

<https://helda.helsinki.fi>

"My personal relationship towards mathematics has necessarily not changed but..." : analyzing preservice teachers' mathematical identity talk

Kaasila, Raimo

2012

Kaasila , R , Hannula , M S & Laine , A 2012 , ' "My personal relationship towards mathematics has necessarily not changed but..." : analyzing preservice teachers' mathematical identity talk ' , International Journal of Science and Mathematics Education , vol. 10 , no. 4 , pp. 975-995 . <https://doi.org/10.1007/s10763-011-9308-x>

<http://hdl.handle.net/10138/230233>
<https://doi.org/10.1007/s10763-011-9308-x>

acceptedVersion

Downloaded from Helda, University of Helsinki institutional repository.

This is an electronic reprint of the original article.

This reprint may differ from the original in pagination and typographic detail.

Please cite the original version.

“MY PERSONAL RELATIONSHIP TOWARDS MATHEMATICS HAS NECESSARILY NOT CHANGED BUT...” ANALYZING PRE-SERVICE TEACHERS’ MATHEMATICAL IDENTITY TALK

Raimo Kaasila, Markku S. Hannula & Anu Laine

ABSTRACT: In this study, we consider five pre-service teachers who had negative views of mathematics at the beginning of elementary teacher education. We focus on methodological challenges: how to analyze their mathematical identity talk which to some readers can sound incoherent. Teacher change studies have often ignored the methodological challenges on which we focus on in this article. We compare pre-service teachers’ talk at the beginning and at the end of a mathematics education course. When analyzing the data we combined discursive, rhetorical, and narrative approaches. We identified six central interpretative repertoires that were manifested in pre-service teachers’ identity talk: Victim, Ego-defensive, Fatalist, Gaining an Insight, Self-development and Responding to the Expectations of the Change. The Ego-defensive and Fatalist repertoires were activated especially when students talked about mathematical tests. The most central rhetorical devices were category entitlement, categorization, active voicing, use of disclaimer, and use of metaphors or extreme utterances. At the end of the course, the talk of the more confident pre-service teachers was more coherent than the others’ talk. Our study shows that combining different approaches can bring useful views for understanding pre-service teachers’ multiple identities.

Key Words: elementary teacher education, interpretative repertoires, mathematics education, mathematical identity talk, narrative inquiry, rhetorical devices

INTRODUCTION

“My personal relationship with mathematics has necessarily not changed . . . but my general relationship with mathematics has certainly changed.” (Ella)

Above, a pre-service teacher Ella talks about her relationship toward mathematics after completing a mathematics education course. She expresses herself about her stable-but-shifting sense of herself in relation with mathematics. To some readers, Ella's identity talk can sound incoherent. The aim of this article is not to judge her talk; instead of it our aim is to describe how to use methodological tools for understanding and analyzing pre-service teachers' identity talk when their views are in transition. In addition, Gellert (2001) has reported about the same type of phenomenon when he studied students' attitudes towards mathematics. In our study the view consists of beliefs, emotions, attitudes and knowledge (cf. Kaasila, Hannula, Laine & Pehkonen 2008).

Investigation of pre-service teachers' mathematical identity talk is in a key role, because it reveals how they are doing identity work. For teacher educators it is important to understand in a versatile way especially pre-service teachers' negative views of mathematics.

Unfortunately, this phenomenon is common among pre-service elementary teachers in many countries (e.g. Trujillo & Hadfield 1999; Hannula, Kaasila, Laine & Pehkonen 2005; Oliveira & Hannula, 2008). The roots of negative emotions can often be traced to pre-service teachers' experiences from their own school years (e.g. Trujillo & Hadfield 1999; Kaasila 2000; Pietilä 2002). Some earlier studies have focused on tools for reducing mathematics anxiety and negative emotions towards mathematics during teacher education (see e.g. Uusimäki & Kidman 2004; Hannula, Liljedal, Kaasila & Rösken 2007; Kaasila, Hannula, Laine & Pehkonen 2008; Lutovac & Kaasila 2011). We want to emphasize that in this article we are not focusing on ways for reducing pre-service teachers' negative emotions as such. Instead, we are interested in methodological questions. We focus on the ways math-anxious pre-service teachers talk about the change that happened in their views. Especially, we focus on how to analyze their identity talk through the narratives they told. Ricoeur (1992) has stated, that people often develop their sense of identity by seeing themselves as protagonists in different stories. According to him, narrative identity mediates between "what is" and "what

ought to be.” In all, we see that analyzing pre-service teachers’ identity talk can help us to understand in a better way their multiple identities. “Multiplicity as a methodological assumption helps us to make sense of the language of others, where it may at first seem incomprehensible.” (Blumenthal 1999, p. 386)

When considering pre-service teachers’ identity talk, we will also take into account the rhetorical dimension. Here, rhetoric refers to discourse that is argumentative and that seeks to persuade: thus, activities of justification and criticism are essential to rhetorical discourse (Billig 1987).

In this article, our focus was to analyze how 5 pre-service teachers’ mathematical identity talk changed during a mathematics education course. One of them was Ella, and they all had negative views of mathematics at the beginning of elementary teacher education. We realised that, by using narrative and rhetorical approaches alone, we could not understand the incoherence that was manifested in math anxious pre-service teachers’ identity talk well enough. Thus, we also applied also discourse analysis. Based on the discursive approach, we saw that different—sometimes also contradictory—kinds of talk belong to different interpretative repertoires. According to Potter (1996), interpretative repertoires (or “linguistic repertoires” or “discourses”) are systems of language that are used to describe various social and other phenomena. Interpretative repertoires are patterns of language people use on particular topics and are systematically related sets of terms that are often used with stylistic and grammatical coherence (Potter 1996). During discussion, people often shift from one repertoire to another. Yet nobody can own repertoires, because they are cultural products. Similar to Milner (2009), we see that interpretive repertoires could support a richer analysis of narratives of identity that people use to describe their experiences in fields such as becoming or being a teacher.

