Sonja Lutovac

FROM MEMORIES OF THE PAST TO ANTICIPATIONS OF THE FUTURE

PRE-SERVICE ELEMENTARY TEACHERS’ MATHEMATICAL IDENTITY WORK
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Pre-service elementary teachers’ mathematical identity work

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This study explored mathematical identity work by drawing on the cases of Finnish and Slovenian pre-service elementary teachers. All cases reported having had negative experiences with mathematics during their school years. These experiences were shown to have a central meaning for pre-service teachers’ mathematical identities. However, identity also extends to the future. For this reason, pre-service teachers’ anticipations of the future were also explored. The concepts of narrative identity (Ricoeur, 1992) and possible selves (Markus & Nurius, 1989) were applied in the context of mathematics education. The overall narrative perspective of the study enabled a psycho-social understanding of identity. The special interest of the study was confined to an understanding of the role that educational contexts play in pre-service teachers’ mathematical identity work.

Narrative inquiry was applied as a research methodology. In-depth interviews invited pre-service teachers to construct narratives of their mathematics-related experiences. These narratives were analysed holistically and categorically, as well as in terms of content and form.

The findings showed striking similarities in pre-service teachers’ school-time memories. The cases in question felt like victims of their own mathematical experiences. The anticipations of mathematics teaching were also underlined by the challenges rooted in their school-time experiences. However, a surprising finding was that the identity work in which the Finnish and Slovenian cases engaged during their teacher education differed substantially. The main reasons for the differences in identity work seemed to stem from different emphases and pedagogical practices in mathematics education courses within the Finnish and Slovenian teacher education settings.

The study argued that identity work can be facilitated during teacher education. To begin such a process, it would be central to focus on pre-service teachers’ biographical context through narrative pedagogical tools. The findings also showed that neglecting issues from school-time experiences might engender further challenges for pre-service teachers’ future mathematics teaching. Finally, the study argued for the need to openly address identity during teacher education. The significant theoretical contribution of the study is the conceptualisation of ‘mathematical identity work’.

Keywords: mathematical identity work, mathematics education, narrative identity, narrative inquiry, negative experiences, possible selves, pre-service elementary teachers, school time memories
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Tiivistelmä


Tutkimusmetodologianä käytettiin narratiivista tutkimusta. Opiskelijat kertoivat syvähaastatteluissa matematiikan liittyvistä kokemuksistaan. Nämä narratiivit analysoitiin holistisesti ja kategorisesti ottaen huomioon myös niiden sisältö ja muoto.


Asiakas: kouluaikaan liittyvät muistot, luokanopettajaopiskelijat, mahdolliset minuudet, matemaattinen identiteettityö, matematiikan opetus, narratiivinen identiteetti, narratiivinen tutkimus, negatiiviset kokemukset
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1 Introduction

1.1 Background and rationale of the study

Since elementary teachers usually teach many different subjects and are not specialised in teaching mathematics, it is not granted that they have a favourable relationship with mathematics. As opposed to students who specialise in becoming mathematics teachers, pre-service elementary teachers usually do not exhibit a ‘strong disciplinary bond’ with mathematics (Hodgen & Askew, 2007, p. 484). In fact, research has documented ‘a rather pessimistic picture’ of how pre-service elementary teachers experience mathematics and the kind of relationship they develop towards the subject (Grootenboer, 2006, p. 271). Negative views of mathematics resulting from negative school-time experiences are considered a common, widespread phenomenon for many elementary teachers (Di Martino & Sabena, 2011; Di Martino & Zan, 2010; Ellsworth & Buss, 2000; Jones, Brown, Hanley, & McNamara, 2000; Kaasila, Hannula, Laine, & Pehkonen, 2008a; Kaasila, 2007a, 2007b; Pietilä, 2002). This issue is of great importance as negative views of mathematics have been considered, as Liljedahl, Rolka and Rösken (2007, p. 320) note, to ‘run counter to contemporary research on what constitutes good practice’.

For example, research has shown that (pre-service) elementary teachers frequently have resilient beliefs about mathematics (Grootenboer, 2006; Liljedahl et al., 2007), negative attitudes towards mathematics (Di Martino & Zan, 2010, 2011), one-sided beliefs about teaching mathematics (Pietilä, 2002; see also Laine & Kaasila, 2007) and various negative emotions in relation to mathematics, including anxiety (Bekdemir, 2010; Palmer, 2009; Wilson, 2009) and shame (Bibby, 2002). They perceive their self-efficacy as teachers to be low (Phelps, 2010; Swars, Daane, & Giesen, 2006) and may also transmit their negative emotions (e.g. anxiety) to their pupils (e.g. Pietilä, 2002; Trujillo & Hadfield, 1999). Alternatively, as discussed by Gellert (2000), they may overprotect their pupils from negative experiences by teaching in such way that the connection with mathematics is lost. Above all, research shows that elementary teachers often have a weak understanding of mathematical concepts (e.g. Ball, 1990; Kaasila, Pehkonen, & Hellinen, 2010; Rech, Hartzell, & Stephens, 1993).

The interest in teachers’ personal experiences (e.g. experiences with mathematics) has led to the considerable importance of narratives and the
narrative research tradition in education (e.g. Connelly & Clandinin, 2000; Elbaz-Luwisch, 2002). Connelly and Clandinin (1990, p. 2) state that ‘education and educational research are understood as the construction and reconstruction of personal and social stories; learners, teachers and researchers are storytellers and characters in their own and others’ stories’. Moreover, many researchers have accepted the view that people construct themselves and their reality by stories, and the assumption that these stories tell much about the storytellers have become justified (Laszlo, 2008). The focus on teachers’ personal experiences has been further highlighted by researchers’ interest in the concept of identity in various disciplines, including in mathematics education research. There have been strong groundings in recent research that clearly demonstrate that the concept of identity is central to thinking about learning and teaching mathematics (Black, Mendick, & Solomon, 2009). As such, I became interested in exploring pre-service elementary teachers’ stories of their mathematical experiences as a way of exploring what these stories tell about pre-service teachers in relation to mathematics. Moreover, due to the fact that for many pre-service elementary teachers, mathematics is an emotion-laden domain, this further highlighted the importance of considering the mathematical identities of those who have had negative experiences during their school time. I also saw the need to better understand how pre-service teachers’ negative past experiences with mathematics might shape their future mathematics teaching. Due to the narrative nature of this study, the aim is also to give a voice to pre-service teachers with negative school-time experiences.

In addition, we know that pre-service teachers enter teacher education programmes with identities that have somewhat already been shaped; however, a teacher education setting is essential for teacher identities to evolve (see Freese, 2006; Sachs, 2005; Thomas & Beauchamp, 2007). I see teacher education settings as a site for pre-service teachers to engage in identity work and thus become aware of their own identities. Therefore, I understood that it was important to consider pre-service elementary teachers’ mathematical identity and identity work within their teacher education setting. An examination of the research literature revealed an extensive body of interdisciplinary research on identity (cf. Beauchamp & Thomas, 2009); however, I noticed a gap in the comparative knowledge of how different teacher education programmes approach evolving teacher identities and their identity work, particularly in mathematics education settings. In my view, such knowledge is beneficial to the development of the
research field, teacher education programmes and, particularly, mathematics education courses and pre-service teachers’ future mathematics teaching practices.

1.1.1 On comparing educational contexts

During my time as a pre-service elementary teacher in Slovenia, Finland’s educational system was often regarded as an exemplary model. The interest in the Finnish educational system was further evident in many references to it in the media as well as in publications. I recall reading a book titled Why Finns Fly Further? [orig. Zakaj Finci letijo dlje?] published by Slovenian authors (Gaber et al., 2006), which analyses ‘the Finnish miracle’. The Finnish PISA success (2000, 2003, 2006, 2009) has certainly raised much international attention in terms of the desire to understand ‘the secret’ behind the success of the Finnish educational system (Pehkonen, Ahtee, & Lavonen, 2007). These discourses about the Finnish success eventually brought me to Finland. When I started my doctoral research in Finland, my integration into the university community got me thinking that it was indeed the high-quality of teacher education and excellent teachers contributed to the level of success (cf. Simola, 2005). I nonetheless began a step-by-step understanding that what I was experiencing could not be simplistically labelled as high quality; rather, it was different from what I knew and what I experienced as a pre-service teacher and researcher in Slovenia.

Several observations informed my research in the early phases. In my earlier research (Lutovac, 2008a, 2008b), I considered emotions towards mathematics, particularly math anxiety among primary school pupils. My findings were consistent with international research; however, what caught my attention was that Slovenian studies addressing this issue were rather scarce. It seemed to me that the mathematics education research community in Slovenia did not perceive the research worthiness of these issues. However, research does show the influence of affect structures on teaching and learning (e.g. Coppola, Di Martino, Pacelli, & Sabena, 2012; Gellert, 2000; Hannula, Liljedahl, Kaasila, & Rösken, 2007b). At the same time, I became aware of the ongoing importance of affective issues to the international mathematics education research community (Grootenboer, Lomas, & Ingram, 2008; Hannula, 2007; McLeod, 1992; Zan, Brown, Evans, & Hannula, 2006). I was also interested in the long Finnish research tradition of studying pre-service teachers’ beliefs and views about mathematics as well as their mathematical identities (Hannula, 2007; Kaasila, 2007a, 2007b; Kaasila et al., 2008a; Kaasila, Hannula, & Laine, 2012; Pehkonen...
According to Hannula (2007), this cluster of Finnish research has provided productive ground for innovations. In addition, while huge amounts of international research context have focused heavily on pre-service elementary teachers’ affect and the meaning of the teacher education context in influencing it, no such studies had been conducted using Slovenian pre-service teachers as research subjects.

I came to Finland with a strong background in quantitative research methodology as this was prevalent in educational research in Slovenia. Qualitative studies have mainly been perceived as lacking legitimacy and are only now beginning to gain some relevance. However, in the Finnish setting, I was introduced to qualitative research, particularly narrative inquiry. I realised the meaning of qualitative methodology, especially for educational research. I started to understand that a quantitative methodology was insufficient or, rather, unsuitable for gaining an in-depth view of complex phenomena, such as identity. Moreover, I saw the emphasis and value attached to the autobiographical context of pre-service teachers in the Finnish setting; narratives were used as a research method and as an educational tool in courses and research (see Chapman, 2008b; da Ponte, 2001; Lutovac & Kaasila, 2009, 2010; Smith, 2003, 2006).

The many differences I observed and experienced led me to think that an examination of pre-service teachers from Finnish and Slovenian contexts might offer an interesting addition to knowledge not only in terms of their mathematical identity but also regarding how the teacher education programmes in which these students enrolled assist in their identity work. However, I wish to emphasise that this study is not a cross-cultural comparison. Rather than generalising on the level of the two countries (e.g. in terms of representativeness), this study particularises social understandings and thus reveals local systems (Alasuutari, 1996). The pre-service teachers in question are representatives of one Finnish and one Slovenian teacher education unit, namely, the University of Lapland, Finland and the University of Maribor, Slovenia. I therefore acknowledge the contextuality of the findings: the Finnish and Slovenian teacher education settings considered in this study are examples within which teacher identities evolve. In addition, the qualitative nature of the study and the small number of research participants further limit generalisations. However, it is possible to draw conclusions on the level of institutional settings. Thus, the comparison will focus on the quality of the differences within non-generalisable findings, such as the nature of the identity work that pre-service teachers engage in within two qualitatively different institutional settings. To my knowledge, comparing and contrasting pre-service
teachers’ mathematical identity work within various cross-national teacher education settings is an under-researched topic.

1.1.2 On mathematical identity

In the last decade, identity has been topical in educational research, particularly in teacher education (Beauchamp & Thomas, 2009; Beijaard, Meijer, & Verloop, 2004; Meijer, 2011; Rodgers & Scott, 2008). Identity is seen in the context of ‘who or what someone is, the various meanings people can attach to themselves, or the meanings attributed by others’ (Beijaard, 1995, p. 282). The importance of identity in teacher education has been acknowledged due to the interaction between teacher identity and teaching practice (e.g. Watson, 2006). This is well reflected in Hamachek’s (1999, p. 209) statement: ‘Consciously, we teach what we know; unconsciously, we teach who we are’. In addition, understanding identity, particularly in teacher education settings, could also enhance the ways in which teacher education programmes are designed (Beauchamp & Thomas, 2009).

The concept of identity has also drawn considerable attention among researchers in mathematics education (e.g. Black et al., 2009; Brown & McNamara, 2011; Cobb, 2004; Grootenboer & Zevenbergen, 2008; Kaasila, 2007a; Kaasila et al., 2008a; Sfard & Prusak, 2005; Solomon, 2007). In one of the issues of *ZDM – The International Journal on Mathematics Education* (June, 2013), teachers’ identity (besides their knowledge and beliefs) was identified as one of the three central lines of mathematics education research on (pre-service) teachers (Skott, Van Zoest, & Gellert, 2013). It has also been argued that the subject matter can serve as a context for the construction of identity (Drake, Spillane, & Hufferd-Ackles, 2001); accordingly, subject-matter identities do exist (see also Esmonde et al., 2011). Grootenboer, Smith and Lowrie (2006) note that by foregrounding the concept of identity and its explanatory potential, a deeper understanding of what influences mathematics teaching and learning could be gained. The research literature on mathematics education has approached identity through various theoretical perspectives and thus offers various understandings of the concept.

