

Dialogue between past and future mathematical identities

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Pre-service teachers' school-time experiences have been addressed much in mathematics education research. These experiences have been shown to have a central meaning for pre-service teachers' views of mathematics and their present mathematical identities. However, the identity is not only bound to the past and present, but it also extends to the future. Further, pre-service teachers' anticipations of the future have been overlooked in the research on identity in a mathematics education context. We focus here on the mathematical identity work of two pre-service teachers and its dialogue between the past and the future. We compare the cases of one Finnish and one Slovenian pre-service teacher, who reported having had negative experiences with mathematics during their school years. Based on the results, two different types of mathematical identity work were identified; resulting from the different facilitators used in mathematics education courses.

It has been discussed that pre-service teachers' experiences of their own years at school have a central meaning for their views of mathematics and their mathematical identities (Kaasila, 2007a; Kaasila, Hannula, Laine & Pehkonen, 2008; Black, Mendick & Solomon, 2009). Here identity is seen as "who or what someone is, the various meanings people can attach to themselves, or the meanings attributed by others" (Beijaard, 1995, p. 282). Identity, especially its past and the present aspects, has been addressed much in mathematics education research (Kaasila 2007a, 2007b; Black et al., 2009). The future aspect, however, has mostly been overlooked (Di Martino & Sabena, 2011; Lutovac & Kaasila, in press).

Additionally, identity work has been studied less frequently, and it has remained broadly defined in the mathematics education context (Lutovac & Kaasila, 2011). We see narratives as essential for identity formation. Narration is considered to be a major way in which people make sense of experiences, construct the self, and create and communicate meaning (cf. Ricoeur, 1992). This is what we understand as identity work.

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Thereby, identity work involves the construction and reconstruction of meaning through stories over time (cf. Rodgers & Scott, 2008; Beijaard, Meijer & Verloop, 2004).

Recently, we reported about pre-service teachers' mathematical identity work and its present-future dialogue (Lutovac & Kaasila, in press). In this paper, we focus on a dialogue between the past and the future in pre-service teachers' mathematical identity work by comparing one Finnish and one Slovenian case who reported having had negative experiences with mathematics during their school years. These two cases broaden the cultural context, one attending Finnish university and the other Slovenian university. Additionally, by focusing on identity work and especially on the past-future dialogue, our study continues and develops Finnish research tradition of studying the beliefs, views of mathematics, and mathematical identities of pre-service teachers (see e.g. Pehkonen & Hannula, 2004; Hannula, 2007; Kaasila, 2007a; Kaasila et al., 2008; Lutovac & Kaasila, 2011; Kaasila, Hannula & Laine, 2012).

Theoretical framework

Narrative mathematical identity

The concept of "mathematical identity" has been approached through various frameworks and thus defined in different ways (Kaasila, 2007a; Black et al., 2009). In discursive framework, the identity has been linked to the concept of mathematical subjectivity or how students regard themselves in relations to math (Palmer, 2009). According to Sfard (2008), subjectifying, that is, communicating about mathematical discourse participants, includes also identifying. Here, however, we apply narrative framework and Ricoeur's (1992) concept of narrative identity: people often develop their sense of identity by seeing themselves as protagonists in different stories. Accordingly, we see mathematical identity as a narrative construction; as such it is a product of reflective processes and therefore changes over time and is constantly under construction (cf. Ricoeur, 1992). Like one's identity, narrative mathematical identity is multiple, shifting, and unstable, and has a (re)constructive, multi-contextual, relational, and emotional nature (cf. Rodgers and Scott, 2008).