In our study, we did not see discourse analysis as an integrated and unified research methodology. We see discourse analysis more as a flexible framework. Here, we do not apply

rhetorical discourse analysis directly; rather, we see that we are completing the use of discourse analysis through a rhetorical and narrative approach. During the last few years, there has been more interest in these perspectives in mathematics or science education. Narrative inquiry is applied, for example, in the studies conducted by Kaasila (2007a, 2007b) and Chapman (2008), rhetorical approaches in the studies of Barwell (2003) and Kaasila (2007b), and discourse analysis in the studies of Gellert (2001), Barwell (2003), Williams et al (2008) and Zeyer and Roth (2009). For example, Kaasila (2007) analyzed the key rhetoric that a pre-service teacher with a positive view of mathematics used on her talk. Yet if we think of teacher change studies in the domain of mathematics or science education, they have often ignored the methodological challenges, which we focus on in this article. According to Talja (1999), researchers have a tendency to employ strategies such as categorization, coding, and selective reading to ameliorate inconsistencies because researchers are “accustomed to regarding the individual as a coherent, consistent unit” (Talja 1999, p. 464). We see that because of traumatic experiences it is especially challenging to analyze anxious pre-service teachers’ mathematical identity talk. To analyze it in a deeper way, it is reasonable to combine multiple methodological approaches as we do in this article.

EMOTIONS AS SOCIAL TEXT

Hannula (2004) distinguishes affect as a subjective experience, as a physiological process, and as a social text. In this article our main focus is on the last one. This view emphasizes the role of emotions in interpersonal interaction and social coordination. People are socially positioned and this will strongly influence how and whether they express their emotions (Evans 2003). We see that emotions and attitudes can differ depending on the social context in which they are embedded (cf. Ruffell, Mason & Allen 1998). For example, anger can be only what this or that people use the word “anger” for (Harré 1986).

The discursive psychology of emotion deals with how people talk about emotions, and how they use emotion categories when talking about other things (Edwards 1997). Here we see for example mathematics anxiety as a discursively constructed social category.

Similar to Gellert, we see that the interview narration itself is a social construction. The interviewer tries to stimulate the interviewee to put into words what she or he thinks or feels about mathematics. The interviewee is constructing a particular version of what the interviewer will call an attitude. The interviewee organizes her or his narration along social conventions of how language is used in interview situations. (Gellert 2001)

MATHEMATICAL IDENTITY TALK

We see that people construct their identity in relationship to others. Krzywacki and Hannula (2010) write about teacher identity as an individual and social construct. Between these two ends, the researchers see a continuous negotiation between how one perceives oneself and the positions that are available. Through interactions we begin to learn the roles of others, and we learn to direct our own actions toward our environment (Beijaard, Meijer & Verloop 2004). We see that people have situational identities that are actualising in different contexts. In this study, we will emphasize the relationship between identity and social context. Similar to Denzin, we see that *narrative* is a story that tells a sequence of events that are significant for the narrator and his or her audience. A narrative has a plot, a beginning, a middle and an end. A *narrative* has an internal logic that makes sense to the narrator. (Denzin 1989, 37) By applying Sfard and Prusak's (2005) definition we see that pre-service teachers' identities are collections of stories about the teachers, and thus, the stories should be taken in the account with a notion of shaping the teachers' future actions (see also Lutovac & Kaasila, 2011). We further suggest that different identities may emerge in different situations. We see that narrative mathematical identity should not be seen as a stable entity but as contextual. We can hold many narrative identities, each of which is connected to different contexts or social

relationships. For example, pre-service teachers' narrative identity can vary when they are telling stories to their professor in contrast to telling stories to their friends. The meaning of the audience often guides our telling: we are selecting certain events and aspects of our lives and connecting them with others. In contrast, we often do not want to tell about such events that give a negative picture about ourselves, not even to ourselves.

By applying Maclure's (1993) view of identity, we see that mathematical identity is something that people use to justify, explain and make sense of themselves in relation to mathematics and to other people acting in mathematical communities. In other words, we see that narrative mathematical identity is a form of argument. This identity is also inescapably moral: identity claims are bound up with justification of conduct and beliefs. According to Lutovac and Kaasila (2011) mathematical identity work emerges in and through narratives as a process of interaction between individual and social mathematical context. It is a process of deep reflection and self-evaluation where past, present and future mathematical identities enter into a dialogue which leads to one's awareness of the tension between the present and ideal state of mathematical identity. We see the presence of tension as a condition for evoking teacher change and developmental process. (Lutovac & Kaasila 2011; c.f. Krzywacki, 2009) In this study, we analyze pre-service teachers' mathematical identity talk. We see that pre-service teachers' mathematical identity work manifests through their mathematical identity talk.

METHOD

This paper forms a part of a research project, Elementary teachers' mathematics (project #8201695), financed by the Academy of Finland. The project draws on data collected on 269 trainee teachers at three Finnish universities (Helsinki, Turku, Lapland). Two questionnaires were developed to measure students' beliefs in the beginning of their studies. The aim of the questionnaires was to measure students' experiences connected to mathematics, their views of

mathematics and their mathematical skills. See more about the project, e.g. in Kaasila, Hannula, Laine and Pehkonen (2008) and Kaasila, Pehkonen and Hellinen (2010).

The mathematical skills test contained 12 mathematical tasks. Four tasks measured mathematical understanding and eight tasks measured calculation skills. The indicators were administered as questionnaires within the first lecture in mathematics education studies in all three universities in autumn 2003.