Identity in mathematics education research has also been seen as an umbrella concept incorporating affect structures, such as beliefs (Beswick, 2006, 2007; Hannula, 2012; Pehkonen & Pietilä, 2003), attitudes (Di Martino & Zan, 2010, 2011), emotions (Bibby, 2002; Op’t Eynde, De Corte, & Verschaffel, 2006) or
views of mathematics (Hannula, Kaasila, Laine, & Pehkonen, 2006; Kaasila et al., 2008a; Pietilä, 2002). A strong cluster of mathematics education research in Finland which has contributed to an understanding of the development of beliefs during teacher education and the development of a theoretical foundation of beliefs research has informed notions of pre-service teachers’ mathematical identity in this study (see Hannula, 2007; Pehkonen & Hannula, 2004). According to Skott, Van Zoest and Gellert (2013, p. 501), the research on teacher identity in the mathematics education context ‘presents a somewhat broader picture of the teachers’ tales of themselves as professionals, that is, one that goes much beyond their knowledge and beliefs about mathematics, although this may be part of it’. Conversely, identity has also been considered as one component in the broader area of affect (Grootenboer et al., 2008; Walshaw, 2004; see also the special issue of Educational Studies in Mathematics, October 2006).

In line with some researchers who have defined mathematical identity as the set of stories we tell about ourselves (Drake et al., 2001; Kaasila, 2007b; Sfard & Prusak, 2005), in this study, identity is understood in terms of a narrative. The study sees the narrative as a story – pre-service teacher’s mathematical (auto)biography which has characters; a beginning, a middle and an end and is held together by a plot (see e.g. Denzin, 1989; Gudmundsdottir, 1996; Kaasila, 2007a; Polkinghorne, 1995; see also Lutovac & Kaasila, 2010). In this sense, the data for the study on mathematical identity are pre-service teachers’ stories. These stories include references to many other constructs, such as pre-service teachers’ beliefs, emotions, attitudes, view of mathematics, knowledge, actions etc. However, in identity narratives, these elements are not separate and independent; rather, they are parts of a narrative by which pre-service teachers get to understand themselves (cf. Polkinghorne, 1996). In this sense, Polkinghorne (1996, p. 364) argues that identity narratives ‘serve as a higher order discourse’ and can ‘unify and integrate disparate elements into a meaningful unity’ (see also Drake et al., 2001). This view is also in line with identity as an ‘umbrella’ concept. For this reason, notions on pre-service teachers’ views of mathematics, their beliefs and emotions as well as other constructs are used for the purpose of understanding their mathematical identities.

1.1.3 On mathematical identity work

This study falls in the category of research on identity development (e.g. Schepens, Aelterman, & Vlerick, 2009) as it considers pre-service teachers’
identity work in mathematics education settings. Beauchamp and Thomas (2009, p. 178) list a variety of terms, such as the ‘development’ of identity (see Watson, 2006), identity ‘formation’ (see Rodgers & Scott, 2008) or ‘building’ identity (see Sfard & Prusak, 2005) used throughout the education literature. To a certain extent, these terms represent what I mean here by identity work. However, building on the understanding that constructing an identity requires a ‘great deal of work’ (Einwohner, Reger, & Myers, 2008, p. 2), I prefer the use of the term ‘identity work’ over identity development or formation. The term ‘identity work’ also seems to imply more of an active role by pre-service teachers in this process (cf. Beijaard et al., 2004) as well as more conscious activity by pre-service teachers who aim to become aware of their identity (Kaasila & Lauriala, 2012).

The development of teacher identity is considered a core aspect of the experience of becoming a teacher (Korthagen, 2004). In a broader sense, I see identity work as a constant process of interpretation and re-interpretation of experiences, involving both a person and a context (Gee, 2001; Geijsel & Meijers, 2005). Further, research shows that relationships with others and the emotions deriving from these relationships are essential in identity development (Beattie, 2000; Hargreaves, 2001; Hawkey, 2006; see also Uitto, 2011). Although some educational studies do address the concept of identity work (Hawkins, 2005), it has been considered much less than the concept of identity, including in the mathematics education context (Black et al., 2009; Hossain, Mendick, & Adler, 2013; Williams et al., 2008). However, to my knowledge, the phrasing ‘mathematical identity work’ has not been used thus far. It also appears that identity work as a concept has remained poorly or broadly defined.

Several studies in the mathematics education context have considered stories about school mathematics in relation to one’s continuous identity construction (Drake et al., 2001; Esmonde et al., 2011; Kaasila, 2007a). Drake et al. (2001) have argued that in telling stories, teachers construct the identities available to themselves and others. Following the narrative perspective, I see mathematical identity work similarly, that is, bound to the construction of narratives. Pre-service teachers’ mathematical identity work is understood as storytelling, as their ways of constructing their mathematical life in their mathematical autobiography (cf. Hauk, 2005; Polkinghorne, 1996). Importantly, the lack of future orientation in explorations of teacher identity development has been addressed in recent work (Chapman, 2008a; Di Martino & Sabena 2011; Hamman, Gosselin, Romano, & Bunuau, 2010; Urzua & Vasquez, 2008). Moreover, understanding pre-service teachers’ identities as narratives has mostly foregrounded past and present
dimensions of identity (Black et al., 2009; Drake et al., 2001; Kaasila 2007a, 2007b). However, in identity narratives, pre-service teachers also talk about their future-oriented thoughts (cf. Urzua & Vasquez, 2008). Therefore, in order to understand pre-service teachers’ identity work, it is important to consider how they anticipate their possible selves as mathematics teachers (cf. Hamman et al., 2010; Markus & Nurius, 1986).

1.2 The research paradigm and narrative perspective of the study

This study falls into the category of interpretive research. Tesch (1990) identifies the interpretive approach as providing thorough descriptions and interpretations of social phenomena. Philosophically, interpretive research is based in hermeneutics and phenomenology. Indeed, the hermeneutics in Ricoeur’s views on life and narrative guide this study and will be discussed later. However, this study is not phenomenological in a pure sense; rather, it has some relation to the principles of phenomenology. For example, it investigates phenomena, the way individuals experience things and the meanings that things have in an individual’s experience (Gillham, 2000; Denzin, 1989). Therefore, the meaning of pre-service teachers’ experiences with mathematics is investigated in relation to their mathematical identity work.

In line with the interpretive paradigm, I see reality as consisting of people’s subjective experiences of the world. There is no direct way to access this reality but through language, consciousness and shared meanings (Orlikowski & Baroudi, 1991). Accordingly, in this study, I understand the world of pre-service teachers as they experienced it. I focus on the complexity of their meaning-making; and I use the in-depth interview as a way of understanding their subjective meanings (cf. Denzin, 2001). The information herein is thus also presented from their perspective. Pre-service teachers’ narratives were treated as analytical lenses or as a research tool to examine their identities (cf. Watson, 2006). As such, the methodological choice was narrative inquiry (Lieblich, Tuval-Mashiach, & Zilber, 1998; Polkinghorne, 1995). The means by which knowledge was produced and assessed in this study will be considered in greater detail in the chapter on methodology.

A theoretical framework that defines a point of view for understanding pre-service teachers’ mathematical identity work is bound to the narrative perspective, particularly Ricoeur’s (1992, 1991b) discussions on narrative identity. The role of narrative in this study is therefore two-fold: it is a frame of reference and a
method. Due to the psycho-social standpoints towards mathematical identity work, I will coordinate individual and social perspectives (Cobb, 1994; Kaasila & Lauriala, 2010). In this sense, Skott, Van Zoest and Gellert (2013) discuss that research on teacher identity in the mathematics education context has emphasised social perspectives to a greater extent than research focusing on knowledge and beliefs. The narrative perspective allows for going beyond an individualistic understanding of identity (Murray, 2003) without overemphasising the social context. Lerman (2013b, p. 628) critically acknowledges that researchers have often misunderstood the ‘social turn’ (Lerman, 2000), which ‘addresses the social context of teachers, for example, but if one wants to examine what teachers actually do or know, researchers need to take a cognitive focus, by which is meant an individual cognitive focus’. In agreement with Lerman’s view, I see the individual and social focus as complementary. Thus, research underlying psycho-social views within mathematics education, as well as from outside of the domain, was taken into account. However, these notions were carefully approached, were combined in consistency with each other and complemented each other. This is in line with the interpretive tradition: there are no ‘correct’ or ‘incorrect’ theories; instead, they should be judged on the basis of how interesting they are for the researcher and to others (Tesch, 1990). In the following text, I describe the narrative perspective. The points discussed will reflect the worldview and nature of knowledge in this study.

First, according to the narrative perspective, the meaning of narrative knowing is underlined (Bruner, 1986). We live our lives through the creation and exchange of narratives (Murray, 2003). I build on the assumption that narration is a crucial way in which people make sense of experiences, construct the self and create and communicate meaning (Chase, 2003). Stories are thus seen as appropriate for producing knowledge. I agree with Beattie (2000, p. 5) that ‘knowledge-making is recognized as an active, creative, interpretive process, in which the telling and retelling of one’s story provides a framework for the construction of knowledge’. In line with researchers who subscribe to this perspective, this work also focuses on questions of how pre-service teachers seek to make meaning of their lives, that is, how they understand themselves as unique individuals and as social beings (cf. Singer, 2004) in the mathematics education context. Moreover, life story construction is central to their self-understandings (cf. Bruner, 2003; Ochs & Capps, 1996; Singer & Salovey, 1993).

Additionally, irrespective of the uniqueness and individuality of narratives, they are inevitably social in character (Ezzy, 1998). I acknowledge that the self is
constructed ‘in the context of its relations with others’ (Beattie, 2000, p. 4). This is central to becoming, for example, a teacher and thus in constructing an identity. I take the position that one’s narrative identity expresses much about the person and his/her world or culture (McAdams & Janis, 2004). Therefore, in conducting this study, I attempted to understand pre-service teachers as well as their mathematics worlds. These views are also consistent with the interpretive view on understanding human beings in a social context. These views highlight the relevance of approaching identity from a narrative perspective, which breaks with the traditional psychological-versus-social distinction and ‘develops a more complex psycho-social subject’ (Murray, 2003, p. 116).

Ricoeur (1984, 1985, 1988) argues that lived experience precedes narrative, and narrative shapes further action. Therefore, action and narration influence each other. Accordingly, the lived experiences are constructed in narratives that, in turn, shape new experiences that are again re-constructed in narratives (see Ezzy, 1998). Telling and living are thus alternating. Ricoeur (1988) asserts that narrative gives a richer meaning to people’s lived experiences. Additionally, narrative perspective on identity includes temporality: the remembered and anticipated experiences become a person’s story (Ezzy, 1998). The current study locates the self in time and in relationships and also contributes to the coordination of individual and social perspectives. Accordingly, as Ezzy (1998) notes, identities are on-going and dynamic as well as constructed by selves and others. Notions on temporality also informed the view of identity work in this study.

1.3 Significance of the study

This sub-section speaks to the research worthiness of the study. First, the study is relevant by virtue of its comparative aspect. Exploring the mathematical identities of pre-service teachers from two different educational contexts (Finnish and Slovenian) will provide a site for comparing the meanings of mathematics and teacher education settings in pre-service teachers’ identity work. This will add to the existing body of knowledge by providing a deeper understanding of the topic. Gaining a more detailed understanding of mathematical identity work in various contexts could also enhance the ways in which mathematics education courses are designed (cf. Beauchamp & Thomas, 2009). The results will provide theoretical knowledge and practical applications for developing mathematics education within the teacher education programmes in question as well as in the wider international context.
Second, the study’s relevance is also theoretical in nature. Understandings of identity in mathematics education seem to be complex and overlapping. There is an obvious need for an elaboration of the concept. Particularly, ‘mathematical identity work’ has not yet been conceptualised in mathematics education research. In order to explore mathematical identity work, the study applies theories and concepts borrowed from other research fields and adapted to the mathematics education context, such as narrative identity (Ricoeur, 1992). In line with a narrative understanding of identity, temporality holds an important position in this study. The novelty of the study is the special focus on the future aspect of pre-service teachers’ mathematical identity work. Future orientation or possible future identities will be addressed by applying Markus and Nurius’ (1986) theory of possible selves. The application of this theory in mathematics education is another contribution of the study. In all, the application of broader theories in the mathematics education context and elaborations of the aforementioned concepts might further the development of theoretical frameworks for research in mathematics education.

1.4 Structure of the research report

This research report consists of two parts. The theoretical, contextual and methodological foundations of the study are discussed in Chapters 2 to 5 while Chapters 6 to 11 present the empirical research on pre-service teachers’ mathematical identity work and discuss its findings and relevance.

The theoretical part of the research report consists of two chapters. In Chapter 2, the focus is confined to understanding identity and identity work through the narrative perspective, especially by applying Ricoeur’s (1992) concept of narrative identity. In Chapter 3, I consider identity within the mathematics and teacher education settings and summarise the research on identity in both contexts. Further, I operationalise the concept of mathematical identity work in this study and derive a working conceptualisation. Finally, this chapter presents the research questions addressed in this study. I wish to emphasise that the study is data-driven; therefore, some concepts and views are discussed along with the findings. Additionally, I do not consider the published theoretical findings of this study in the theoretical framework; rather, I discuss them in the summary of the findings. This decision came about because of the data-driven nature of the study and in order to avoid revealing the findings of the study too early on in the research report.
In Chapter 4 of the theoretical framework, I describe the context of the study. The education systems in Finland and Slovenia are briefly described. Specifically, the focus is on teacher education at the University of Lapland and the University of Maribor, and the mathematics education courses within these universities are described in order to outline the educational context of the study. Chapter 5 discusses the research methodology, particularly narrative inquiry and how it was applied in the study.

