are not only told by the individual about herself. Sfard and
Prusak (2005) sort different kinds of identifying narratives depending on who is
telling them and for whom they are intended. First-person identity refers to
identifying narratives told by the identified person herself. Second-person identity
refers to identifying narratives told to the identified person by someone else. Third-
person identity refers to identifying narratives told by a third party to a third party.
What a person endorses as true about herself may not be what others see enacted, and
it is only the First-person identity that qualifies as the “reifying, significant and
endorsable stories” used in this research project. But, since they are collectively
shaped, they are influenced by second- and third-person identity. They are also a link
between the individual’s identity development and the settings in which the identity
development takes place.

The study focuses not only on identity but also on identity development. The
narratives of first-person identity can be split into two subsets, narratives consisting
of the actual state of affairs and those consisting of the state of affairs which, for one
reason or another, is expected to be the case. Sfard and Prusak (2005) define these as
current identity (actual state of affairs) and designated identity (expected state of
affairs). These words are also used in this research project, and identity development
for the primary teachers means learning from current identity (novice primary
teachers) to designated identity (active primary teachers). In the narratives, current
identity narratives are usually told in the present tense and designated identity can be
recognized by the use of the future tense with words that express wish, commitment,
obligations or necessity. Designated identity is not always desired, but gives direction
to the individual’s actions and needs. Both current identity and designated identity
determine what is learned with the purpose of closing the gap between the two. The
research project’s focus is on beliefs and knowledge for teaching mathematics in
school as building blocks in this learning process.

Identity as narrative: an example

Ten prospective primary teachers were interviewed a month before their graduation.
The purpose was to investigate whether and how they identified with their
prospective roles as primary teachers of mathematics. The interviews contained open
questions as well as examples of student solutions and student-teacher dialogues, all
focusing on beliefs and knowledge for teaching mathematics in school. The
interviews treated not only how the teachers perceived the questions, solutions and

14). These narratives can be created in different situations, interviews or spontaneous talks, during
teaching, and so on. The situation, setting and context for each identifying narrative are important
since there are reflexive relationships between setting and individual.
dialogues at the moment, but also how they believed they would deal with similar situations as active primary teachers. The interviews were tape recorded and transcribed. The interview situation is the setting where the identifying narratives in this paper were created, and the individuals’ experience of this setting, the context, has influenced the outcome. In the next part of the paper I will show how these identifying narratives are used in the research project as the prospective teachers’ current identity and designated identity, respectively, and also how beliefs and mathematical knowledge for teaching mathematics in school are visible in these identifying narratives. To do this I use parts of the interview with Jenny, whom I quoted in the introduction. I could have chosen any of the ten prospective teachers, however, since the focus here is on the methodological aspect. The purpose of this example is to illustrate how identifying narratives work as a methodological tool in the study.

At one point in the interview Jenny says “…I as a teacher”, and I ask her if she sees herself as a teacher. At first she is quiet, but then she starts to laugh:

Jenny: I think that was the first time I called myself teacher. Yes, no, yes, wow, now it turned into something big. Yes but, I’m going to become a teacher. Eventually, I am.

Jenny says “I’m going to become…” which indicates that being a teacher is a part of her designated identity, not yet in her current identity. But the distance is very close, which becomes more obvious when she continues the interview by talking about how she will formally become a teacher when she graduates (See the quotation in the introduction). In that quotation she also talks about her own competences as a teacher and, talking further about her competences, she says:

Jenny: I haven’t taken certain courses so I feel like I lack those competences. While sometimes, but I know these things so why should I not count as a teacher? Or something like that. And before that, I was in the childcare programme and became a child minder. But that wasn’t enough. Then I have to move on somehow. Yes, but yes, in my own eyes I hope I am accepted as a teacher.

Hanna: Yes.

Jenny: At least after graduation. But as far as competences go I believe I’m missing a lot.

According to Jenny, this interview was the first time she called herself a teacher, the designated identity that was the aim of her education. Her narrative shows both the social and individual elements of current and designated identity. It also shows that the designated identity exists from her perspective. Both her current and designated identity contain setting perspective but also individual professional competences. According to Jenny, you can reach the designated identity in two ways, from setting perspective by graduating and from your own perspective by developing professional competences. Jenny’s current identity is in the borderland, and from her perspective,
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In one way society is an important element regarding when her designated identity will become her current identity. In another way, she sees that her competences decide when she will reach her designated identity.

This competence-based part of her current and designated identity is made up of her beliefs and knowledge for teaching mathematics in school. At the same time, it is these beliefs and knowledge for teaching mathematics in school, her competences, that according to her will eventually make the designated identity her current identity.