After the mathematics skill test and the questionnaire data were collected, we chose 21 pre-service teachers for the qualitative part of the study. Six of the selected students had presented positive, seven neutral, and eight negative views of mathematics in the questionnaire. In the most negative group of students, their self-confidence registered within the weakest 15% and in the test the weakest 30%. After the courses we captured for the interviews 15 of the 21 students. In this paper, we focus on 4 female students (Ella, Erja, Aila and Inka) and on 1 male student (Ari) who all had negative views of mathematics at the beginning of teacher education program. Here we have used pseudonyms. They all had selected general mathematics courses in upper secondary school, Inka and Erja did not take mathematics in their Matriculation Examination, and the others did not pass the examination or their scores were poor. Aila and Inka had more than 3 years experience working as an elementary school teacher or as a kindergarten teacher. Erja and Ella had some (less than 3 months) experience of working as an elementary school teacher, but at least 1 year of working as a school helper. Ari did not have any earlier experience of working at school. Within this paper, we aim to answer the following research questions:

1. How did pre-service teachers' identity talk change during their mathematics education course?

1.1 What kind of interpretative repertoires and rhetorical devices did pre-service teachers use at the beginning of their mathematics education course?

1.2 What kind of interpretative repertoires and rhetorical devices did pre-service teachers use after mathematics education course?

1.3 How did the interpretative repertoires and rhetorical devices the pre-service teachers use change during the mathematics education course?

1.4 In which ways does the use of discursive, rhetorical and narrative methodologies help us to understand the incoherence manifested in pre-service teachers' mathematical identity talk?

Our data analysis took influences from narrative, discursive, and rhetorical approaches. We analyzed the experiences of 5 pre-service teachers and the ways in which the teachers talked about their identity as narratives. In the first interview, the students reported their mathematical autobiographies that revealed how they had constructed their mathematical identities. Especially, we sought key episodes from their autobiographies. In the second interview, in spring 2004, we asked the students how their views of mathematics possibly had changed during the mathematics education course.

The discursive approach analyzes the expression of opinions in terms of discursive action. Rather than being straightforward reports of internal states, attitude-statements are uttered as stances on matters of public controversy. Attitude-statements typically bear a rhetorical meaning: when persons give their opinion in dialogue, they give typically arguments, justifying their own views and criticizing counter-views (Billig, 1997).

There are many approaches in discourse analysis with different ways of analysis. Some of them have are formal, and others less prescribed. Our analysis was iterative and arrived at through intensive readings of the transcripts. Firstly, sections of text were selected on the basis of their relevance to students' past memories and experiences during teacher education. Secondly, we identified the particular perspectives or point of views represented in the

students' talk. We paid attention to the contradictory and changeable perspectives in the data (Potter & Wetherell, 2001), especially to inconsistencies and internal contradictions in the answers (Talja, 1999). We noticed that in some data excerpts students described themselves through passive perspective, as passive objects, and in some data excerpts through active perspective, as active subjects. In students' talk there was also a clear dichotomy between positive and negative expectations towards future, between optimistic and pessimistic way to talk. Defensive talk was also present. Thirdly, we began to search main metaphors that are connected to the passive and active point of views. Interpretative repertoires that are often organized around one or more central metaphors (Potter, 1996a). Metaphors represent patterns of thought based on systematic ways of experiencing and expressing one thing in terms of another (Lakoff & Johnson, 1980). Then we sorted and named the various ways of talking as inductively derived abstract categories, interpretative repertoires. For example, we found that in some data excerpts where students described themselves as objects, pre-service teachers used the metaphor of an "outsider". They felt that they lack control over their learning of mathematics, and they could not do anything to change their negative situation. We named this interpretative repertoire the Fatalist repertoire because Fatalism does not include any hope; it is the denial of free-will and chance.

In addition to seeking interpretative repertoires, we were interested in rhetoric. Especially we draw our attention to the following rhetorical devices: category entitlement, categorization, active voicing, and the use of disclaimer. *Category entitlement* can be used to build up the factuality of the accounts. Certain categories of people are treated as knowledgeable. Category entitlement obviates the need to ask how the person knows through being a member of some specific category—professor, hockey player, etc. (Potter, 1996b, pp. 122, 136). For example, a pre-service teacher can invoke an expert's or some other authority's talk. Through *categorization*, the specific sense of something is constituted. It is not understood just as a rather banal naming process (Potter, 1996b, p. 177). Categorization is a

complex social accomplishment. For example, in our study some math anxious preservice teachers categorized themselves as victims. *Active voicing* (Wooffitt, 1992) is a rhetorical device that means reporting someone else's speech within an account of what really happened. Students can tell how good they are by reporting someone's positive talk about themselves. People can use *disclaimers* when they know that what they are saying may attract criticism. For example, "I am not racist, but . . ." (Billig, 1988). In addition, we found the following rhetorical devices (Potter, 1996b) in our data: the use of detailed description and narratives, the use of metaphors, rhetorical questions, or extreme utterances. Here "utterance" can consist of single words, phrases, clauses, and clause combinations spoken in context (Carter & McCarthy, 2006).

RESULTS

Interpretative Repertoires and Rhetorical Devices Before and After the Course

We identified six central interpretative repertoires that were manifested in pre-service teachers' mathematical identity talk, and named them in the following way: 1) Victim, 2) Ego-defensive, 3) Fatalist, 4) Gaining an Insight, 5) Self-development, and 6) Responding to the Expectations of the Change. The last two repertoires were present only after the mathematics education course. In the context of each repertoire, we will also describe the most typical rhetorical devices.

Victim Repertoire. In the Victim repertoire, presented themselves as victims (the main metaphor). They described themselves as a passive role: they could not influence things that happened to them. Threat from teacher or classmates was often strongly connected to their narratives. This repertoire can be manifested in a milder or in a stronger form but always carries a negative connotation.