The empirical part of the research is two-fold as I analysed pre-service teachers’ narratives in two ways. First, the results of the narrative analysis consisted of pre-service teachers’ mathematical biographies. Chapter 6 presents four biographies: two Finnish and two Slovenian cases. Second, in the analysis of narratives, the narratives of the Finnish and Slovenian cases were compared and contrasted. Chapters 7 and 8 present the results of the analysis. These chapters follow the theoretical consideration of the temporality of narrative and identity and are accordingly divided into two sub-chapters in which I discuss mathematical identity work as identified in the pre-service teachers’ narratives. Chapter 9 synthesises the main findings by answering the research questions and derives a conceptualisation of mathematical identity work. Following the results of the study, I tackle the trustworthiness and limitations of the study in Chapter 10 of the research report. Finally, in Chapter 11, I discuss the findings of the study. The chapter concludes with educational recommendations and suggestions for future research.
2 Setting the Theoretical Landscape: The Narrative Perspective on Identity

Over the last few decades, the narrative has been used as an organising concept in many different ways (Hinchman & Hinchman, 2001). As Bruner (1986) maintains, there has been a narrative and linguistic turn in the social sciences (see also Chase, 2003; Mishler, 1986; Polkinghorne, 1995). The reasons behind this turn are varied. There has been a paradigm shift towards a more humanistic approach with a focus on language whereby narratives have a central position (Elliot, 2005; Riessman, 1993). This shift is evident also in the domain of education. Hänninen (2004) argues that the interest in the concept of narrative seems to originate from its ability to integrate knowledge from the various disciplines. Verhesschen (2003) maintains that the current enthusiasm with narrative reflects a particular cultural and social context. Moreover, it has often been stated that we live in a world of narratives and that we understand our world and ourselves through narratives (Bruner, 1986; Murray, 2003; Polkinghorne, 1988). This assumption intersects the narrative with the concept of identity (Ricoeur, 1991b).

In this chapter, I first discuss the narrative perspective in general and introduce key notions on narrative. The latter is important as it provides the grounding for understanding pre-service teacher’s identities in this study. Secondly, I introduce the concept of identity, understood through a narrative perspective. This sub-chapter explicates Ricoeur’s framework of narrative identity. Finally, I discuss identity work within the same frame of reference.

2.1 The narrative perspective

Researchers argue that stories are meaningful and that the ability to think in terms of stories is universal (Bruner, 1986). According to Gilbert, Hipkins and Cooper (2005, p. 3), this refers to the ability to understand and use stories as implicit, cultural knowledge: ‘It relies on a deep knowledge of people—their feelings and concerns, their relationships to others, and what they are likely to do in particular contexts’. Peoples’ stories are numerous: those told by individuals about themselves, those told by others and ‘those retained by their cultures in oral and written forms’ (Polkinghorne, 1996, p. 365). Gilbert et al. (2005) emphasise that stories are important means for people’s interaction. Further, I concur with
Hinchman and Hinchman’s (2001) assumption that stories are so prevalent in our culture that they create people’s reality.

2.1.1 The narrative way of knowing

In his book *Actual Minds, Possible Worlds*, Bruner (1986) makes a distinction between two forms of complementary human thinking which organise our experiences and construct reality in different ways. One form is the paradigmatic or logical-scientific mode, which works with ‘abstract concepts, constructs truth by means of empirical evidence and methods of formal logic, and while doing so, it seeks causal relations that lead to universal truth conditions’ (Laszlo, 2008, p. 2). According to Bruner (1986), the narrative mode on the other hand is more life-like and investigates stories. The narrative mode thus seems more appropriate for dealing with people and their lives. Bruner (1986) also maintains that all human beings learn to think in the narrative mode, but in order to understand the diversity of human thought, we need both modes.

In Carr’s view (2001), people’s actions, motivations and relationships are explained through stories; thus, the narrative is essential to understanding people. Similarly, Hinchman and Hinchman (2001, p. xiv) see stories as ‘the best clues about why people act as they do’. Bruner (1986) highlights the status of the narrative as a provider of ‘true’ knowledge. He believes that stories should not be seen as less real or less accurate in producing knowledge only because they differ in form. In accordance with Bruner’s (1986) paradigmatic versus narrative thinking, Schank and Abelson (1995) believe that all knowledge is derived from storytelling and story understanding. They argue that ‘virtually all human knowledge is based on stories constructed around past experiences’, and ‘new experiences are interpreted in terms of old stories’ (Schank and Abelson, 1995, p. 1).

2.1.2 The meaning of narrative

The term narrative (or story) has been widely applied and has a variety of meanings due to its popularity across various disciplines. Gudmundsdottir (1996) argues that narratives are an account of an experience containing affective, practical and theoretical observations of that experience. Polkinghorne (1995) describes various uses of the term, from the view of narrative as any prosaic discourse to the more narrow definition of narrative as a story.
In this study, the terms narrative and story are used synonymously. I understand narrative in a traditional sense, following Aristotelian concept of tragedy as having a beginning, middle and end (see Hyvärinen, 2006). Further, I build on Polkinghorne (1995, p. 5) who recognises that many qualitative (narrative) researchers limit the term narrative to a story in which ‘events and happenings are configured into a temporal unity by means of a plot’. The plot is also one of the central concepts in narrative research (Bruner, 1986, 1991; Denzin, 1989; Hinchman & Hinchman, 2001; Ricoeur, 1985). I follow the view that narratives are constructions and the result of ‘emplotment’ (Verhesschen, 2003; see also Murray, 2003; Polkinghorne, 1995). In telling a story, the narrator is trying to organise events into a plot and create a meaning (Ricoeur, 1988). In this sense, emplotment generates a story and attempts to give the events a narrative form. Therefore, for Ricoeur (1988), the central role of the narrative is to bring order whereby order reveals wholeness.

Further, Connelly and Clandinin (1990) refer to essential aspects of the narrative as emplotment, character, scene, time and place. Stories also have some sort of problem or issue to be resolved (Gilbert et al., 2005), a narrator and an audience (Watson, 2006). A narrator or storyteller constructs a story in particular ways and for a particular purpose (Denzin, 1989; MacLure, 1993). Chase (2008) argues that the narrative thus communicates the narrator’s point of view and why the narrative is worth telling. In this sense, narratives also have the power to explain (e.g. Ricoeur, 1984); they express emotions, thoughts and interpretations (Chase, 2003, 2008) and offer insights about peoples’ experiences (Hinchman & Hinchman, 2001). A narrative tells us which past experiences are meaningful for the teller as well as the situation in which the narrative is told (Polkinghorne, 1988; Ricoeur, 1984). I follow Riessman’s (1993, pp. 4–5) view that stories are ‘constructed, creatively authored, rhetorical, replete with assumptions, and interpretive’.

I build on the assumption that our stories are not merely our own personal (mental or verbal) narratives (Laszlo, 2008). Therefore, I coordinate individual and social perspectives (cf. Cobb, 1994), seeing narratives as being simultaneously created by the individual and social contexts of our culture (cf. Gudmundsdottir, 1996; Murray, 2003). Every society has its own ‘historically crystallized stories’, and although individuals may view them from different standpoints and create different stories out of the same experienced event, culture provides the set of possible story frames (Laszlo, 2008, pp. 7–10). For example, educational settings and academic disciplines are only some contexts which
supply ready-made narrative models (cf. Hänninen, 2004). Mattingly and Lawlor (2000) maintain that:

Stories show how human actors do things in the world, how their actions shape events and instigate responses in other actors, changing the world (and often the actors themselves) in some way. Stories also reveal the way events and other actors act upon someone, shaping his/her possibilities, the way he/she views himself/herself and his/her world. Whether hinted at or baldly stated, stories explore the complex motives that drive individuals to act in some ways rather than others and they also reveal the constraints of environment, of body, of social contexts that delimit a person’s possibilities for action. (Mattingly & Lawlor, 2000, p. 6)

Considering Mattingly and Lawlor’s (2000) thoughts, stories are inherently social and include a rhetorical component, namely, they are always directed to a specific audience (see also Denzin, 1989; Elliot, 2005; Hinchman & Hinchman, 2001; MacLure, 1993). We adapt our storytelling according to the audience (Denzin, 1989). As Murray (2003) notes, the character of the story told will depend upon the relationship between the narrator and the audience. Finally, our knowledge about the world and ourselves is determined by our relationships with others (Mead, 1934; Ricoeur, 1992). These aspects reveal the manner in which the study of narrative develops a more complex psycho-social subject.

2.2 Identity through the narrative perspective

Identity is a complex phenomenon and is of vital importance to social life and human functioning (Laszlo, 2008). Due to its relevance, the concept has been widely explored within various disciplines, thus resulting in many different meanings ascribed to it. Furthermore, the concept has been explored through its various components, such as the personal, social and professional aspects of one’s identity (Tajfel, 1982). I wish to emphasise here that the choice of certain perspectives and theories on identity and identity work in this study is not necessarily underlined by the weaknesses of other theories; rather, it is based on what is appropriate in terms of the research problem of this study and the collected data.

Traditional notions on identity define the concept as something that is ‘fixed and unchanging, something inside of us’ (Currie, 1998, p. 2). However, newer understandings build on the work of G. H. Mead and E. H. Erikson and paint a
very different picture. In line with these new understandings, I subscribe to the view that one’s identity develops throughout one’s life. Identity is therefore chronological and changing (and therefore unstable), relational, multiple and multi-contextual and has a (re)constructive as well as an emotional nature (Rodgers & Scott, 2008). According to these understandings, I also coordinate individual and social aspects of identity. I agree with Erikson’s (1968) psycho-social theory of identity that identity is formed on the basis of experiences that arise in social interactions. Mead (1934) also contends that identity has meaning within relationships (e.g. social setting), thus making it a relational phenomenon. Watson (2006, p. 509) further discusses that alternative views on identity necessarily understand the concept as ‘having to do with the recognition of sameness and difference between ourselves and others’. Moreover, as MacLure (1993) points out, identity has a rhetorical purpose; it is used to justify and make sense of ourselves in relation to others. These more dynamic understandings of identity are acknowledged in this study.

It has further been discussed that a person’s identity has multiple aspects. Higgins (1987), for example, has examined three basic domains of the self: the ideal self, ought self and actual self. In addition, one of the multiple aspects of identity is identity in the context of one’s profession – professional identity. Building on Gee (2001), I interpret professional identity as one component of ‘a person’s identity which comes from his/her professional status or position in society, his/her interactions with others and his/her interpretations of his/her experiences’ (see Lutovac & Kaasila, 2011, p. 2). Furthermore, professional identity may consist of many sub-identities that may be either aligned to or in conflict with each other (cf. Pratt & Foreman, 2000). This holds particularly true for future elementary teachers as their multi-disciplinary teaching might form different discipline-related sub-identities. For example, elementary teachers might form different identities relating to teaching a native language or mathematics. The former also relates to the notion of identity being a context-bound concept. In this vein, I borrow Gee’s (2001, p. 99) definition of identity as a ‘certain “kind of person”, in a given context’; one has a ‘core identity’, as well as ‘multiple identities’ across different contexts. Therefore, the multiple and dynamic nature of identity in terms of context is highlighted (Beauchamp & Thomas, 2009). In this study, identity is also seen as emotional in nature. For instance, Zembylas (2003, p. 115) argues that ‘emotion and the self are inextricably bound’ and play a key role in the construction of identity.
Narratives have also been considered important in the development of our identity; they create the context within which we develop a sense of self and our place in relations to others (Hinchman & Hinchman, 2001; Polkinghorne, 1988). Because narratives allow for imagination, they also actively construct our reality (Gilbert et al., 2005). Therefore, the importance of identity stories for understanding the meaning people construct for their lives has been widely acknowledged (Polkinghorne, 1991).

2.2.1 Narrative identity

Subjects recognize themselves in the stories they tell about themselves. (Ricoeur, 1988, p. 247)

Many narrative researchers agree that we construct ourselves through narrative and make sense of our lives by telling stories (Bruner, 1986; Connelly & Clandinin, 2000; Laszlo, 2008; Polkinghorne, 1996). In reflexive terms, narrative is a means through which we get to understand ourselves (Galindo, 2007; Murray, 2003). Similarly, Hinchman and Hinchman (2001) suggest that our personal identity emerges in and through narrative. Further, Lieblich, Zilber and Tuval-Mashiach (2008) conceptualise identity as a life story, a construction. Bruner (2003) also claims that narratives are important for our self-definition. From the perspective of narrative theory, ‘who one is, is inseparable from the way one’s personal history unfolds, and the way that its overall course is emplotted and interpreted by oneself and others’ (Polkinghorne, 1988, p. 150). Polkinghorne (1988) further maintains that narrative is necessary for this process of continuous interpretation.

Arguably, when telling stories about our lives to ourselves and others, we create a narrative identity (Ricoeur, 1991b, 1992). Narratives as a form of discourse also allow us to communicate to ourselves and others about who we are (Chase, 2003; Galindo, 2007). This also means that identity narratives do not necessarily have to be told to others. Further, I subscribe to the view held by some authors that the stories we tell are constructed and that life itself has a narrative structure, rooted in temporality (Bruner, 1986, 1991; Kerby, 1991; Ricoeur, 1984–88, 1991a). According to these authors, people experience themselves as temporal beings through narrativity. In this study, I build on the notions of these narrativists, particularly on Ricoeur’s theorising on narrative identity.
2.2.2 Ricoeur’s framework of narrative identity

Ricoeur (1991b, 1992) has been credited with developing the concept of narrative identity. He sees it as a specific type of identity, a self-understanding mediated by a narrative (see also Galindo, 2007). This means that we can reach this identity through narrative. In what follows, I present some of the central characteristics of Ricoeur’s framework applied in this study (see also Ezzy, 1998).