Pre-service teachers' mathematical identity is understood in terms of the narratives they create to explain themselves in relationship to mathematics and their mathematical lives (cf. Kaasila, 2007a, 2007b; Drake, Spillane & Hufferd-Ackles, 2001). We define mathematical identity as a set of stories pre-service teachers tell themselves or others about themselves as mathematics learners and teachers (Kaasila, 2007a, 2007b; Lutovac & Kaasila, in press). These stories carry various meanings

pre-service teachers attach to themselves, or the meanings attributed by others (cf. Beijaard et al., 2004; see also Sfard, 2008). An important part of mathematical identity is the view of mathematics, consisting of one's knowledge, beliefs, conceptions, attitudes, and emotions (see e.g. Kaasila et al., 2008). Further, pre-service teachers can have many mathematical identities connected to different contexts or social relationships (see also Kaasila, 2007a; Palmer, 2009). Mathematical identities also convey information about the situations pre-service teachers are in and their audience (cf. Ricoeur, 1992; Kaasila et al., 2012).

Past-future dialogue in mathematical identity work

Pre-service teachers' stories about mathematics are closely related to their ongoing mathematical identity construction (e.g., Kaasila, 2007a; Lutovac & Kaasila, 2011). We see that when pre-service teachers construct narratives from their experiences with mathematics, they are doing mathematical identity work and in turn construct their mathematical identities. Therefore telling stories is "doing identity work" (cf. Lutovac & Kaasila, in press). To understand this process, it is important to know how pre-service teachers construct narratives from their experiences. Earlier (Lutovac & Kaasila, 2011) we conceptualized mathematical identity work as a narrative process including an interaction between the individual and the social mathematical context; a process of self-reflection where past, present, and future mathematical identities enter a dialogue. This leads to one's awareness of a tension or gap between the actual and the ideal state of mathematical identity. For evoking teacher change processes, the presence of a gap is crucial.

When considering pre-service teachers' mathematical identities, we have to understand them not only in terms of the present, but also as extending to the past and future selves (cf. Ricoeur, 1992). Past identities in the context of teacher education and mathematics education have been explored much; however the future aspect of identity has so far been overlooked. We agree with Beijaard et al. (2004, p.122) that

Professional identity formation is, in our view, not only an answer to the question "Who am I at this moment?" [...], but also an answer to the question: "Who do I want to become?", which is in line with what Conway (2001) called the function of anticipatory reflection.

Anticipatory reflection, or imagining a possible future, may influence pre-service teachers' development (Conway, 2001). A rare example in mathematics education research considering future identity is Sfard and Prusak's (2005) discussion on designated identity, which is understood as "narratives presenting a state of affairs which, for one reason or another,

is expected to be the case, if not now then in the future” (p.18). Our viewpoint is similar; however, by applying the notions on *possible selves* proposed by Markus & Nurius (1986), we were able to explore pre-service teachers’ future anticipations by including the interaction between their past and the future selves. We see that pre-service teachers create possible selves, defined as views about what one might become, what one would like to become, and what one is afraid of becoming in the future. Such future-oriented views can be very motivating (Markus & Nurius, 1986).

Anticipatory reflection is important for identity work, particularly in the sense of envisioning a future identity, such as possible selves or an “ideal” self (Markus and Nurius, 1986; Lutovac & Kaasila, 2011, in press). Thereby, we see that when pre-service teachers’ identity talk is future-oriented, it reveals future-oriented reflection that projects a future identity (Urzúa & Vásquez, 2008). Because possible selves bridge the present and future as well as the past and future by specifying how one may develop, we see these as central when considering pre-service teachers’ future-oriented identity work (cf. Dunkel & Anthis, 2001). Additionally, because possible selves are created within an individual’s social and cultural context, they are likely to be derived from it (Hamman, Gosselein, Romano & Bunuan, 2010). The latter seems particularly useful when exploring the identity work of the cases belonging to different cultural contexts.

Finally, by combining the notions on anticipatory reflection and possible selves, we identified in our earlier study (Lutovac & Kaasila, 2013) two types of mathematical identity work regarding the present-future dialogue: “decisive” (characterized by balancing between possible selves and a strong emphasis on learning and self-development) and “irresolute” (characterized by an imbalance between possible selves and helplessness regarding the future). The resolution was essential for understanding the difference between the two. All pre-service teachers in the study seemed to fear the future. However, some rose above their fears and insecurities and were willing to invest extra effort in order to secure a future benefit, whereas others seemed submitted to their fears and did not show similar agency.