Before the mathematics education course, moral stance and judgment were reflected strongly in Ella's, Inka's, and Aila's stories. Ella recalled her traumatic experiences from elementary school in the following way:

I sometimes had to go to remedial instruction, and I think it was the most humiliating experience in the world. It always began the same way: the teacher, who gave remedial instruction, came and knocked on the door of our class. Then he said hello to our teacher. After that, teachers talked to each other. And then our teacher pointed her finger at some pupils, who had to go to remedial instruction. And I recall it really shamefaced, because she said in front of all pupils that "Ella, you must learn fractions in remedial instruction" . . . I think it was awfully humiliating.

In her story, Ella used many rhetorical devices. First, she crystallized the whole story by using an extreme utterance: "the most humiliating experience in the world." Second, she used a detailed description that enabled the audience to take her role easily. Third, she used active voicing by presenting a direct quote from her teacher speech. Fourth, she categorized herself as a victim. This is a very effective rhetorical device that assured listeners that this student's experiences were very tragic.

Inka recalled the following episode:

Inka: "In secondary school the teacher asked everyone in turn . . . And because I was insecure and anxious, I was afraid that I will give a wrong answer."

Interviewer: "Do you remember some event where you gave a wrong answer?"

Inka: "Yes, I do. Thereby it was so scary. And our class in secondary school was an unsafe place, because some pupils get very negative feedback. It was very scary."

Interviewer: "Did they laugh or what kinds of reactions they had?"

Inka: "They really wondered why I did not know the answer . . . And because I am so very susceptible, I can begin to cry. I always was afraid of it, that if I begin to cry, it provokes them to continue bullying."

Inka's episode also crystallizes her fear related to waiting her turn to answer and shame related to giving the wrong answer, which is compounded with mockery by her classmates:

“Don’t you really know the answer?” At its worst, it could make Inka cry, and this could trigger a vicious cycle. Similar to Ella, Inka also used active voicing when presenting a direct quote from pupils’ talk. The plots of both stories reflect each other: At first, they are waiting for a threatening moment, which caused feelings of anxiety, and at the end, the teachers had feelings of shame in front of other pupils. In Ella’s story, the teachers, and, in Inka’s story, both pupils and the teacher are seen as enemies who are threatening Ella’s and Inka’s mathematical identity.

Aila said that she experienced a bad turn at the beginning of secondary school. The reason for this turn was “a strange teacher”:

He pointed a wet blackboard sponge at us and meant to throw it if someone does not know . . .

Usually he pointed a sponge at girls. I was a kind of target for him . . . So I decided that I only make exercises unnoticeably and don’t put up my hand very much.

Aila presents the sexism of the teacher as a reason for her withdrawal from the subject. Her story is evocatively described in a way that invites the listener to identify with her and hence to understand her attempts to disappear in the classroom as a response to her being a "target" of the teacher. Aila used categorization as a rhetorical device for presenting herself as a victim.

After the course, the Victim repertoire manifested only in Aila’s and Ella’s talk that was connected to their own years at school. They still categorized themselves as victims and their teachers as the enemy. If the teacher had taught in a better way, then they would have been better in mathematics. Aila said, “If my teachers at school had used concrete materials, I would have understood.” Ella said, “Now I have most in my mind my memories of my own school time . . . I was recalling one of my physics teachers. Always when I asked him something, he looked at me like I would be a real idiot.”

Ego-defensive Repertoire. For the Ego-defensive repertoire, self-defensive and self-protective talk is characteristic. At the beginning of the mathematics education course, Aila, Erja, Inka, and Ella used an Ego-defensive repertoire. Aila said that she had no need to learn

mathematics: “I lack the capability to learn math. I don’t need it [math]. I will succeed in my life without it.” Yet, as a future teacher, she will not be able to avoid teaching mathematics. Here Aila used pleading opposite values as a rhetorical device. In her first interview, Inka stated, “I don’t remember any major anxiety”; “My sister and my friend were even lower achievers than I.” Erja also said, “I never had any kind of learning difficulties.” Here Inka and Erja used rejection of difficulties as a rhetorical device to protect their mathematical identity. In the first mathematics test, Erja had answered only a few questions. When we asked about this, she dropped her safeguard: “I wondered how I would dare to give the test paper back.” In the first interview, Erja said, “Because I *personally* have not liked math, so certainly to me as a teacher it is difficult suddenly to say, that math is wonderful.” Ella was also anxious when we asked about her solutions on the first test: “Immediately when I begin new educational program, you dash math against my face again. I felt oppressed.”

After the course, Ego-defensive repertoire was used much less than at the beginning of the course. We found signs of the Ego-defensive repertoire in Erja’s and Ella’s talk. When the interviewer asked Erja about the ways she tried to solve the tasks of the final math proficiency test, her talk changed clearly. She gave many explanations why her success had been poor: “Now I am not able to think. For me it will take time to come inside it. So, I really can not at all think [the tasks].” Often the use of explanations manifests that the thing is problematic for the speaker (Linde, 1993).

Ella’s talk also included the Ego-defensive repertoire, and she gave many explanations:

I did not prepare myself in any way for the test. And I was not present during the lecture where the concept of the scale was taught. And also when making the test, I was busy, and wanted to go away.

Fatalist Repertoire. The Fatalist repertoire is often manifested through a metaphor of an “outsider.” This repertoire includes a belief that some people are insiders and some outsiders in relation to mathematics, and the latter can do nothing to change the fact that they lack the

talent. Hence, the Fatalist repertoire includes a rhetorical device of categorizing oneself as an outsider. At the beginning of the course, all 5 preservice teachers used the Fatalist repertoire in their talk: Ella said, “I think there is a whole language that I don’t understand at all” and “I really have lost very much, because I am not a person who understands math and logical things.” Ari also observed that he is not talented in mathematics: “I have implicitly thought that math is a subject which you either can or can’t learn . . . I can attain a certain level with the gifts I have.” Inka blamed herself by asking a rhetorical question: “Why must I be so stupid?” One part of Fatalist repertoire is the belief, “Mathematics is an affair for men.” Aila said, “My mom asked at home exercises of other subjects, and my father gave advice in math, because he knows it well . . . We *always* had different affairs for men and women.”