There is a circular relationship between life and narrative

Ricoeur’s work (1984, 1985, 1988) is a major elaboration of the relation between narratives and life (see also Verhesschen, 2003). Verhesschen (2003, p. 458) interprets Ricoeur’s views as follows: ‘the not-yet-told story of action’ becomes explicit in the construction of the narrative, and ‘in the act of reading, narrative returns to life’. The narrative thus transforms the thinking and acting of the reader. Therefore, Ricoeur’s view of the relationship between the narrative and life is circular (Ezzy, 1998). Similarly, Bruner (1987, p. 12) notes that there is an interrelationship between life, construction and interpretation: ‘Narrative imitates life, life imitates narrative’ (see also Ricoeur, 1984–1988). Verhesschen (2003) maintains that Ricoeur’s view allows us to think of the narrative as a construction rooted in life. In this sense, the narrative constructs the lived experience and gives it a clearer meaning (Ezzy, 1998; Ricoeur, 1988). Further, our experiences get their meaning in the context of a narrative as they contribute to the development of the plot (Verhesschen, 2003). Ricoeur’s (1991a) view of the plot as a construction allows us to understand that we can create different narratives about the same events. This also means that the meaning of those events will change according to the narrative. Additionally, Ricoeur (1984, 1985, 1988) asserts that for the construction of a narrative, we use plot-types available in our culture.

We make sense of our own identities as we do the identities of characters in stories

Ricoeur (1992, 1991b) believes that people develop their sense of identity by seeing themselves as protagonists in different stories. He states that ‘the narrative constructs the identity of the character, what can be called his or her narrative identity, in constructing that of the story told. It is the identity of the story that makes the identity of the character’ (Ricoeur, 1992, pp. 147–48).
Notwithstanding, identity is a dynamic structure, and as Ricoeur (1991b) maintains, the narrative identity takes part in the story’s movement. Following Mishler’s (2004) critique of identity theories, I assert that we can tell a particular identity-defining event in very different ways in different contexts, thus leading to the construction of different identities. As such, if the narrative is a model for identity, identity too becomes a construction (Verhesschen, 2003). This is what Ricoeur calls narrative identity. Finally, Ricoeur (1992, p. 131) highlights that the narrative identity constitutes us: ‘Our own existence cannot be separated from the account we can give of ourselves’.

**Narrative identity is seen as a fusion of fiction and history**

In line with the relationship between life and narrative, Ricoeur (1992) sees narrative identity as having the characteristics of history and fiction. Ricoeur (1988) also explains that self-narratives are formed in interaction between ‘events, imagination, significant others’, as well as the structure of a person’s self-talk (Ezzy, 1998, p. 251). Therefore, in Ricoeur’s (1991a) view, when we narrate, we interweave historical and imaginative events. This allows us to understand that, depending on the context and audience, one can construct a different narrative about oneself (Verhesschen, 2003); certain elements can be emphasised, and others might be omitted (see also Singer, 2004). However, each narrative will offer a view of who one is. Thus, in Ricoeur’s framework, the answer to that question is a narrative, the narrative identity (Verhesschen, 2003). Finally, according to Ricoeur (1988, 1992), the narrative identity also reveals what the teller stands for. For example, the narrative identity of a pre-service teacher can tell the audience what is important to him or her.

**A person’s identity is seen as either sameness or selfhood**

Ricoeur (1988, 1992) makes a distinction between selfhood (*ipse*) and identity or sameness (*idem*). He refers to the reflexive nature of the self as selfhood. This means that selfhood is able to reflect upon itself (see also Ezzy, 1998). Selfhood refers to an identity which belongs to an individual and which differs from the identity belonging to another individual (Ricoeur, 1992, 1991b). Ricoeur’s (1992) concept of identity (*idem*), on the other hand, is the narrative outcome of the abovementioned reflective process. Identity is seen as a narrative one tells oneself or others. In this sense, identity may be understood as ‘self’ and ‘sameness’, thus
‘self-sameness’ (Ezzy, 1998, p. 245; Ricoeur, 1988, 1991b). As Ricoeur asserts ‘the narrative identity constructs a sense of self-sameness, continuity and character in the plot of the story a person tells about himself/herself’ (Ricoeur, 1988, p. 247). Finally, Ricoeur (1992) points out that the self is discovered in its own narrational acts and that it constitutes of both, idem and ipse identity (see Ezzy, 1998; Singer, 2004).

In line with Ricoeur’s (1992) views, Rodgers and Scott (2008) have elaborated on the difference between ‘self’ and ‘identity’ in the following way:

Self, then, might be thought of as the meaning maker and identity as the meaning made, even as the self and identity evolve and transform over time. The self in its completeness, however, remains unknowable… Still, despite the inevitable discontinuities and change and the intangible nature of the self, there is a belief that there exists over time a ‘Self’ that is recognizable and a coherence that allows one to move in the world with a certain confidence. For the purposes of this discussion, then, self will subsume identity(ies) and will be understood as an evolving yet coherent being, that consciously and unconsciously constructs and is constructed, reconstructs and is reconstructed, in interaction with the cultural contexts, institutions, and people with which the self lives, learns, and functions. (Rodgers & Scott, 2008, p. 739, emphasis in original)

In congruence with Rodgers and Scott’s (2008) definition, I see the concept of self as wider than the concept of identity. The self is constitutive of identities. I also see the self as the meaning maker and identity as the meaning made. This is in line with the work of Mead (1934) and his two components of the ‘self’, ‘I’ and ‘me’. Beijaard et al. (2004) interpret Mead’s views as follows: ‘I’ articulates thoughts through reflection and ‘me’ is the identity that the self develops. In all, I see the self as a storyteller that gives meaning to experiences and identity as the meaning made that emerges from the story.

The temporality of the self in the narrative: past, present, future

Narrative identity is based on self-understandings across time (Ricoeur, 1991b). In this sense, human temporal experience is organized and clarified in a narrative (see also Galindo, 2007). Central to the development of identity is a sense of self, achieved through an awareness of past, present and future existence (Ricoeur, 1988). When one narrates his or her life, this brings to one’s life a sense of
temporal unity (Ezzy, 1998; Polkinghorne, 1995; Singer, 2004). Similarly, Hinchman and Hinchman (2001) argue that we construct narratives as we direct our present choices and actions in light of the imagined future and remembered past.

In his discussion on temporality, Ricoeur (1984) draws on Augustine’s three-fold view of the present in Book XI of his *Confessions* (see also Conway, 2001). According to Conway (2001), Augustine understood the mind as temporally distributed and our conception of the past, present and future as a series of ‘nows’. Accordingly, the past and future are part of the present, so we can talk about ‘the past-in-the-present, the immediate present and the future-in-the-present’ (Conway, 2001, p. 92). Mead (1934; see also Flaherty & Fine, 2001) similarly argues that the temporality of experience is a flow that is primarily present; the past is part of one’s experience now, and the future is also part of one’s experience now. This framework is useful as it allows for the understanding of the past and the future as the stories people tell themselves in the present (Conway, 2001). Ricoeur’s work deals much with making sense of the past and our constant involvement with it (see Dauenhauer & Pellauer, 2011): he argues that despite the fact that we cannot access the past, traces of it remain as the past in the present. Narratives therefore ‘articulate retrospection and prospection’ (Ricoeur, 1992, p. 163), and in this sense, identity includes not only the present but also the past and the future.

Further, Markus and Nurius (1986, p. 954) discuss possible selves as a ‘type of self-knowledge that pertains to how individuals think about their potential and about their future’. Possible selves are different from current selves (e.g. present selves), however, Markus and Nurius further note that possible selves and current selves are intimately connected. They argue that:

Possible selves are the ideal selves that we would very much like to become. They are also the selves we could become, and the selves we are afraid of becoming. The possible selves that are hoped for might include the successful self, the creative self, the rich self, the thin self, or the loved and admired self, whereas the dreaded possible selves could be the alone self, the depressed self, the incompetent self, the alcoholic self, the unemployed self, or the bag lady self. (Markus & Nurius, 1986, p. 954)

Markus and Nurius (1986) see that one’s enduring goals, aspirations, motives, fears and threats manifest as possible selves. Possible selves are understood as providing direction. In addition, the possible selves that each individual will have
are personalised, but they are also ‘distinctly social’ (Markus & Nurius, 1986, p. 954). In this sense, they may be a result of social comparisons. The authors exemplify this as ‘What others are now, I could become’ (Markus & Nurius, 1986, p. 954). Just as people’s stories, various possible selves are derived from cultural models. Finally, in line with the temporality in the narrative, I consider possible selves as constituents in one’s narrative identity.

**Changeability and unity of self are in the narrative**

Ricoeur’s (1988, p. 259) view is that identities are changeable: ‘There is no plot of all plots’. This means that there is no one single narrative identity. A narrative understanding of identities is useful as it allows for continuity and integration as well as plurality (Ezzy, 1998; Verhesschen, 2003). According to Polkinghorne (1996), when we look at identity through a narrative lens, we see more than an identity story; we also see the story’s contents. These contents are the parts of an integrated story and are full of personal meanings. Polkinghorne (1996, p. 364) also maintains that the value of the narrative approach lies in ‘its capacity to serve as a higher order discourse’ and ‘has the capacity to unify and integrate disparate elements into a meaningful unity’ (see also Polkinghorne, 1995). I refer to this view of the narrative as an ‘umbrella’ concept. Various aspects of identity achieve integration in peoples’ identity stories (Polkinghorne, 1996). Consequently, Ezzy (1998) argues that the narrative identity is a product of an ongoing integrative process. It is processual and unfinished because it describes on-going lived time (see Ricoeur, 1984). Narrative identities are therefore continuously constructed and reconstructed as events happen; they can be revised until the story ends (see Dauenhauer & Pellauer, 2011; Galindo, 2007). Ricoeur (1988) states that sameness across time and space is achieved through narratives of self-consistency through changes in life. He argues that this is a basis for identity; while narratives can change, they still provide a sense of self-sameness (Ezzy, 1998). These narratives show that the subject of the story is the same person across time and space.

**Narrative identity is integrally social**

Ricoeur’s framework of identity is integrally social as he emphasises the importance of others in self-understanding (Ezzy, 1998; Ricoeur, 1992). According to Verhesschen’s (2003) interpretation of Ricoeur’s work, the
narratives we tell about ourselves also show that our narrative identity is influenced by the context and the audience. Dauenhauer and Pellauer (2011) interpret Ricoeur’s work asserting that the story by which we construct our own identity shows that our life is always linked to others. It is considered that we can hold a variety of narrative identities, each of which is connected to different social relationships but also provides us with a sense of coherence and stability (Murray, 2003). This is evident in Ricoeur’s (1992) view that identity consists of being recognised by others as being the same person. Hence, Ricoeur’s framework (1992) suggests that we can make sense of ourselves only in and through our interactions with others (see also Laszlo, 2008; Singer, 2004). In all, Ricoeur’s framework allows us to see identity by coordinating individual and social perspectives; identity changes throughout one’s life and with social contexts, however, for the individual, the integration is represented by his or her life story (see also Erikson, 1968; Singer, 2004).

2.3 Identity work through the narrative perspective

Identity development can be characterised as ‘a process of interpreting oneself as a certain kind of person and being recognised as such in a given context’ (Beijaard et al., 2004, p. 108). Consistent with the latter definition, there is a consensus in the literature that identity development is an on-going process and that identity is reconstructed within experience (Beauchamp & Thomas, 2009; Hinchman & Hinchman, 2001). I am interested here in pre-service teachers’ subjective experiences as manifested in their autobiographical narratives (cf. Lieblich et al., 2008). There seems to be a consensus that identity is constructed through interactions and is a product of discourse (see e.g. Markus & Kitayama, 1991). In Bruner’s (2003) view, identity thus serves a cultural and individual function. The author claims that we also come to know ourselves through the statements of others. At the same time, our knowledge of others is based on our knowledge of ourselves.

The literature in this area emphasises the importance of narrative in the construction of identity (Bruner, 1986, 2003; Ricoeur, 1992). From the latter point of view, identity is related to how people construct their experiences in stories, which may differ in time and context (Mishler, 1986; Ricoeur, 1984, 1985, 1988). The literature offers various terms to characterise how identity comes about, such as the development of identity, the construction of identity, identity formation, identity making, creating an identity, building identity etc. (see Beauchamp &
Thomas, 2009). In this study, I use the term identity work (cf. Fraser, Davis, & Singh, 1997; Hawkins, 2005; Snow & Anderson, 1987; Sveningsson & Alvesson, 2003). In line with the narrative perspective, this term implies that a person is an author of his or her own story and an active subject in his/her own identity work (Hinchman & Hinchman, 2001). In what follows, I develop an understanding of identity work by discussing a few theoretical aspects derived from notions on narrative identity (Ricoeur, 1992, 1991b).

*It is in telling stories that we give ourselves an identity*

It has been stated that people experience identity in the act of telling (Ochs & Capps, 1996; Polkinghorne, 1988; Ricoeur, 1985; Singer, 2004). This means that individuals become aware of who they are by telling stories of their experiences. This is what I consider as identity work. Identity work can thereby be understood and accomplished by considering identity as emerging in and through narratives (cf. Hinchman & Hinchman, 2001). Gubrium and Holstein (1994, p. 697) state that ‘lives are narratively constructed, made coherent and meaningful, through the “bio-graphical work” that links experiences into circumstantially compelling life courses...’. Arguably, therefore, and building on Hinchman and Hinchman (2001, p. xix), if narratives have the power to construct and reconstruct identities, by exploring identity through a narrative perspective, we can see identity construction as a ‘work in progress’ that can be ‘revised’ as circumstances require. Importantly, these notions led to the decision to use the term ‘identity work’. Lieblich et al. (2008, p. 613) point out that when narrators are narrating their life story, they first, ‘tell a story of their being and development’, and second, ‘they provide explanations of how and why they have reached their present situation or identity’ (see also Lieblich et al., 1998). These identity stories therefore reveal what has driven them from one point in their lives to the next.