The context

Pia, a pre-service teacher from the University of Lapland, Finland, underwent a mathematics education course in the second year of her studies. Its main aim is developing students’ views of mathematics, especially their self-confidence (cf. Kaasila et al., 2008), and also their mathematical understanding by exploring mathematical contents with manipulatives. Collaborative work is emphasized. Students apply the knowledge from

the course immediately after, in the teaching practice. Ines, a pre-service teacher from the University of Maribor, Slovenia, underwent three mathematics courses. The mathematics content course focused on basic mathematical concepts. The first mathematics education course focused on developing understanding in mathematics, exploring mathematical contents with manipulatives, and learning methodical principles in elementary school mathematics. The second mathematics education course prepared students for teaching mathematics. Together, the courses aim to develop students' confidence in their own mathematical ability.

Methodology

Focus of the study

The focus here is to understand pre-service teachers' future-oriented mathematical identity work, especially its past-future dialogue. We compare and contrast one Finnish and one Slovenian case with a negative view of mathematics. Our paper was guided by the following research questions:

- In what kind of mathematical identity work and its past-future dialogue do pre-service teachers engage?
- What is the link between pre-service teachers' identity work and the facilitators used during a mathematics education course?

Research persons

In 2009, the first author of this paper purposively chose 19 pre-service teachers as research persons for her dissertation: six pre-service elementary teachers were from the University of Lapland, Finland, and 13 were from the University of Maribor, Slovenia. A negative view of mathematics that developed during a pre-service teacher's time in school was a pre-determined criterion for participation in the study. The Finnish and Slovenian cases included were therefore rather homogenous (Patton, 1990). For this paper, we systematically selected one case from each country for examination: Finnish student Pia and Slovenian student Ines.

The two cases were selected by using *critical case* strategy (Patton, 1990): selecting a small number of cases to illuminate important information about their possible future identities. They contribute greatly to the understanding and conceptualizing of mathematical identity work as they make a point clearly, are particularly information-rich, and expressed themselves vividly. Based on these two cases, logical generalisations are still possible in the sense of "if it happens there, it can happen

anywhere" (Patton, 1990, p.174). Second, these cases are intense examples of identity work, but are based on the prior research literature, not unusual cases (Patton, 1990).

Data collection and analysis

The underlying premise of narrative inquiry (see, e.g., Lieblich, Tuval-Mashiach & Zilber, 1998, Kaasila, 2007a, 2007b) applied in this study is the belief that pre-service teachers make sense of themselves and their world by telling stories (cf. Ricoeur, 1992). We therefore need to study identity work narratively. Moreover, narrative inquiry has been increasingly used to explore identity in mathematics education research (Kaasila, 2007a; Black et al., 2009).

The in-depth interviews with pre-service teachers lasted 45 to 70 minutes. Confidentiality was assured, the purpose of the interview was explained, and the relationship between interviewer and interviewees was established. The interview consisted of asking pre-service teachers to tell about their past experiences related to mathematics by using open-ended prompts. We also asked the following: *Tell me about your future as a mathematics teacher.*

First, we emplotted pre-service teachers' mathematical biographies to obtain a holistic view of their mathematical identity from the past to the future (Kaasila, 2007b). However, here we focus on applying the categorical approach (Lieblich et al., 1998). We analyze how pre-service teachers anticipate their future as mathematics teachers and commonalities between the two cases. Each pre-service teacher's story was dissected; sections belonging to the "future" category, particularly where pre-service teachers are reflecting on the future in relations to the past, were separated for the analysis (Lieblich et al., 1998). This broad category was therefore labelled as "past-future dialogue". The analysis was data-driven in order to avoid projecting categories from one context to another, which avoided any cultural bias. Systematic comparison yielded a common conceptual manifestation among the cases, labelled as future-oriented identity work. The contrasts between the cases led to the creation of two subcategories of identity work.