After the course, Aila disclaimed of the Fatalist repertoire: “The reason for my learning difficulties is outside me.” Ari also back-pedaled on his earlier talk: “I am not *terribly* talented in mathematics, I will survive . . .” In Erja’s and Inka’s talk, there was still some signs of the Fatalist repertoire but in a milder form than earlier. Erja said, “I am *not so much* talented in math,” and Inka said, “I don’t understand *higher mathematics* well enough.” The Fatalist repertoire includes a pessimistic view about the possibility of deep change: Ella still had low confidence, but her talk no longer included a fatalist view.

Self-Development Repertoire. Here students describe themselves as an active actor who has clear goals. Their talk is future oriented and includes very optimistic connotation. The roots of self-development and lifelong learning rhetoric are in Western culture, and they are strongly emphasized in teacher education (Kaasila, 2007b). According to Komulainen (1998), self-improvement narratives describe a tension that either divides the protagonist against herself into conflicting halves or brings her into conflict with other people. In these stories, identity is viewed as though it were a separate object. We see that preservice teachers’ mathematical identity is open-ended, never completed, and that they criticize the unsatisfactory half of their mathematical identity (see also Kaasila, 2007b). The Self-

development repertoire also includes an optimistic belief about the possibility of deep change. “I want to develop into a good math teacher” rhetoric is an important part of discourse of teacher education: it includes an idea that you must at all times control what you are doing and reflect on it afterwards, and you must learn through your experiences.

After the course, the Self-development repertoire was manifested in many ways. Inka said, “I believe that my thoughts will change in time . . . I want to stop the negative spin,” and Ella said, “Even I can learn by working hard.” Erja and Ari also had adopted optimistic view of the future. Erja said, “I know that I can learn if I only go into it,” and Ari said, “At the next teaching practice, I will know much more about myself, my ways to act, my strengths, and weaknesses.” They all categorized themselves as self-developers.

Gain an Insight Repertoire. The Gain an Insight repertoire is often connected to the metaphor of “seeing things in a new light.” Through this rhetorical device, the audience understands that the change is significant. Students described themselves as an active role, and their talk is full of optimism. The Gain an Insight repertoire differs from Self-development repertoire because in the former the insight is connected to some concrete facilitator that influenced preservice teachers’ mathematical identity. The Gain an Insight repertoire was manifested after the course in all students’ talk. We divided the Gain an Insight Repertoire into different parts depending on the facilitator during the mathematics education course.

Making mathematics concrete was an insight connected to the use of manipulative models. Erja said, “I really think that children will learn in a better way when using manipulative models,” and Inka said, “To increase pupils’ understanding, I will use concrete models in my teaching.” In an extreme form, this repertoire can be crystallized as “making mathematics concrete is a salvation,” in which case we can draw a parallel with a revival: Ella emphasized the usefulness of concretizing like a mantra: “*The key to everything* is the very

many concrete materials” and “Now *I see all* the [mathematical] contents *in a new light*.”

Here she used extreme utterances and repetition as rhetorical devices.

Using previous negative experiences as a resource was an insight that became evident when students reflected on their experiences from their years at school. For example, Ella told, “My *mission* is to turn my failure experiences around, so that others [pupils] can get positive experiences.” Ella became aware that her ability to take the role of weaker pupils can be a useful resource when teaching mathematics (see also Kaasila, 2000).

Other facilitators were present in students’ talk. Aila said, “I am excited because now for me it has taught mathematics basic concepts . . . I have understood the whole picture of mathematics, its parts, and how they are connected to each other.” Ari emphasized: “Now I have adopted versatile teaching methods. Before, I thought that in math lessons pupils are sitting at their desks and their teacher tells them what to do. For me, teaching math was a positive surprise.”

Responding to the Expectations of the Change Repertoire. Pre-service teachers know that expectations of change are built into teacher education, and therefore, many think how to justify if they see that their view of mathematics has not changed. This dilemma leads to a tension that manifests through the Responding to the Expectations of the Change repertoire.

This repertoire was present only after the course in Ella’s, Inka’s, and Erja’s talk. This repertoire is connected to a pessimistic view about the possibility of a deep, permanent change. Ella observed:

Uncertainty that I felt before, has modified into another form . . . *My personal relationship* towards mathematics has necessarily not changed: I know that same thoughts as before crisscross in my head, if I suddenly must solve some tasks, but *my general relationship* towards mathematics has certainly changed.

Her talk seems to be composed on two levels: the deep level (my personal relationship with mathematics) has not changed. The second one (my general relationship with mathematics) is

the surface level, which seems to have changed. The rhetorical device Ella used is connected to the dichotomy between her personal and general views. It seems that she used the latter as a disclaimer. This disclaimer helped Ella to tell her personal view that is against the norms and expectations of teacher education.

Inka said: “When I read Lindgren’s article, I woke up by the following sentence, ‘It is characteristic for teacher trainees to use information they get during teacher training rather to confirm their preconceptions than to change them.’” Here Inka used the category entitlement as a rhetorical device by invoking an authority (Lindgren, 1997). She continued with a rhetorical question: “I began to think how this [teacher] education has influenced me. Has it changed my conceptions. Maybe it has not necessarily *fundamentally* changed.” Erja said, “I could think that mathematics would be the most unpleasant subject to teach, but of course, my aim is not to have this kind of attitude because this would influence my teaching in a bad way.”