Since the aim of the study is to investigate identity development from the perspective of the individual, in the interview Jenny was asked to tell about herself as an active primary teacher:

Jenny: You know, you have that picture of a teacher. How a teacher is supposed to be and how a teacher is supposed to act. And as a new teacher you may have to yield a little to your big ideas. But at the same time you want to show your best side, I don’t know. Sometimes it feels like some of the teachers out in the field, so to say, have this thought that you take too much initiative. Yes, now you’re newly graduated but you’re not allowed to be too full of enterprise. Yes I have, you need to have backing for what you want and what you want to do. And then I think, it can be hard to suggest new ideas. This template or how you think, well it’s not a template either because it changes the whole time. You could say society wants new stuff from teacher students. Out with the old and in with the new sometimes. […]

In the study, identity development is seen as learning and shifts in current identity. This learning is, according to Jenny, not a matter of course solely dependent on graduation or professional competence. The settings in which the identity development takes place are also important. These settings can be seen as communities of practice where Jenny’s identity development will continue after graduation. Jenny’s talk about “yielding” to big ideas and not being “allowed to be too full of enterprise” can be seen as an expression of the conflict regarding coming to terms with different communities’ memberships that according to Wenger (1998) can be the greatest challenge for a person moving from one community of practice to another. Jenny’s expectations about this challenge are a part of her beliefs in her current identity and will affect how she is acting in order to reach her designated identity.

Jenny has a picture of what kind of teacher she wants to become, a designated identity, but this picture is not static. When Jenny talks about what will be important for her as an active primary mathematics teacher and what it is that characterizes a good mathematics teacher, she says:

Jenny: No but it is the structure somehow, a good structure that works on most of the pupils. You can’t reach them all, you can, I don’t think it’s possible. […] And then I also mean this with different methods, group work, individual work, being outdoors, being indoors, using the book, not using
the book, or is it paper or is it you, that’s what structure’s all about, from what I see.

Jenny was also asked if she sees any differences between teaching mathematics and teaching other subjects.

Jenny: The only thing that differs is the content. That, the books, the information. Math has to do with numbers and stuff like that, counting skills. Yes, things like that, while if we take Swedish there are different rules for that. And it’s, yes we have a curriculum and a syllabus to go back to. In other words it is. But I believe you can use my method of working anywhere.

The questions about good mathematics teachers and things that are important to Jenny as a future active mathematics teacher aim to shed light on what beliefs and knowledge for teaching mathematics in school she focuses on in her narratives. When she tells about herself as a mathematics teacher and about professional competence, she does not mention content knowledge. Instead, she talks about pedagogical knowledge, pedagogical content knowledge and curricular knowledge. That Jenny does not mention content knowledge in relation to professional knowledge does not have to mean that she does not find it important, but it does mean that it is not what she focuses on in the interview when describing professional competence. Her narrative could represent identity even for a teacher of another subject, and her description of professional competence seems to, in line with Meleod (1992), be part of a larger belief system regarding how to form teaching in classrooms. This belief system is a part of both her current identity and her designated identity. The belief system is not specific to her as a mathematics teacher; according to Jenny, what differs is the content in teaching.

In the quotations presented here I have tried to show how identity “as a set of reifying, significant, endorsable stories about a person” can be used, and is used, as identity in my research project. Current identity, designated identity and beliefs and knowledge for teaching mathematics in school are visible in the quotations. The next step is to analyze all the interviews using this methodological approach to get a picture of current identity and designated identity before the primary teachers’ graduation. Since these interviews are just part of a research project investigating the professional identity development of novice mathematics teachers, further data collection has to be done. This is only the first step in the research project, and in the last part of the paper I will briefly describe the continuation of the study.

**CONTINUATION OF THE STUDY**

Skott (2001) points out the problem that empirical studies are analysed based entirely on teachers’ understanding of mathematics, teaching and learning. Instead, you ought to see the world from the eyes of the teacher. To allow for this, teachers have to be seen in their settings (Lerman, 2002; Skott, 2009). The starting point has to be that every teacher’s actions are rational from their perspective. In the current research project, identity development is seen as learning. Identity development is about
learning, and becoming and participating in practices. Cobb, Wood and Yackel (1990) assert that it is only when we analyse teachers’ actions in the classroom that we can come to see classrooms as learning environments for teachers. Simon, Tzur, Heinz and Kinzel (2000) emphasize the importance of the starting point of treating every teacher’s actions as rational from their perspective. This means observing their utterances and actions as they occur in settings. According to these authors, earlier research focuses on special aspects of beliefs or knowledge, but extension to the setting is necessary for understanding. To approach the perspective of the primary teachers in the study, continued data collection will be done through classroom observations followed up by interviews. This will make it possible to see the identifying narratives in the contexts in which identity development takes place. This is important because both identity development and the beliefs and knowledge for teaching mathematics in schools are related, in different ways, to settings. What resources do the newly graduated teachers use in their identity development in their communities of practices, and what are the critical elements of this identity development? The methodological tool is likewise identifying narratives, but in relation to observations of the settings in which the identifying narratives are created.

References