Results

Pia's and Ines's past mathematical identities

Pia summarised: "I didn't like mathematics, because I didn't understand what we were doing and our teacher didn't explain it well". For Pia, "not

understanding" influenced her beliefs about herself: "It's like I'm missing something in my brain". She experienced feelings of frustration and gave up on math. Pia did not identify herself as able to do math: "Mathematics is important, but also something that is for people whose work requires lots of mathematics. I only needed the basics, nothing else".

Ines was affected by being compared with her older brother by several teachers: "I just knew I am not that good in mathematics. But the comments caused hatred". Ines's aversion towards math worsened due to a "bad teacher" and his negative attitude towards pupils: "He had comments like, 'If you don't know this, then you can go on the street or to some lower school and maybe you will be more successful there' ". Ines summarised: "When I saw my math notebook, I felt like throwing up. I would never understand it".

Past and future identities in dialogue

Pia's identity work: "distancing from the negative past"

My experiences will prevent me to become a good teacher, because if I would be more confident, more positive about mathematics, I would probably be better at it. But I think the negative experiences help me understand those pupils who don't understand. I've noticed that other students have similar feelings toward mathematics. Some have negative views about mathematics; usually about something they don't understand, because it's hard to understand some of the contents. So I think that's the benefit. On the other hand, I'm thinking about pupils who are good in mathematics. Am I really good enough for pupils, despite the fact that I don't understand the content so well? I think mathematics is an important subject, so the teacher should be very good at it. That's why I feel bad for these pupils, because they would need something more. (Pia, Finland)

Pia sees that her negative past may hinder her from becoming a good mathematics teacher. However, she distanced herself from the past by understanding that other students had also struggled with math and had developed a negative view of mathematics. Pia found a benefit in her past experiences; she feels better suited to understanding pupils' difficulties with mathematics (Di Martino & Sabena, 2011; Kaasila, 2007a). Pia's past experiences are not hindering her future-oriented reflection (cf. Conway, 2001; Urzua & Vasquez, 2008), in that she shows much self-awareness. In her talk she doubts her competence to teach mathematics to high-attaining pupils, particularly by seeing a strong link between her math ability and teaching competence. Additionally, she considers mathematics as a

valuable subject domain. Therefore, Pia feels that her math ability should be better in order to be able to teach math well and her concerns about the future seem to be bound to this aspect, rather than to her negative past experiences.

For Pia, the mathematics education course was "something really like new doors opening, like understanding that there really are different ways how you can do mathematics" (see also Palmer, 2009). She interpreted the past in light of the present: "I couldn't do mathematics and it's because I've been thinking about those rules and theories, but it's more. There are different paths to the result". Additionally, Pia refers to the narrative rehabilitation (Lutovac & Kaasila, 2011) applied at the beginning of the course, where pre-service teachers were told about four pre-service teachers' mathematical biographies considered in Kaasila (2007a). These included different mathematical backgrounds; based on them, pre-service teachers shared their prior experiences with others in smaller groups. Consequently, Pia "understood that there are other people who don't understand so well". This encouraged her to think she "could go deeper in mathematics" to ensure her future success as a teacher.

Ines's identity work: "reliving the negative past"

I hope my experiences will not prevent me to be a good teacher. I wish to forget, so that it won't happen again. But I think if I will enjoy teaching, if I will be inside of it, it will be my pleasure. At least for now it is and I think I will forget my experiences. But I will have in mind that you can't have strange attitude towards pupils; that with these kinds of comments, you are mean towards them and you bring negative feelings. I could feel that myself. I think I can surely find some benefits. But I really hope the experiences will not disable me, so that I would have reluctance towards mathematics. I don't have it anymore like I had it before. I think I will take out of my experiences a lot of benefits. (Ines, Slovenia)