Summarizing the Results

We present a summary of the main interpretative repertoires and rhetorical devices in Table 1.

[Table 1 about here]

In Table 2, we present the main interpretative repertoires pre-service teachers had before and after the mathematics education course.

[Table 2 about here]

Based on Table 2, we see that when pre-service teachers at the beginning of the course talked about school memories or about the first mathematics test, the most common repertoires were the Victim, Ego-defensive, and Fatalist repertoires. All the pre-service teachers did poorly on the mathematics test at the beginning of the mathematics education

course, and this may be reflected in the repertoires the students used. After the mathematics education course, all pre-service teachers had adopted two new repertoires that included a positive connotation: the Gain an Insight repertoire and the Self-Development repertoire. When the repertoires were compared before and after the course, the biggest positive change was observed in Aila's and Aris's talk. After the course, Aila no longer used the Fatalist or Ego-defensive repertoire, and Ari no longer used the Fatalist repertoire. In addition Inka's, Ella's, and Erja's mathematical identity talk had changed during the course, but they were still balancing between the Self-development and Gain an Insight repertoires and the Responding to the Expectations of the Change and Ego-defensive or the Fatalist repertoire.

DISCUSSION

We identified six central interpretative repertoires that were manifested in preservice teachers' mathematical identity talk: Victim, Ego-defensive, Fatalist, Gaining an Insight, Self-development, and Responding to Expectations of the Change. Interpretative repertoires help us to understand pre-service teachers' talk, which, to an outsider, can sound incoherent: the reason for the inconsistency is that during the same interview they shifted from one repertoire to other, for example, from the Fatalist repertoire to the Self-development repertoire. Although it is possible to find from our data other interpretative repertoires, we see that through six main repertoires we can describe pre-service teachers' mathematical identity talk in a versatile way.

When naming the repertoires, we also took into account that the way we named them can include a moral view. This is true always when researchers name repertoires they have found. For example, the Victim repertoire could also be named the Threat repertoire, but we see that Victim repertoire describes in a more versatile way the utterances the preservice teachers used. We want to emphasize that the repertoire names are open to further negotiation through their use by other researchers. The most central rhetorical devices that manifested in the

preservice teachers' identity talk were category entitlement, categorization, active voicing, use of disclaimer, and use of metaphors or extreme utterances. Rhetorical devices are not exhaustive (see also Edwards and Potter, 1992, pp. 160–163), and not mutually exclusive, and often they are manifested in combination in talk (Barwell, 2003).

At the beginning of the mathematics education course, many preservice teachers' narratives with negative experiences mainly followed the plot used in tragedies. Often, feelings of shame and hopelessness were related to anxiety (Pekrun et al., 2002). Threat was often manifested in preservice teachers' narration: they felt their mathematical identity threatened. Often they also had a fear connected to loss of face (see Goffman, 1967). So it is understandable that the Moral repertoire was present at the beginning of the mathematics education course. It is a matter of presenting the self in an acceptable moral light (Edwards & Potter, 1992). Students judge themselves and others in relation to standards of goodness (Ochs & Capps, 2001, pp. 45–46). Preservice teachers often categorized themselves in the role of a victim. This is an effective rhetorical device, which persuaded listeners that the experiences had been tragic. It seems that the Ego-defensive and Fatalist repertoires were activated in specific contexts, especially when students talked about the mathematics proficiency test at the beginning or at the end of the mathematics education course.

When we compare the repertoires that manifested in preservice teachers' talk at the beginning and at the end of the mathematics education course, we see that the biggest positive change occurred in Aila's and Aris's talk. It is possible that because Aila and Ari did better than Inka, Ella, and Erja in the final mathematics test at the end of the course, this was also reflected in the interpretative repertoires Aila and Ari used. Although Inka's and Ella's mathematical identity talk after the mathematics education course included a more positive connotation than at the beginning of the course, they were still balancing between backward-looking insecurity and forward-looking optimism. Especially, their traumatic past was often present in their narration, sometimes explicitly, sometimes in a more latent form. On the other

hand, we see that the Gain an Insight repertoire can work in their talk as a positive bridge between their past and present mathematical identities. In the best case, these students can define their past mathematical identity in a more positive way than earlier (see Kaasila, 2000). The Gain an Insight repertoire (e.g., making concrete) can also work as a positive resource that helps students use manipulative models to add their understanding of mathematics and to find a different way to teach mathematical contents. On the other hand, in an extreme form (“making mathematics concrete is a salvation”), it can work as an obstacle to improving abstract thinking. This is possible especially if they do not realize the bridge between the use of manipulative and abstract mathematical ideas. The smallest change happened in Erja’s identity talk: she was the only one whose talk after the course included signs of the Ego-defensive and Fatalist repertoires. Erja did worse on the final test than the other students.

One central rhetorical device including the Fatalist repertoire is connected to the way preservice teachers construct their mathematical identity by using negations or negative sentences. For example, Ella said at the beginning of the course, “If you can’t learn mathematics, you are nothing as a person.” She was categorizing herself against the dominant norms of our society. This is also one way of producing otherness. Interpretive repertoires can legitimate a specific version of reality while silencing other discourses that could be framed around a specific theme (Milne, 2009).

This study has some implications to mathematics teacher education. During mathematics methods courses it is important to give pre-service teachers tools to deal with their recollections and experiences: If students reflect on occasions in their mathematical autobiography and discover that the interpretations of events can be changed, it can free them to search for new perspectives on their mathematical past and future (see also Kaasila et al., 2008). It is also important to challenge the Fatalist repertoire. One way to do is to consider critical beliefs connected to mathematical talent.