*Identity work involves the process of emplotment as well as temporality*

If identity work is defined as storytelling, the notion of emplotment becomes relevant in understanding identity work. Emplotment is an active process of interpreting and understanding life (Hyvärinen, 2006; Verhesschen, 2003). Further, as discussed earlier, we continuously create our identities by linking them to our past and future stories. Here, Ricoeur (1984) understands narration as a transition between description and prescription; between an account of what is
and what ought to be done. In Mead’s view (1936, p. 290), temporality ‘involves the continual appearance of that which is new’. Thus, we are constantly progressing into the new future, different from the past. Mead sees the future as the key aspect in directing our conduct. He explains how we are moving on through time: ‘the past is moving into the present and into the future’ (Mead, 1936, p. 509). The meaning of the past is, in his view, determined by the emergent present and impending future (see Ezzy, 1998). Moreover, Mead (1936, p. 301) further advances that ‘the future can influence the present’, which may seem paradoxical (Flaherty & Fine, 2001). This means that by anticipating certain happenings in the future, we choose certain actions now. This is in line with understandings of possible selves by Markus and Nurius (1986). Further, by acting towards the future, people become active agents of their life (Flaherty & Fine, 2001).

Identity work is a dynamic personal and social process

The narrative perspective highlights the social nature of identity work. Accordingly, identities are constructed in the narratives we tell about our lives to ourselves and to others (Watson, 2006). Watson (2006, p. 510) opines that ‘people construct narratives and narratives construct people, and our identities emerge through these processes’. Identity work should therefore be seen as a complex social process; it integrates the relation between narrator and culture (cf. Chase, 2003). This means that we should pay attention to understanding what narrators tell in their stories and the manner in which this telling is shaped by culture. Similarly, Murray (2003) illustrates the process of narrative identity formation as occurring in a changing personal and social context:

The meanings attached to different experiences in that context influence the character of events recalled and thus the shape of the story told. [...] In the same way as personal narratives are involved in the creation and re-creation of personal identities, these social narratives define the history of a collective and distinguish it from other collectives. Further, these collective narratives overlap with personal narratives in such way that individuals can define themselves as part of the group. (Murray, 2003, p. 116)

Individual life narratives can be constructed by drawing from the cultural stock of stories (Bruner, 1986; Hänninen, 2004; Polkinghorne, 1991). This means that our identity stories depend on the larger cultural stories and that these larger stories
are socially transmitted (Hänninen, 2004). These kinds of narratives are models for personal identities. Bruner (1987, p. 15) explicates this by stating that in telling our identity stories, ‘we become variants of culture’s canonical forms’. In the narrative framework, it is understood that cultures provide their identity answers in storied form and their members retain them in storied form (Bruner, 1991; Kerby, 1991; Ricoeur, 1992). Lieblich et al. (2008) further discuss that every culture offers its members a repertoire of available answers to identity questions. The authors note that some options for narrating life are more dominant while others are marginal. They then offer an example of Western culture which emphasises agency, that is, ‘the autonomous individual who leads his/her life according to his/her will and wishes’ (Lieblich et al., 2008, p. 614). This, however, might be different in other cultures.

**Identity work involves acquiring self-knowledge and self-understanding**

The concept of narrative identity also raises the issue of self-knowledge and self-understanding. In Ricoeur’s (1991a) view, narratives are the medium through which we can understand ourselves. He writes that ‘self-knowledge is an interpretation’ (Ricoeur, 1991a, p. 188). Therefore, self-interpretation is mediated by a narrative (Verhesschen, 2003). In acknowledging the constitutive function of language and narratives, Verhesschen (2003, p. 463) interprets Ricoeur’s views and states that ‘self-understanding is not the result of the description of something that existed previously, but rather is something that emerges in the action and in the narratives that are told about it’.

**Identity work is not entirely based on the lived stories; it is neither an entirely conscious process**

According to Polkinghorne (1996), narrative identity is experienced as a felt meaning. The author points out that by telling or writing identity narratives, ‘the experienced meaning of an identity narrative undergoes a transformation’; ‘it has to be converted into a literary form’ (Polkinghorne, 1996, p. 365). This results in, as discussed earlier, differences between the identity story as it is lived and the story as it is told (Ricoeur, 1984). Told stories also have a rhetorical dimension; they are affected by the audience to whom they are told (Denzin, 1989; MacLure, 1993). To produce a coherent, interesting and personally favourable narrative, told stories omit details, elaborate other parts and make some parts more consistent.
(Polkinghorne, 2005a; Riessman, 1993; Singer, 2004). Additionally, people cannot consciously access all elements of their storied identity. Ricoeur (1992) suggests that through reflection, we cannot fully access our operating identity story and that our lived identities must be approached indirectly through the interpretation of expressions and actions. As per Lieblich et al. (1998), I do not claim in this study that when pre-service teachers narrate their lives, they are aware and concerned with the theoretical groundings in the creation of narratives; they are simply trying to make sense of their lives while using a common cultural stock of stories (see also Hänninen, 2004). Moreover, I build on Polkinghorne (1996) that identity work is not an entirely consciously directed process in the sense that people are not always aware of the occasions in which they are engaged in it.

*Identity work may alter the meaning of the experiences*

The experiences in one’s life are constitutive of identity (Josselson, 2009), and therefore, the memory of their content may persist throughout one’s life (Singer & Salovey, 1993). However, it has been argued that they may still be reconstructed as life progresses (McAdams & Janis, 2004; Mead, 1936). Arguably, therefore, identity work, as meaning-making activity, may alter how one evaluates such memories, which may thus alter one’s identity (Josselson, 2009). Further, following Dauenhauer and Pellauer (2011), doing identity work creates new plots which, in turn, produce new meanings. Mead (1936) explains this by arguing that each new event interrupts the continuity of the individual’s experience. Therefore, the author further notes that the past must be reconstructed in such a way that it integrates the new event into the individual’s ongoing experience. Past identities, especially in narratives of transformation, serve as contrasts to present identities (cf. McAdams & Janis, 2004). In all, building on Hinchman and Hinchman (2001, p. xiv), I maintain that identity work emphasises the ‘active, self-shaping quality of human thought’ and the power of narratives to construct and reconstruct identities.
3 Identity in Mathematics and Teacher Education Settings

Researchers focusing on teacher development during teacher education programmes have expressed significant interest in the concept of teacher identity as well as in the processes of identity formation (see Beauchamp & Thomas, 2009; Beijaard et al., 2004; Freese, 2006; Gaudelli & Ousley, 2009; Hoban, 2007; Sachs, 2005). Beauchamp and Thomas (2009) assert that teacher education programmes seem to be the ideal site for awakening the need to develop pre-service teachers’ professional identities. In the case of elementary teacher education programmes that prepare their students for teaching various subject domains, it should be considered that they do not only shape general teacher identity; they also shape subject-related identities. Moreover, these identities can vary tremendously (Oliveira & Hannula, 2008).

In the following sub-chapters, I first consider research on teacher identity and identity development. These findings have been useful for understanding subject-related identities, such as a mathematical identity. I then introduce research on identity in mathematics education. Finally, I outline the understanding of mathematical identity work in this study.

3.1 Research on teacher identity

The research literature in education demonstrates that teachers’ professional identity or teacher identity is an issue of growing interest (e.g. Rodgers & Scott, 2008). According to Meijer (2011), this interest arose particularly after the year 2008. Reviews of teacher identity research by Beijaard et al. (2004) and Beauchamp and Thomas (2009) showed that identity has been explored in a variety of ways. These studies demonstrated that teacher identity has been linked to concepts, such as teacher development, teacher change and reflection (e.g. Conway, 2001; Cooper & Olson, 1996; Kaasila & Lauriala, 2012; Korthagen & Vasalos, 2005; Urzua & Vasquez, 2008). Moreover, teachers’ beliefs and emotions have been linked to identity (Buehl & Fives, 2009; O’Connor, 2008; Shapiro, 2010; Walkington, 2005). In addition, several studies have linked teacher identity to narrative (Connelly & Clandinin, 1999; Sfard & Prusak, 2005; Watson, 2006) and agency (Lasky, 2005). Beauchamp and Thomas (2009, p. 176) assert that these concepts often overlap, thus making it challenging to ‘delineate one from the other’.
Beijaard et al. (2004) have produced a systematic analysis of the relevant literature between 1988 and 2000. They were interested in how the concept of teachers’ professional identity was used in the findings of these studies and reviewed reports on the absence of an explicit definition in several studies, which I believe clearly reflects the challenges in defining the concept. Additionally, they maintain that ‘different concepts were used to indicate the same thing, or it was not clarified how they are related’ (Beijaard et al., 2004, p. 126). In all, various conceptualisations and the ways of understanding the concept as well as the use of the terms ‘self’ and ‘identity’ have generated confusion (Beauchamp & Thomas, 2009). Lasky (2005, p. 901), for example, defines teacher identity as ‘how teachers define themselves to themselves and to others’. Coldron and Smith (1999, p. 712) assert that ‘being a teacher is a matter of the teacher being seen as a teacher by himself or herself and by others; it is a matter of acquiring and then redefining an identity that is socially legitimated’. Applying Gee’s (2001) notions, I understand teacher identity as one component of multiple aspects of a person’s identity that are bound to his/her professional status (i.e. being a teacher) (see also Lutovac & Kaasila, 2011). Sachs (2005, p. 15) maintains that ‘teacher identity provides a framework for teachers to construct their own ideas of “how to be”, “how to act” and “how to understand” their work’. Some researchers identify teacher identity in terms of specific categories; for example, Beijaard et al. (2004) allude to subject matter and pedagogical and didactical expertise. Flores and Day (2006) distinguish between personal history, teacher training and practice and school culture.

Teacher identity has been considered from personal and social perspectives (see Beijaard et al., 2004; Beauchamp & Thomas, 2009). The personal perspective of teacher identity may include different aspects that characterise personal identity, such as professionalism, commitment, self-image, self-esteem, self-efficacy, motivation, job satisfaction, task perception and teachers’ expectations of their career (Day, Kington, Stobart, & Sammons, 2006; Kelchtermans, 1993). The social perspective defines teachers’ professional identity as, for example, a ‘set of attributes that are imposed upon the teaching profession’ by outsiders and teachers themselves (Sachs, 2005, p. 153). Some authors make a clear distinction between personal and professional identity (e.g. teacher identity). Consequently, Beijaard et al. (2004) underscore the unclear distinction between personal and professional identity in the research literature. However, both personal and professional aspects are arguably combined in teachers’ identity as there are personal and professional aspects of teaching (cf.
Beauchamp & Thomas, 2009; Day et al., 2006). Similarly, some researchers explicitly connect teachers’ personal and professional dimensions in their identity development. For example, Lipka and Brinthaupt (1999) argue for a balance between the two dimensions. In this sense, professional identity is conceptualised as an interaction between a teacher’s personal and professional experiences (Connelly & Clandinin, 1999).

Like one’s personal identity, teacher identity is also characterised as dynamic, multiple (Coldron & Smith, 1999; Volkmann & Anderson, 1998), changeable over time under internal and external influences (Beijaard, 1995; Flores & Day, 2006; Rodgers & Scott, 2008; Sachs, 2005; Zembylas, 2003) and developing across different contexts and relationships with others (Beijaard, 1995; Coldron & Smith, 1999). Identity has also been shown to be continuously developing. Finally, as the reviews (Beijaard et al., 2004; Beauchamp & Thomas, 2009) of research on teacher identity have suggested, additional knowledge is needed in order to recognise the value of identity in teacher development. Rodgers and Scott (2008) assert that more has been written about teacher identity from the theoretical viewpoint than from the empirical; however, the number of empirical studies, particularly qualitative ones, in the past years have increased. Beijaard et al. (2004) illustrate that most studies on teacher identity were underlined by a cognitive perspective. In this study, attention will be focused on both the psychological (cognitive) and social (contextual) aspects related to pre-service teachers’ identities and identity work.

3.2 Research on identity development in the teacher education context

Teacher identity applies to all persons involved in the teaching profession (Sachs, 2005), including pre-service teachers whose teacher identity is still evolving during teacher education. Pre-service teachers’ identity development has been acknowledged as important. However, it has not always been evident in the concrete actions in teacher education and its pedagogical practices, neither are these practices always intentional (see Hoban, 2007; Korthagen, 2004). Identity shifts are central to considerations of the identity development of pre-service teachers (Beauchamp & Thomas, 2006; Beauchamp & Thomas, 2009; Thomas & Beauchamp, 2007; Meijer, 2011). Meijer (2011), however, advances that there is a gap in the literature on what kind of learning is needed for identity shifts to occur. Following Korthagen (2004, p. 85), identity shift or change ‘is a difficult, and
sometimes painful process, and often there seems to be little change at all’ in terms of how pre-service teachers view themselves. Moreover, Beauchamp and Thomas (2009) suggest that overt attention to shifts has not always been evident.

Other studies address identity within a teacher education context. For example, Freese (2006) has explored pre-service teachers’ discoveries of their teacher selves through reflection and practice. Arnon and Reichel (2007) link pre-service teachers’ images of the ideal teacher to the process of identity development. Meijer (2011) has explored the role of crisis in pre-service teachers’ identity development and suggests that encouraging crisis and learning beyond the comfort zone challenge pre-service teachers’ identities. This may help in preventing teachers from quitting the teaching profession in the long run. Korthagen (2004) points to different levels of change as well as the level of identity that can be influenced in people. Beauchamp and Thomas (2009, p. 185) summarise that pre-service teachers face many challenges during teacher education: ‘they must negotiate within shifting conceptions of what teaching is and should be, relate to the identities of others and nevertheless become agents of their own identity development’. Therefore, becoming a teacher is a complex process (see also Thomas & Beauchamp, 2007).

Contextual factors have been explored in the context of teacher identity development (Flores & Day, 2006; Kaasila & Laurila, 2010); however, they seem to be underemphasised (Beijaard et al., 2004). According to Hamman et al. (2010), contextual considerations may explain a wide range of issues in teachers’ identity development. A comparative study by Cardelle-Elawar, Irwin and Lizarraga (2007) highlighted the role of context in the identity development of teachers from Ghana, Spain and the USA. The pre-service teachers in the current study attend two different teacher education contexts, Finnish and Slovenian; therefore, attention will also be paid to the contextual factors influencing their mathematical identity work. (I discuss about the context in Chapter 4).