Ines sees that her past experiences might prevent her from becoming a good teacher, especially because these experiences are still very vivid in her thoughts. Ines believes that the joy of being a teacher might help her "forget the past". The latter idea signals that Ines failed to distance herself from the negative past (cf. Lutovac & Kaasila, 2011). Further, she sees the future as an opportunity to compensate for the negative past; she wants to avoid mistakes which were imputed to her by her teachers (Di Martino & Sabena, 2011). Her memories of school-time mathematics closely relate to her "bad" teachers, who were mostly labelled as such because of their lack of empathetic relationship with pupils, which manifested as a negative

attitude and behaviour towards pupils. The central aspect in Ines's talk is therefore avoiding becoming an insensitive teacher (cf. Hagger & Malmberg, 2011) and further conveying her aversion towards math (Di Martino & Sabena, 2011). Ines tries to draw on the benefits for the future; however, she can anticipate it only by avoiding the past.

During the mathematics education course, Ines found a new perspective on what mathematics is: "you don't think anymore that mathematics is some drill, equations, but you start thinking how to explain this to pupils and how was this explained to me and this I wouldn't do like that. I perceive mathematics totally different". It seems Ines started seeing mathematics through the lens of teaching. Ines says, "I think I got a positive feeling about mathematics"; however, it seems that past memories still continue to invade her thoughts: "Even though still when I think of mathematics, I still remember. It is still in me and I just don't know how to erase it". Ines again implied she wants to forget those memories; however, she does not know how to achieve this.

Comparing Pia's and Ines's mathematical identities

The central idea behind the past-future dialogue is pre-service teachers' anticipations regarding whether their negative past may or may not hinder their future mathematics teaching. Both pre-service teachers ground their concerns about the future in their past difficulties; however, they both also refer to the past as a resource for their future teaching. Accordingly, Pia feels better suited to understanding low-attaining pupils' struggles (Di Martino & Sabena, 2011; Kaasila, 2007a), and Ines wants to act in a more caring way towards her pupils (Hagger & Malmberg, 2011). Therefore, pre-service teachers' identity talk appears similar; however, important differences in their anticipations of the future were identified.

We see that Pia used her negative past experiences for building *positive* possible selves, such as *expected* and *hoped-for* selves. Her talk is future-oriented: the future rather than the past is dominant. She is reflecting on her teaching competence. She seems to understand the meaning of her past and is therefore distancing herself from it; she anticipated the future without impediments from the past. Her emotionally challenging past experiences seem to be handled, and she is moving on. For that reason, she is able to fully reflect on her strengths and weaknesses and consider her cognitive qualities as a math teacher, such as whether she can become a good enough teacher for higher-attaining pupils.

Ines, on the other hand, derives from the past mainly *negative* possible selves, such as *feared* and *avoidant* selves. Her past experiences are strongly dominant in her anticipations of the future. She fears becoming

an insensitive teacher as her past teachers were and for that reason she anticipates having affective qualities as a teacher by "being careful with the attitude towards pupils" (cf. Hagger & Malmberg, 2011). We see that past experiences are for Ines still very much alive and have not been handled in such way that she is able to distance herself from the negative past (cf. Lutovac & Kaasila, 2011). Moreover, she is constantly reliving it and is therefore not able to fully reflect on the future.

Discussion

The results show that the two pre-service teachers are engaged in different past-future dialogues within their mathematical identity work. We labelled Pia's identity work as *distancing from the negative past*, while Ines's was labelled as *reliving the negative past*. Pia's talk shows a move-away from the negative past and a focus on anticipating future teaching. Ines's talk, however, seems to be bound to the negative past, which is constantly invading her thoughts to the extent to which the anticipations of the future are regarded only as avoidances of the past. We see that the reasons for the occurring differences in identity work are different facilitators applied in mathematics education courses.

Pia, a Finnish case, had undergone a mathematics education course, which seems to be directed towards developing a mathematical identity with the emphasis on pre-service teachers' views of mathematics and promoting pre-service teachers' personal growth. Special attention was paid to pre-service teachers' personal beliefs and prior experiences as manifested through pre-service teachers' reflection through narrative tools (Kaasila & Lauriala, 2012; Lutovac & Kaasila, 2011, 2009). However, Ines, a Slovenian case, had undergone mathematics education courses, which seem to be developing a competency by emphasising knowledge, skills, and attitudes (cf. Korthagen, 2004). Additionally, the coursework does not include the focus on pre-service teacher's autobiographical context and thus identity (Lutovac & Kaasila, in press).