In summary, multiple research methods enabled us to understand the inconsistencies manifested in preservice teachers' mathematical identity talk. We agree with Gellert (2001) when he says that interpretation of a single isolated utterance can lead to wrong or oversimplified evidence. According to Talja (1999), interview talk is interpretive work: it is reflexive, theoretical, and contextual, because the objects of talk are not abstract objects that everybody uses in the same way. During the mathematics education course, many preservice teachers do mathematical identity work, and this process includes their awareness of the tension between their present and ideal state of mathematical identity (Lutovac & Kaasila, 2010). To overcome these challenges, and to analyze mathematical identity talk, we first need narrative methodology because narrative identity mediates between "what is" and "what ought to be" (Ricoeur, 1992). Second, we need discursive methodology for understanding that in preservice teachers' talk there are often shifts between their real and ideal identities. Preservice teachers have multiple mathematical identities, and these identities are activated in different situations or contexts. Alternatively, we can see them as negotiating for a position in the social context. For that purpose, we need rhetorical methodology because, through the rhetorical devices that preservice teachers use, we can better understand that their mathematical identity talk is always directed to some audience. In sum, we see that, by combining narrative, discursive, and rhetorical approaches, it is possible to get a deep understanding of preservice teachers' multiple and conflicting identities.

REFERENCES

- Barwell, R. (2003). Discursive psychology and mathematics education. Possibilities and challenges. *ZDM*, 35(5), 201–207.
- Beijaard, D., Meijer, P.C. & Verloop, N. (2004). Reconsidering research on teachers' professional identity. *Teaching and Teacher Education*, 20, 107–128.

- Billig, M. (1988). The notion of 'prejudice': Some rhetorical and ideological aspects. *Text*, 8, 91–110.
- Billig, M. (1997). Discursive, rhetorical and ideological messages. In C. McGarty & A. Haslam (Eds.), *The message of social psychology* (pp. 36–53). Oxford: Blackwell.
- Blumenthal, D. (1999) Representing the divided self. *Qualitative Inquiry*, 5, 377–392.
- Carter, R. & McCarthy, M. (2006) *Cambridge grammar of English*. Cambridge: Cambridge University Press.
- Chapman, O. (2008). Narratives in mathematics teacher education. In D. Tirosh & T. Wood (Eds.), *The international handbook of mathematics teacher education: Tools and processes in mathematics teacher education* (pp. 15–38). Rotterdam/Taipei: Sense.
- Denzin, N. (1989). Interpretive biography. *Qualitative Research Methods Series*, 17. Newbury Park, CA: Sage.
- Edwards, D. (1997). *Discourse and cognition*. London: Sage.
- Edwards, D. & Potter, J. (1992). *Discursive psychology*, London: Sage.
- Gellert, U. (2001). Research on attitudes in mathematics education - a discursive perspective. In M. van den Heuvel-Panhuizen (Ed.), *Proceedings of the 25th Conference of the International Group for the Psychology of Mathematics Education. Vol. 3* (pp. 33–40). Utrecht: Utrecht University.
- Hannula, M.S. (2004). *Affect in mathematical thinking and learning*. Turku, Finland: Annales universitatis turkuensis B 273.
- Hannula, M.S., Kaasila, R., Laine, A. & Pehkonen, E. (2005). Structure and typical profiles of elementary teacher students' view of mathematics. In H.L. Chick & J.L. Vincent (Eds.), *Proceedings of the 29th conference of the International Group for the Psychology of Mathematics Education, Vol. 3* (pp. 89–96). Melbourne: University of Melbourne.
- Hannula, S.M., Liljedahl, P., Kaasila, R. & Rösken, B. (2007). Researching relief of mathematics anxiety among pre-service elementary school teachers. In J. Woo, H. Lew,

- K. Park & D. Seo (Eds.), *Proceedings of the 31st Conference of the International Group for the Psychology of Mathematics Education* (pp. 153–162). Seoul, Korea: PME.
- Kaasila, R. (2000). *Eläydyin oppilaiden asemaan* [Insight into the role of pupils. The significance of school recollections in the formation of the conceptions and teaching practices of mathematics for preservice teachers]. *Acta Universitatis Lapponiensis* 32. Rovaniemi dissertation.
- Kaasila, R. (2007a). Mathematical biography and key rhetoric. *Educational Studies in Mathematics*, 66, 373–384.
- Kaasila, R. (2007b). Using narrative inquiry for investigating the becoming of a mathematics teacher. *ZDM – International Journal of Mathematics Education*, 39, 205–213.
- Kaasila, R., Hannula, M.S., Laine, A. & Pehkonen, E. (2008). Socio-emotional orientations and teacher change. *Educational Studies in Mathematics*, 67, 111–123.
- Kaasila, R. & Lauriala, A. (2010). Towards a collaborative, interactionist model of teacher change. *Teaching and Teacher Education*, 26, 854–862.
- Kaasila, R., Pehkonen, E. & Hellinen, A. (2010). Finnish pre-service teachers' and upper secondary students' understanding on division and reasoning strategies used. *Educational Studies in Mathematics*, 73, 247–261.
- Krzywacki, H. (2009). *Becoming a teacher: Emerging teacher identity in mathematics teacher education*. Dissertation. Department of Applied Sciences of Education, Research Report 308, University of Helsinki.
- Krzywacki, H. & Hannula, M.S. (2010). Tension between present and ideal state of teacher identity in the core of professional development. In C. Frade & L. Meira (Eds.), *Proceedings of the 34th Conference of the International Group for the Psychology of Mathematics Education*. Belo Horizonte, Brazil: PME 34.