The meaning of (auto)biography has been particularly highlighted by the research on teachers’ professional identity formation (Beijaard et al., 2004; Connelly & Clandinin, 1999; Knowles, 1992). Some educational researchers have defined teachers’ professional identity in line with the narrative perspective. Much of this research draws on the work of Connelly and Clandinin (1990, 1999, 2000). Connelly and Clandinin (1999) refer to teachers’ professional identity in terms of ‘stories to live by’ that teachers use to understand themselves and their teaching. Conceptually, the authors bring together teachers’ personal practical knowledge, their professional knowledge and their identity. In this sense, identity
is constructed and reconstructed by the stories teachers tell and use when they communicate with others (Beijaard et al., 2004; see also Beattie, 2000). Additionally, several authors acknowledge that teachers’ stories are not only influenced by teachers’ own knowledge, values, feelings and purposes; they are also collective stories as they reflect the school context where teachers work as well as the broader social, cultural, and historical context (Beijaard et al., 2004; Coldron & Smith, 1999; Connelly & Clandinin, 1999; Elbaz-Luwisch, 2002; Flores & Day, 2006).

Reflection is another component in the construction of identity (Beauchamp & Thomas, 2009). It is also one of the central concepts in educational research (Beattie, 1997; Hatton & Smith, 1995; LaBoskey, 1993). However, there is no common definition of reflection. In line with LaBoskey (1993), I maintain that the aim of reflection is to enhance new understanding; importantly also, emotions play a central role in reflective processes. Within the literature on reflection, some authors refer to reflection while others address self-reflection. The role of reflection has been widely acknowledged in the identity development of pre-service and in-service teachers (see Cattley, 2007; Conway, 2001; Dolk & Hertog, 2008; Freese, 2006; Hamlin, 2004; Urzuá & Vasquez, 2008). This literature recognises reflective skills as important for one’s development as a teacher as these skills are considered central to effective teaching. However, reflection has also been recognised as central to individuals’ interpretations of themselves (cf. MacLure, 1993) and is thus crucial for teachers’ identity. Korthagen and Vasalos (2005) suggest that reflection directed at identity and mission is needed to reach a sense of self. The authors explain that reflection on the level of identity has to do with ‘how we experience ourselves’, whereas reflection ‘on the level of mission triggers such issues as “why” the person decided to become a teacher’ (Korthagen and Vasalos, 2005, p. 53). Walkington (2005, p. 59) highlights that self-reflection or ‘reflection on one’s own perceptions, beliefs, experiences and practices is a core activity for all teachers’ and that reflection on action assists in the development of the teacher’s role and contributes to the ongoing development of a teacher’s identity. Additionally, building on Korthagen (2004), reflection helps pre-service teachers to develop themselves in line with their personal identity. In all, reflection in this study is closely related to narrative and its meaning-making process in which a pre-service teacher evaluates his/her past experiences, present situation and future goals (cf. Connelly & Clandinin, 1999; 2000; Kaasila & Lauriala, 2012) (I discuss more on reflection in Chapter 3.4).
The role of emotions in identity formation and change has also been acknowledged (Beauchamp & Thomas, 2009; O’Connor, 2008; Zembylas, 2003). Zembylas (2003) suggests that an understanding of the connection between emotions and self-knowledge is needed in order to understand teacher identity. Studies by Hargreaves (2001), Sutton and Wheatley (2003) and Shapiro (2010) engage in discussion on a wide range of emotional experiences in teaching. Uitto (2011) discusses about emotions in the context of teacher-student relationships. According to Hargreaves (2001), emotions are an influential factor in teachers’ approaches to teaching as well as in their identities. Shapiro (2010) notes that emotions are seen as central to teachers’ processes of decision-making, professional development and identity formation. Finally, O’Connor (2008, p. 119) asserts that educational policy tends ‘to downplay or ignore the emotional dimensions of the teaching role’. (I discuss about emotions related to mathematics in Chapter 3.3.2).

3.3 Research on mathematical identity

Subject matter has been seen as distinct in the construction of teacher identity (Drake et al., 2001). Accordingly, when dealing with pre-service elementary teachers, it is possible to distinguish sub-identities related to different subject disciplines, such as language teacher identity (Varghese, Morgan, Jonston, & Jonson, 2005) or music teacher identity (Thompson & Campbell, 2010) etc. These so-called sub-identities are considered to develop in different contexts and are based upon different influences (Beijaard et al., 2004; Volkmann & Anderson, 1998). Here, I focus on pre-service teachers’ identity in a mathematics education context, that is, an identity related to mathematics learning and teaching. The phenomenon of identity in mathematics education research emerged as a result of the ‘social turn’ (Lerman, 2000). Consequently, mathematics education research on identity has been drawing on research in the social and humanistic sciences. It has been acknowledged that the concept of identity in mathematics education research has benefited from interdisciplinary theorising (e.g. Chronaki, 2013). For that reason, I shall intertwine notions obtained from educational and mathematics education research. Research in both contexts is relevant as pre-service elementary teachers simultaneously belong to both camps.
3.3.1 Differing understandings of mathematical identity

Identity is a relatively new concept in mathematics education (Black et al., 2009), however, an increase in the number of studies investigating this concept has been evident in mathematics education research. Identity in mathematics education has been approached as a means to understanding student engagement or disengagement and their relationships with mathematics (Black et al., 2009; Boaler, 2002; Boaler & Greeno, 2000; Boaler, William, & Zevenbergen 2000; Forster, 2000; Sfard & Prusak, 2005; Solomon, 2007; Williams et al., 2008). Additionally, research has explored the development of pre-service teachers’ identity (Klein, 2002; Walshaw, 2004), in-service teachers’ identity (Goldsmith & Schifter, 1997; Hodgen & Askew, 2007; Hodges & Cady, 2012) and the identity of teacher educators (Smith, 2006). Additionally, many studies have dealt with the role of class, gender and race in identities within a mathematics education context (Mendick, 2005; Rodd & Bartholomew, 2006).

Identity in mathematics education has been explored by researchers employing various theoretical perspectives, including the psychological (Evans, 2000), socio-cultural (e.g. Ma & Singer-Gabella, 2011; Solomon, 2007; Williams et al., 2008), and post-structural perspectives (e.g. Walshaw, 2004; Lerman, 2012). Particularly, socio-cultural theories have been used to understand identity in a mathematics education context. Lerman (2013b, p. 624) maintains that the assumption of studies drawing on socio-cultural theories is that ‘teacher learning is about changing participation in social practices’. I do not, however, label my study as socio-cultural, particularly due to the data collected. I do not explicitly address the aspect of practice; this is done only from the viewpoint of pre-service teachers talk about it. As discussed earlier (see Chapter 2), I apply a narrative perspective on identity. I do acknowledge that we can understand identity in terms of a narrative by employing various perspectives, including the socio-cultural, as done, for example, by Sfard and Prusak (2005). These authors understand identity as ‘a set of reifying, significant, endorsable stories about a person’ (Sfard & Prusak, 2005, p. 14). Because the focus of the current study is on what pre-service teachers tell about what they think or feel and what they tell about the social context which promoted their feelings and thoughts and in which their actions occurred, my choice of viewpoint on the concept is rather psycho-social. In the same vein, I employ wider theories outside the domain of education which emphasise both individual and social aspects of identity (see Chapter 2). Among
the findings from mathematics education research, I consider and combine those that emphasise individual and social dimensions.

Researchers in mathematics education also use different terms to explore the concept of identity. There is a body of research focusing on ‘mathematics teacher identity’ (de Freitas, 2008; Graven, 2003; Hodgen & Askew, 2007; Hodges & Cady, 2012; Krzywacki, 2009; van Zoest & Bohl, 2005). This research usually involves individuals who specialise in teaching mathematics or those who have completed their mathematics degree and are thus mathematics teachers. Most of these studies have been informed by theories originating from social theory (Lerman, 2000), much of which has drawn from the work of Lave and Wenger (e.g. Graven, 2003; Hodgen & Askew, 2007; Van Zoest & Bohl, 2005). For example, van Zoest and Bohl (2005) have developed a framework on the identity of mathematics teachers which incorporates cognitive (i.e. teachers’ knowledge and affective domain) and social aspects (i.e. teachers’ participation in communities of practice). Lerman (2013a, p. 40), however, is critical that ‘the socio-cultural is too often defined as social class, ethnicity and political issues and then separated from what matters, learning’ and also contends that researchers building on the work of Wenger often used the concept of identity in an oversimplified manner (Lerman, 2013b).

The research literature also utilises the concept of ‘mathematical identity’ (or ‘mathematics identity’), which has been widely and variously used (Kaasila, 2007a, 2007b; Grootenboer et al., 2006; Sfard & Prusak, 2005; Solomon, 2007; Williams et al., 2008). Consequently, it has been defined in different ways. In a broad sense, Bikner-Ahsbahs (2003, p. 98) defines mathematical identity as ‘a construct that describes the relationship of a person with mathematics’ and ‘assumes the necessity of interaction’. Various authors in the book by Black et al. (2009) also maintain that essential to one’s relationship with mathematics is his/her sense of self and his/her understanding of how mathematics relates to it. Grootenboer et al. (2006, p. 612) advance that identity can be seen as ‘how individuals know and name themselves (I am: a teacher, a student, good at maths…), and how an individual is recognised and looked upon by others (that person is: white, tall, smart, an introvert…)’. In a narrower sense, multiple definitions have been offered. In Solomon’s (2007) view, identity consists of a participatory belonging in a mathematical community of practice. In a discursive framework, the key is how narratives create one’s identity (Sfard & Prusak, 2005). In the latter framework, identity has also been understood as mathematical
subjectivity. For instance, Palmer (2009) sees subjectivity as how students regard themselves in relation to math.

Finally, because I focus on the mathematical identity of pre-service elementary teachers, the term ‘mathematics teacher identity’ is not the most appropriate. First, as mentioned earlier, mathematics is not the subject they will necessarily be qualified to teach, and it is also not the only subject they will teach. Therefore, they will not become mathematics teachers; rather, they will become teachers of mathematics in elementary school. Second, pre-service teachers are somewhere in between their learner and teacher identities as they are learners of becoming teachers (see Oliveira & Hannula, 2008). I therefore see the term mathematical identity as better suited as it also applies to other individuals or groups, not only teachers.

### 3.3.2 Mathematical identity as an ‘umbrella’ concept

In mathematics education research, identity has been used as an analytical and interpretive tool (Sfard & Prusak, 2005). Grootenboer et al. (2006, p. 612) assert that the concept is able to bring ‘together a range of elements integral to our understanding of mathematics contexts and learning spaces’. Therefore, mathematical identity acts as a unifying concept that can bring together multiple interrelated constructs, such as experiences, beliefs, attitudes, emotions, life histories and personal narratives (Grootenboer & Zevenbergen, 2008). These previously disparate research areas may be united under the concept of identity (cf. Rodger & Scott, 2008). Therefore, these abovementioned concepts are of importance in an attempt to understand pre-service teachers’ mathematical identity; at the same time, an understanding of identity might also shed some light on these concepts.

In the following sub-chapters, I first briefly consider mathematics education research on school time experiences since these experiences seem to have a central meaning for pre-service teachers’ beliefs, attitudes, emotions, views of mathematics and their mathematical identities (Black et al., 2009; Kaasila, 2007a; Kaasila et al., 2008a). Afterwards, I summarise some of the findings in the research on affect in mathematics and its components as they constitute an understanding of identity as an ‘umbrella concept’ and have informed the notions on mathematical identity in this study. I particularly confine my focus to findings that address pre-service elementary teachers’ affective challenges in relation to mathematics.
School-time experiences

Pre-service teachers’ school-time mathematics experiences have been widely considered (Di Martino & Zan, 2010; Ellsworth & Buss, 2000; Hoskonen & Pelkonen, 2005; Jones, Brown, Hanley, & McNamara, 2000; Kaasila, 2000; Kaasila et al., 2008a; Pietilä, 2002; Trujillo & Hadfield, 1999). This line of research is especially important as it has been shown that the sharpest decline in how students perceive their academic abilities across subject disciplines occurs in mathematics (e.g. Marsh, 1986). Furthermore, Jackson and Leffingwell (1999) have found that 16% of students have their first negative experience with mathematics as early as grades three and four. They characterise some mathematics teachers as hostile, insensitive, making derogatory comments about students in front of their peers, demonstrating impatience or pointing out students’ errors to the entire class (see also Perry, 2004). According to Jackson and Leffingwell’s (1999), students report many of the same problems at the elementary and secondary school levels.

Studies on pre-service teachers have revealed that this group of students sees mathematics as a troublesome subject (Bekdemir, 2010; Rodd & Bartholomew, 2006). Di Martino and Sabena’s (2011) investigation into how Italian pre-service elementary teachers remember their past mathematical experiences suggest that pre-service teachers link their relationship with mathematics to their school performance and their relationship with their mathematics teachers. Those pre-service teachers who declared a negative relationship with mathematics often recognised a teacher as one of the main reasons for this; however, sometimes, a negative relationship was ascribed to innate personal predispositions, bias or beliefs about themselves (Di Martino & Sabena, 2010; see also Kaasila et al., 2008a).