Earlier, we addressed autobiographical context as important for understanding pre-service teachers' mathematical identity (Kaasila et al., 2008; Lutovac & Kaasila, 2011). Kaasila et al. (2008) have identified in their study with 269 pre-service teachers the following ways to facilitate the shift in their identities: exploring content with manipulative models, pair work or peer tutoring, and handling experiences. Also the study by Palmer (2009), where alternative mathematics course was conducted to shift and enhance students' understandings of themselves in relations to math, highlights the meaning of taking into account school time memories seriously. The mathematics education course, which Pia attended, includes

narrative rehabilitation and bibliotherapy as facilitators for handling school time memories. Narrative rehabilitation enables creating meaningful narratives and gaining insight into the new aspects of one's mathematical past and future (Hänninen & Valkonen, 1998; Lutovac & Kaasila, 2011). Through bibliotherapy, the use of reading, affective changes promoting one's personal growth can be induced (Lenkowsky, 1987). In line with our earlier study (Lutovac & Kaasila, 2011), these facilitators led to "distancing from the negative past", which we consider as an important part of identity work. This is how Pia's identity work was promoted enabling her to resist negative possible selves (Lutovac & Kaasila, 2013).

Additionally, we see that unlike "identity-based approach", "competency-based approach" does not give pre-service teachers an opportunity to appropriately deal with their past memories (see also Lutovac & Kaasila, in press). An emotion-laden past thus persists in their thoughts, disabling them to cope with the future. Ines's case shows how her past remains within her as a possible self and thus represents Ines's ongoing concerns (cf. Markus & Nurius, 1986). Furthermore, in our recent studies (Lutovac & Kaasila, 2013, in press) we concluded that "identity-based approach" promoted decisiveness in pre-service teachers' talk, whereas "competency-based approach" may have prevented pre-service teachers from making more conscious choices (Korthagen, 2004), rendering them irresolute. Here we elaborate on these views by seeing that the facilitators for inducing pre-service teachers to distance themselves from the past may further promote them to engage in "decisive" identity work. Similarly, pre-service teachers who fail to do that may engage in "irresolute" identity work. Such identity work may hinder successful mathematics teaching even more than the negative view of mathematics itself.

We assured the plausibility of this study by "raising" Pia's and Ines's voices through the data excerpts. Considering the past and future aspects, we showed how their mathematical identities developed and what facilitated possible shifts. Further, results here are in line with earlier studies, which are reinforcing the plausibility. However, we are aware of the limitations of our cases, particularly because we considered only two, both having a negative view of mathematics. Therefore, we do not generalize our findings to all pre-service teachers in particular contexts. We neither want to lay stress upon the cross-national comparison of the teacher education programs, nor praise or criticize either of the two teacher education programs in question. Although the two cases belong to different cultural contexts, they are in this study only illustrating mathematical identity work in which pre-service teachers may engage. The findings, however, show there is a connection between identity work and facilitators used during mathematics education courses. Taking into account our

findings, teacher educators can address pre-service teachers' needs and influence pre-service teachers' mathematical identities in a way which may promote successful future teaching, although we are aware that their identities will continue to be constructed and influenced also by their practice as teachers (see also Palmér, 2010).

Finally, we present the following recommendations. Mathematics education courses should give space for pre-service teachers to handle their school-time memories in order to enhance their views of the future as (mathematics) teachers (see also Palmer, 2009). Additionally, anticipatory reflection should be promoted in a mathematics education context, as we see it as an essential part of their future-oriented mathematical identity work (cf. Urzua and Vasquez, 2008). Finally, appropriate facilitators may result in the development of "positive" mathematical identity and may raise pre-service teachers' decisiveness regarding their future as well as the need for self-development. Later, we aim to study pre-service teachers' mathematical identity work by expanding the cultural context.

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