- Lakoff, G. & Johnson, M. (1980). The metaphorical structure of the human conceptual system. *Cognitive Science*, 4, 195–208.
- Lerman, S. (2001). Cultural, discursive psychology: A sociocultural approach to studying the teaching and learning of mathematics. In: C. Kieran, E. Forman & A. Sfard (Eds.), *Learning discourse: Sociocultural approaches to research in mathematics education. Educational Studies in Mathematics*, 46, 87–113.
- Linde, C. (1993). *The creation of coherence*. New York: Oxford University Press.
- Lindgren, S. (1997). Voidaanko matematiikan opiskeluasenteita muuttaa? [Can we change attitudes towards mathematics]. In P. Räsänen, P., Kupari, T. Ahonen & P. Malinen (Eds.), *Matematiikka -näkökulmia opettamiseen ja oppimiseen* (pp. 381–396). Jyväskylä, Finland: Niilo Mäki instituutti ja Koulutuksen tutkimuslaitos.
- Lutovac, S. & Kaasila, R. (2011). Beginning a pre-service teacher's mathematical identity work through narrative rehabilitation and bibliotherapy. *Teaching in Higher Education* 16(2), 225 – 236.
- Maclure, M. (1993). Mundane autobiography: Some thoughts on self-talk in research context. *British Journal of Sociology of Education*, 14, 373–384.
- Ochs, E. & Capps, L. (2001). *Living narrative. Creating lives in everyday storytelling*. Cambridge, MA: Harvard University Press.
- Oliveira, H. & Hannula, M.S. (2008). Individual prospective mathematics teachers. In K. Krainer & T. Wood (Eds.), *Participants in mathematics teacher education: Individuals, teams, communities and networks* (pp. 13–34). Rotterdam: Sense.
- Pietilä, A. (2002). *The role of mathematics experiences in forming pre-service elementary teachers' views of mathematics*. In A. Cockburn & E. Nardi (Eds.), *Proceedings of the 26th Conference of the International Group for the Psychology of Mathematics Education. Vol. 4* (pp. 57–64). Norwich, England: University of East Anglia.

- Potter, J. (1996a). Discourse analysis and constructionist approaches: Theoretical background. In J. Richardson (Ed.), *Handbook of qualitative research methods for psychology and the social sciences* (pp. 125–140). Leicester, England: BPS Books.
- Potter, J. (1996b). *Representing reality: Discourse, rhetoric and social construction*. London: Sage.
- Ricoeur, P. (1992). *Oneself as another*. Chicago: University of Chicago Press.
- Ruffell, M. Mason, J. & Allen, B. (1998). Studying attitude to mathematics. *Educational Studies in Mathematics*, 35, 1–18.
- Sfard, A. & Prusak, A. (2005). Telling identities: The missing link between culture and learning mathematics. In H. L. Chick & J. L. Vincent (Eds.), *Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education*, Vol. 1 (pp. 37–52). Melbourne: University of Melbourne.
- Talja, S. (1999). Analyzing qualitative interview data: The discourse analytic method. *Library and Information Science Research*, 21, 459–477.
- Trujillo, K.M., & Hadfield, O.D. (1999). Tracing the roots of mathematics anxiety through in-depth interviews with preservice elementary teachers. *College Student Journal*, 33, 11.
- Uusimäki, S.-L. & Kidman, G. (2004, July). *Challenging maths-anxiety: An intervention model*. Paper presented at the ICME-10 conference, Copenhagen, Denmark.
- Williams, J., Black, L., Hernandez-Martinez, P., Davis, P., Pampaka, M. & Wake, G. (2008). Repertoires of aspiration, narratives of identity, and cultural models of mathematics practice. In M. Cesar & K. Kumpulainen (Eds.), *Social interactions in multicultural settings* (pp. 39–70). Rotterdam: Sense.
- Wooffitt, R. (1992). *Telling tales of the unexpected*. Hemel Hempstead, England: Harvester.
- Zeyer, A. & Roth, W.-M. (2009). A mirror of society: A discourse analytic of 15–16-year-old Swiss students' talk about environment and environmental protection. *Cultural Studies of Science Education*, 4, 961–998.

TABLE 1.

The main interpretative repertoires and rhetorical devices in preservice teachers'

mathematical identity talk

The name of the repertoire	Examples of the contents and rhetorical devices connected to the repertoire
Victim	Moral stance and judgment Categorizing teachers or classmates in the role of enemies Categorizing oneself in the role of victim Active voicing Detailed description, narratives, metaphors, extreme utterances
Ego-defensive	Self-protective talk Pleading opposite values Rejecting math anxiety Use of explanations
Fatalist	Categorizing oneself in the role of outsider Internalizing beliefs about talent Pessimism about deep change Extreme utterances, rhetorical questions, negative sentences
Self-development	Presenting (categorizing) oneself as a self-developer Lifelong learning rhetoric in a general level (not focused on some specific things) Optimism about deep change
Gain an Insight	Seeing things "in a new light" Insight is connected to some specific facilitators An extreme form: Seeing an insight as a salvation
Responding to the Expectations of the Change	Dichotomy and tension between students' own views and the expectations held by teacher education Disclaimer Category entitlement: Invoking authority Pessimism about deep change

TABLE 2.

**The main interpretative repertoires in pre-service teachers' talk before
and after the mathematics education course**

Pre-service teacher	Repertoires at the beginning of the course	Repertoires at the end of the course
Aila	Victim, Ego-defensive, Fatalist	Victim, Gain an Insight, Self-development
Ari	Fatalist	Gain an Insight, Self-development
Ella	Victim, Ego-defensive, Fatalist	Victim, Ego-defensive, Self-development, Gain an Insight, Responding to the Expectations of the Change
Inka	Victim, Ego-defensive, Fatalist	Fatalist, Self-development, Gain an Insight, Responding to the Expectations of the Change
Erja	Ego-defensive, Fatalist	Ego-defensive, Fatalist, Self-development, Gain an Insight, Responding to the Expectations of the Change