There have been similar observations in two Finnish studies. In Kaasila’s (2000) study on the school-time memories of 60 pre-service elementary teachers, the author identified categories among students who experienced mathematics negatively; these included: ‘Mathematics was boring, I lost my interest’ (36%), ‘I fell off the track’ (20%), and ‘I survived by learning by heart’ (9%). Similarly, based on 80 pre-service elementary teachers’ written responses, Pietilä (2002) has identified that 31% thought that ‘Mathematics is difficult and unpleasant’. This is in line with Rodd and Bartholomew’s (2006, p. 2) observation that mathematics ‘has an aura of being important, hard, boring, high status and challenging’. There is much evidence that school-time experiences with mathematics greatly
influence one’s affective relationship with the subject (Zan et al., 2006), which is why studies on affect overlap with studies on mathematical experience. School-time experiences with mathematics thus often lead to the development of hindering beliefs, negative attitudes towards mathematics and negative emotions or negative overall views of mathematics.

**Affect in mathematics**

Over the past decades, the research literature has focused on affect – beliefs, attitudes and emotions – more in relation to mathematics than to other subjects (Graven, 2003). Many constructs, such as anxiety, have been especially scrutinized in the context of mathematics. Research on affect in mathematics education is thus extensive (Coppola et al., 2012; Di Martino & Zan, 2010, 2011; Hannula, 2012, 2007, 2004; McLeod, 1992; Zan et al., 2006). There are different approaches and conceptualisations of affect as well as much disagreement on how the components of affect are defined and approached (see special issue of *Educational Studies in Mathematics*, 2006). For example, research reviews show that the concept of beliefs is fuzzy (Furinghetti & Pehkonen, 2002; Op’t Eynde, de Corte, & Verschaffel 2002; Pehkonen & Pietilä, 2003). Some researchers consider the concept of attitudes towards mathematics as ambiguous and have addressed the theoretical challenges related to it (Di Martino & Zan, 2010, 2011; Hannula, 2004). In addition, Hannula (2004) maintains that researchers do not agree on a conceptualisation of emotions. Parallel to studies on affect are studies on ‘views of mathematics’. The term was originally introduced by Schoenfeld (1992) as a ‘mathematical world view’ and later adapted by others (Hannula et al., 2006; Kaasila et al., 2008a; Op’t Eynde et al., 2002; Pehkonen & Törner, 1996; Pietilä, 2002).

As such, there are many challenges in understanding the concepts in the affective domain of mathematics. Pehkonen and Pietilä (2003) assert that the challenges also occur as researchers use the same terminology to study different phenomena. On the other hand, a common point of this branch of research is the premise that teacher’s and students’ affect determines the effectiveness of mathematics teaching and learning (Coppola et al., 2012; Hannula, 2012; Zan et al., 2006).

**Beliefs.** Research on teachers’ and students’ mathematics beliefs is extensive (Beswik, 2006, 2007; McLeod, 1992; McLeod & McLeod, 2002; Pehkonen & Hannula, 2004; Thompson, 1992). In this study, building on Pehkonen and Pietilä
(2003), I understand beliefs as subjective, experience-based, and often implicit knowledge on some matter (see also Furinghetti & Pehkonen, 2002). I also understand beliefs as contextual (Beswick, 2007) as they can vary from context to context. According to McLeod (1992), there are various mathematics beliefs classified in terms of students’ or teachers’ experiences, such as beliefs about mathematics; beliefs about the self (including self-concept, confidence and self-efficacy); beliefs about mathematics teaching and beliefs about the contexts in which mathematics education occurs (i.e. classroom, family and broader social context). The ‘social turn’ in mathematics education (Lerman, 2000) has influenced theories on beliefs in a way that they include both individual and social perspectives. Cobb and Yackel (1996), for example, have extended individual beliefs with social and socio-mathematical norms.

Interest in mathematics beliefs has broadened to include a focus on ‘self-efficacy’ beliefs (e.g. Britner & Pajares, 2006; Phelps, 2010; Usher, 2009; Zeldin & Pajares, 2000). Self-efficacy is defined as ‘people’s beliefs of their capabilities to produce designated levels of performance’ (Bandura, 1986, p. 72). Arguably, research on mathematical identity can also benefit from this line of research, particularly in seeking to understand the identities of those students who experience mathematics negatively. Building on Bandura (1986), Zeldin and Pajares (2000) have discussed that people’s beliefs about their mathematics ability affect the choices they make, the amount of effort they put forth, their resilience when they face failure, their persistence, the anxiety level and the level of success they achieve. As evidenced in research on school-time experiences in mathematics, students’ self-efficacy beliefs are believed to develop on the basis of their perceptions of past performance as well as the social context (Bandura, 1986). Therefore, while perceived success strengthens efficacy, repeated failure can lower it (Bandura, 1986; see also Usher, 2009; Zeldin & Pajares, 2000). Bandura (1986) further notes that observing the successes and failures of others, verbal messages and social encouragement can help or undermine individual efforts. Zeldin and Pajares (2000, p. 2) exemplify this as ‘when women receive messages that they do not belong in a male-dominated field, such as mathematics, they may be especially vulnerable to believing that they are not and cannot be competent in that area’.

Research on pre-service (and in-service) elementary teachers suggest that their beliefs about mathematics and mathematics learning and teaching are established on the basis of their own school-time experiences (Ball, 1990; Di Martino & Zan, 2010; Kaasila et al., 2008a; Kaasila, 2007a, 2007b). Liljedahl et
al. (2007) explain that during school time, beliefs are formed and concretised into deep-seated beliefs about mathematics and its learning and teaching. Researchers agree that teachers’ beliefs about mathematics and mathematics teaching account for what happens in the classroom (e.g. Op’t Eynde et al., 2002). For example, Cooney and Wilson (1993) showed that beliefs about effective mathematics teaching influence differences in practices even when teachers’ have similar mathematics understandings. Overall, research has shown that teachers who perceive their ability to teach mathematics to be low are more likely to teach in a teacher-centred way (e.g. Thompson, 1992). However, teaching has often been found to be inconsistent with beliefs (Raymond, 1997; Thompson, 1992).

In addition, much of the mathematics education research dealing with beliefs has highlighted belief change or the so-called teacher change (Kaasila & Lauriala, 2010; Kaasila et al., 2008a; Liljedahl et al., 2007; Phelps, 2010; Rolka, Rösken, & Liljedahl, 2007). It has been suggested that understanding pre-service teachers’ beliefs can facilitate their learning experiences, and in turn, broaden their knowledge (Buehl & Fives, 2009; Liljedahl, 2011). Finally, according to the premise that beliefs lie ‘at the very heart of teaching’ (Kagan, 1992, p. 85), research links beliefs to teacher identity. Therefore, if teacher identity is seen to be based on beliefs (cf. Walkington, 2005), this means that changing beliefs might influence teacher identity.

Emotions. There has been an increased interest in the role of emotions in teaching as well as their role in teachers’ professional and personal development (Hargreaves, 2001; Lasky, 2005; Zembylas, 2003). Emotions have been recognised as central to effective teaching; and still the failure to address emotions in teacher education has also been noted (Hawkey, 2006). The concept of emotions in mathematics education is fundamental when it comes to discussions about affect (Hannula, 2004), however, besides math anxiety, less research has been devoted to researching other emotions (Di Martino & Sabena, 2011; Op’t Eynde et al., 2006; Zan et al., 2006). Building on Hannula (2004), I assert that emotions are linked to personal goals, that they involve a physiological reaction and that they are important for human coping. Hannula (2004) further opines that emotions affect cognitive processing, meaning that they influence attention and memory. Students are also aware of their emotions and may reflect on them.

According to Brady and Bowd (2005), the emotions evoked by mathematics are a product of mathematics-related school time experiences. Positive emotions towards mathematics, such as satisfaction and joy, have been identified in the
research literature (e.g. Di Martino & Sabena, 2011). However, mathematics as a subject is commonly perceived as impersonal, rational and rule-bound (Leder, 1986) and is often associated with negative emotions, such as fear, anger, horror or even panic (e.g. Di Martino & Sabena, 2011; Op't Eynde et al., 2002). Moreover, negative emotions seem to explain students’ avoidance of mathematics (Meece, Wigfield, & Eccles, 1990).

‘Mathematics anxiety’ is one of the foci of research on affect (Bekdemir, 2010; Brady & Bowd, 2005; Norwood, 1994; Stodolsky, 1985; Tobias, 1998). It has been identified as a learning difficulty for many children (Newstead, 1998). Research has focused on test anxiety (see Reyes, 1984), which has been shown to negatively influence performance, particularly because it hinders cognitive processes (Ashcraft & Kirk, 2001). Accordingly, students have difficulties recalling what they have learned and report the feelings of a ‘blank mind’. It has also been suggested that repeated failure may lead to math anxiety (Stodolsky, 1985; Tobias, 1998). Anxiety is also linked to the way in which mathematics is taught as well as to the teacher’s role (Jackson & Leffingwell, 1999; Vinson, 2001).

Unfortunately, mathematics anxiety seems to be a widely occurring phenomenon. For example, Norwood (1994) suggests that 70% of college students enrolled in mathematics classes experience high levels of anxiety. Moreover, pre-service elementary teachers seem to experience the highest level of math anxiety among students across different study disciplines (Hembree, 1990). Similarly, Rech, Hartzell and Stephens’ (1993) study on pre-service elementary teachers in a US college found that they possessed more negative attitudes towards mathematics and scored lower in mathematics competency tests than the general college population. Trujillo and Hadfield (1999), for example, have traced the roots of mathematics anxiety in pre-service elementary teachers. The authors suggested providing pre-service teachers with professional development opportunities that reduce mathematics anxiety. The research literature suggests that pre-service elementary teachers’ emotions in general, and mathematics anxiety specifically, hinder their ability to teach mathematics effectively (Wilson, 2009) and can thus interfere with becoming a good mathematics teacher (see also Brady & Bowd, 2005; Hannula et al., 2007b; Kaasila et al., 2008a). Pre-service teachers are shown to have low confidence levels to teach mathematics and low mathematics teaching efficacy (Bursal & Paznokas, 2006; Phelps, 2010; Swars et al., 2006).
Following Di Martino and Sabena (2011), I contend that pre-service teachers’ emotions are not limited to mathematics anxiety; instead, these authors distinguish between pre-service teachers’ emotions towards mathematics and their emotions towards the perspective of having to teach it. Their findings in the study on Italian cases and their emotions towards mathematics and its teaching suggested that almost every second pre-service elementary teacher associates mathematics with only negative emotions, often very strong ones, such as ‘fear, discomfort, terror, stress, concern, frustration, anguish, sadness, loneliness, oppression, tension, despise, rage, uneasiness, agony, coldness, panic, embarrassment, distress, inhibition, resignation, discouragement, disappointment, repulsion, hate, and disgust’ (Di Martino & Sabena, 2011, p. 95). Indeed, there was a strong presence of mathematics anxiety in their data; however, insecurity towards mathematics was also extensive and was expressed with words, such as ‘disorientation, confusion, uneasiness, uncertainty, sense of inadequacy, sense of incapability, insecurity, feeling unprepared, bewilderment, and powerlessness’ (Di Martino & Sabena, 2011, p. 96).

Di Martino and Sabena (2011, p. 100) have further shown that similar to emotions related to past experiences, pre-service teachers’ emotions towards mathematics teaching were also negative: ‘one teacher over two affirms to feel negative emotions associated to the fact of having to teach mathematics’. These negative emotions seem to be linked to pre-service teachers’ self-efficacy beliefs towards mathematics teaching (see also Phelps, 2010). However, Di Martino and Sabena (2011) reveal an interesting finding: some pre-service teachers expressed negative emotions towards mathematics but expressed positive emotions towards future teaching. The reason for this seems to be in pre-service teachers’ understanding that their difficulties with mathematics can have positive consequences, for example, being better suited to understanding pupils’ difficulties (see also Kaasila et al., 2008a) or compensating for their own past (Di Martino & Sabena 2011). In all, due to the many challenges that pre-service teachers face in the mathematics education context, emotions deserve a greater amount of attention in discussions on mathematical identity. Consequently, I concur with Di Martino and Sabena (2011, p. 103) that anxiety is ‘only the tip of an iceberg and that there is a great variety of negative emotions that pre-service elementary teachers associate to mathematics’.

**View of mathematics.** One’s ‘view of mathematics’ refers to individual’s statements developed on the basis of his/her experiences as a learner of mathematics (Pietilä, 2002; Pehkonen & Pietilä, 2003). Pehkonen and Pietilä
(2003) define pre-service teachers’ view of mathematics as consisting of knowledge, beliefs, conceptions, attitudes and emotions. As in the studies of Kaasila, Hannula, Laine and Pehkonen (2006, 2008a), I consider the view of mathematics as part of pre-service teachers’ mathematical identity and further distinguish its three components: 1) the view of oneself as a learner and teacher of mathematics. Pre-service teachers’ self-efficacy, control, task-value and goal-orientation have all been considered to fall into this category (Hannula et al., 2006). One essential aspect of the first component is self-confidence, which plays a central role in the formation of pre-service teachers’ view of mathematics. 2) The view of mathematics and its teaching and learning. In this category, Hannula et al. (2006) distinguish between pre-service teachers’ view of mathematics education, such as mathematics as a subject, mathematical learning and problem solving and mathematics teaching in general. 3) The view of the social and cultural context of learning and teaching mathematics (see also Op't Eynde et al., 2002). This category includes social and socio-mathematical norms in the class and the role of one’s teacher (Hannula et al., 2006). Moreover, Pietilä (2002) suggests that the view of mathematics has a hard core that includes pre-service teacher’s fundamental views; therefore, only experiences that can influence the core can shift or change the view of mathematics.

Research has recognised a negative view of mathematics as a widespread phenomenon among pre-service elementary teachers (Kaasila et al., 2008a; Raymond, 1997). Studies by Kaasila (2000) and Pietilä (2002) suggest that 20–30% of Finnish pre-service elementary teachers have a negative view of mathematics at the beginning of their studies. Kaasila et al. (2006) also suggest that 22% of Finnish pre-service teachers have low self-confidence in mathematics. Much of international research has identified similar issues (see Grootenboer, 2006). Moreover, Lipovec, Antolin and Lutovac (2010) have conducted a study on Slovenian cases and showed that almost 70% of pre-service elementary teachers reported having a negative view of mathematics. It has also been suggested that teachers with very similar mathematical knowledge may teach very differently depending on their views on the teaching and learning of mathematics (Kaldo, 2011). A view of mathematics therefore regulates pre-service teachers’ thinking and actions in mathematics-related situations (cf. Pehkonen & Pietilä, 2003).

Pre-service teachers’ views of mathematics are considered important because they are the first to teach mathematics to children (Hannula et al., 2006; Kaasila et al., 2006). Those who hold a negative view of mathematics can transmit their
negative emotions (e.g. math anxiety) to their pupils (Pietilä, 2002). In addition, some elementary teachers might tend towards overprotecting their pupils from mathematics (Gellert, 2000). As such, Hannula (2007) suggests that pre-service teachers should find constructive coping strategies in order to avoid the debilitating consequences that a negative view of mathematics may have on their teaching. In order to assure good teaching, it has been suggested that pre-service teachers need a deep knowledge and positive view of themselves as mathematics learners (Cooney & Wilson, 1993; Ma, 1999).

3.3.3 Narrative mathematical identity

Several studies have employed the narrative perspective to explore identity in the mathematics education context (Black et al., 2009; Drake et al., 2001; Drake, 2006; Kaasila, 2007a; Kaasila et al. 2008a; Sfard & Prusak, 2005). Sfard and Prusak (2005) see identities as discursive constructs and define them as collections of stories. They maintain that ‘it is our vision of our own or other people’s experiences’ that constitutes identities and argue that identities act as self-fulfilling prophecies in determining learning and its success or failure (Sfard & Prusak, 2005, p. 17). In studies by Kaasila (2007a, 2007b), pre-service teachers’ mathematical identity was considered as part of their narrative identity. Therefore one’s mathematical identity is manifested in telling or writing stories about one’s relationship with mathematics, its learning and teaching. Drake et al. (2001; see also Drake, 2006) understand mathematical identity as and through stories. They point out that teachers construct storied identities (see also Connelly & Clandinin, 1999) and that these stories can help understand their approaches to instruction. Moreover, they compare mathematical and literacy stories and show that storied identities that teachers construct are subject-matter-specific.

In line with the abovementioned research, I see mathematical identity as pre-service teachers’ narratives of their mathematical experiences (cf. Bruner, 1991). For that purpose, I apply Ricoeur’s (1992) concept of narrative identity. Concurring with Ricoeur (1992), the identity of the story makes the identity of the pre-service teacher. Building on Kaasila (2007a), I thus define mathematical identity as narratives that pre-service teachers tell themselves or others about themselves as mathematics learners and teachers (see also Drake et al., 2001; Kaasila, 2007b). These narratives carry various meanings that pre-service teachers attach to themselves as mathematics learners and teachers or meanings attributed by others (cf. Beijaard et al., 2004). Additionally, these narratives
include all the narrative constructs, such as themes, plots and characters (Connelly & Clandinin, 1999; Polkinghorne, 1995), and pre-service teachers’ stories have a double meaning for them. Through stories, they come to know themselves; further, these stories guide their action. Similarly, by applying Gilbert et al. (2005), I contend that mathematical identity narratives do not only reflect a pre-service teacher’s world; they play an active role in constructing as well as transforming it.

Drake et al. (2001) assert that one’s beliefs can be understood within narrative identities. I add to this understanding other affective structures (e.g. emotions) along with the view of mathematics (see Chapter 3.3.2). These constructs have been commonly considered in the research as isolated fragments, however, narrative identity allows for understanding them as ‘interconnected and interrelated systems’ (Drake et al., 2001, p. 3). This is in line with identity as an ‘umbrella’ concept. Notwithstanding, an identity narrative or narrative identity brings additional benefit to the understanding of these constructs; it offers a more holistic understanding of these constructs, and such an understanding may, for example, be a more accurate representation of the way in which pre-service teachers construct and change their beliefs. A narrative mathematical identity also offers a holistic view of the relationship between a pre-service teacher and his/her mathematics context (cf. Williams et al., 2008).

In this study, I consider mathematical identity in personal and social terms. Sfard and Prusak (2005) argue that despite the fact that identities are individually told, they are collectively shaped. Grootenboer et al. (2006) affirm that the way people experience social settings plays a role in their mathematical identity. Arguably, therefore, various contexts, social relationships and interactions are of key importance to mathematical identity (Hodges & Cady, 2012; Kaasila, 2007a; Op’t Eynde et al., 2006; Solomon, 2007; see also Ricoeur, 1992). Therefore, a narrative mathematical identity is a product of reflection; it changes over time and is constantly under construction (cf. Ricoeur, 1992, 1991b). Sfard and Prusak (2005, p. 21) argue that the stories people tell about themselves or about others to others (also to researchers) should not be treated as ‘windows to another entity that stays unchanged when “the stories themselves” evolve’. This means that as stories change, identities also change. However, the narrative perspective accepts stories as ‘words that are taken seriously and that shape one’s actions’ (Sfard & Prusak, 2005, p. 21). The rhetorical aspect, especially the meaning of an audience for one’s narrative mathematical identity, has been discussed in the literature (Kaasila, 2007b; Kaasila et al., 2012). Here, I
borrow from Sfard and Prusak (2005) that like stories, identities also have authors and recipients and can consequently change because of them. Moreover, the concept of narrative identity is useful in defining mathematical identity because it explains how one can remain the same person despite life changes (Verhesschen, 2003). For example, when pre-service teachers relate their narratives, the elements they chose to include or emphasise—such as particular mathematics learning or teaching experiences—often depend on whom they were addressing, e.g. a peer or teacher. While such narratives vary, they each contain a pre-service teacher’s narrative identity (cf. Verhesschen, 2003; see also Lutovac & Kaasila, 2014).

3.4 Mathematical identity work in this study

The term ‘identity work’ has been used within the general research literature (e.g. Schwalbe & Mason-Schrock, 1996; Snow & Anderson, 1987; Sveningsson & Alvesson, 2003) but has not been used as much in educational research (Fraser et al., 1997; Gaudelly & Ousley, 2009; Hawkins, 2005), and even less so in the mathematics education context (Hossain et al., 2013). Moreover, although mathematical identity has raised much interest, identity development in the context of mathematics education has not been sufficiently addressed. Moreover, it has been understood in a myriad of ways. For example, drawing on the sociology of education, Gellert, Espinoza, & Barbe (2013, p. 537) understand the formation of professional identity as ‘developing a fitting to a situation, with relating individually centered social processes to the socially constructed institutionalized world’. The concept of identity work does appear within mathematics education research (Chronaki, 2013; Boylan & Povey, 2009; Hodgen & Marks, 2009; Williams et al., 2008); however, this research often lacks clarification on what exactly researchers mean. Nevertheless, as I have observed, the phrasing ‘mathematical identity work’ has not been used thus far.

Following Sfard and Prusak (2005), in order to understand mathematical identity and its development, it needs to be conceptually expliciated. The following chapter therefore discusses key issues of how pre-service teachers’ mathematical identity work is understood in this study. Mathematical identity work is discussed by applying the notions addressed in previous chapters, which are derived from the narrative perspective of the study. Accordingly, this chapter can be seen as providing a working conceptualisation of pre-service teachers’ mathematical identity work; however, the discussion here will leave room for
elaborating and explicating the views and some of the concepts along with the findings of the study.

3.4.1 Mathematical identity work as narrating mathematical experiences

Like the mathematical identity of pre-service teachers, their identity work revolves around the narrative aspect. The ways in which narratives construct and are constructed by identity are considered here as identity work. In defining mathematical identity, I have equated pre-service teachers’ narratives of their mathematical experiences with their mathematical identities (cf. Ricoeur, 1992, 1991b). Similarly, the key idea here is to equate identity work with storytelling (cf. Sfard & Prusak, 2005). I draw on the research literature which sees identity work as the construction and reconstruction of meaning through stories over time (cf. Beijaard et al., 2004; Rodgers & Scott, 2008). As discussed by Watson (2006, p. 525), telling or constructing narratives is ‘doing identity work’. Building on Carr (2001), through storytelling, we integrate the past, present and future aspects and thereby construct personal and social identities.

Accordingly, when pre-service teachers construct narratives from their mathematical experiences, they conduct mathematical identity work and thus construct their mathematical identities. In this study, mathematical identity work therefore means narrating mathematical lives (cf. Watson, 2006). Gudmundsdottir (1996) explains that the construction of narratives is a meaning-making process in which the narrator tries to make sense of experience. I apply Beattie’s (2000, p. 5) view that in making sense of our lives by telling stories, ‘the knower is connected to the known, and knowledge-making is recognised as an active, creative, interpretive process’. In this sense, I see mathematical identity work – the telling and retelling of one’s ‘mathematical’ story – as providing a framework for the construction of a pre-service teacher’s mathematical identity (cf. Beattie, 2000; Connelly & Clandinin, 1990).

Following Watson (2006, p. 525), telling stories involves selecting, arranging and reflecting on events which contains meaning for the pre-service teacher and ‘seeks to persuade the listener of its significance’. To understand pre-service teachers’ mathematical identity work, it is therefore important to know how they construct narratives from their experiences (cf. Singer, 2004), that is, what they evoke out of their experiences in their plots and how. In this line, it is useful to understand the rhetoric used in identity narratives (Kaasila et al., 2012). For
example, Kaasila (2007b) has identified ‘self-development rhetoric’ in one Finnish pre-service teacher’s talk, a future-oriented talk with an optimistic connotation; by describing one as an active actor with clear goals, it strongly relates to the idea of lifelong learning (Kaasila et al., 2012).

3.4.2 Mathematical identity work and its past and future orientations

In line with Ricoeur’s (1984–88) framework, I see reflection as constitutive of identity work as it has been suggested that constructing narratives involves reflective processes. Accordingly, pre-service teachers’ identity work includes present reflective thoughts which extend to their past and future selves (cf. Conway, 2001; Mead, 1934; Ricoeur, 1992, 1988).

Retrospective and anticipatory reflection

Pre-service teachers’ mathematical background is important for their mathematical identity (Black et al., 2009; Drake, 2006; Drake et al., 2001; Kaasila, 2007a; Kaasila et al., 2008a). Here, I use the term past orientation to assess aspects of pre-service teachers’ narratives which focus on their past, such as their school-time experiences with mathematics. In this regard, retrospective reflection is crucial as it requires looking back at past thoughts or practices (Conway, 2001). According to Boud and Walker (1993), such a reflection process entails an intentional return to the experience, paying attention to emotions and re-evaluating the experience. Retrospective reflection and its abovementioned phases are thus components of pre-service teachers’ mathematical identity work.

Educational research has foregrounded past and present dimensions of identity. Similarly, narrative research on pre-service teachers’ mathematical identities has focused primarily on their current or past experiences (Black et al., 2009; Drake et al., 2001; Kaasila, 2007a) while future orientation has not received similar attention. However, an awareness of the importance of the future dimension in the identity development appears to be growing among educational researchers (e.g. Beauchamp & Thomas, 2006; Conway, 2001; Hamman et al., 2010; Urzua & Vasquez, 2008) while in the mathematics education research community, this focus has to date been overlooked (Chapman, 2008a; Di Martino & Sabena, 2011). Future identities in mathematics education research therefore require further investigation.
In this vein, I build on Beijaard et al. (2004, p. 122) that identity work is also an answer to the question ‘Who do I want to become?’ which is in line with Conway’s (2001) discussion on anticipatory reflection. According to Conway (2001), anticipatory or prospective reflection allows a look into the future, that is, a look into the future practice or a future way of thinking. Similarly, in the mathematics education context, Sfard and Prusak (2005, p. 18) use the term ‘designated identity’, which consists of ‘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’. I advance these thoughts by claiming that anticipatory reflection allows for anticipating a future identity, such as possible selves (Hamman et al., 2010; Markus & Nurius, 1986).

**Possible selves**

I build the future orientation of mathematical identity work on the concept of possible selves (Markus & Nurius, 1986). Thus, the premise here is that pre-service teachers’ identity work also includes anticipating their possible future identities as mathematics teachers: what they might become, what they would like to become and what they are afraid of becoming as teachers of mathematics (cf. Hamman et al., 2010; Markus & Nurius, 1986). Sfard and Prusak’s (2005) concept of designated identity has offered some useful notions; notwithstanding, the concept of possible selves proposed by Markus and Nurius (1986) offers a greater possibility of examining pre-service teachers’ future anticipations more broadly. I therefore concur with Hamman et al. (2010) that the advantage of considering teacher identity in terms of possible selves is concerned with the developmental and contextual questions surrounding identity development. Possible selves theory (Markus & Nurius, 1986) has been applied in educational research (Hamman et al., 2010) as well as in the mathematics education context to examine the possible selves of upper secondary school students or higher education students in general (Hauk, 2005; Lips, 2004). However, my examination of the research literature revealed that pre-service elementary teachers’ possible selves in the mathematics education context have not been examined. Moreover, much of the studies applied a quantitative methodology; however, in this study, I explore narrated possible selves (see Whitty, 2002).

The notions on possible selves are useful in this study because they do not only intersect the concepts of self and identity, they also intersect those of reflection and narration. It has been suggested that one’s narrated possible selves
are a rich source of identity information (Markus, 2006; Whitty, 2002) and that one can reflect upon her/his possible selves (cf. Hamman et al., 2010; Markus & Nurius, 1986). Examining pre-service teachers’ possible selves provides information about their identity in the present, includes information about their identity in the future and might display their development (cf. Markus, 2006). I thus see possible selves as relevant to understanding pre-service teachers’ mathematical identity work. Because possible selves are created within an individual’s social and cultural context, they are also likely to be derived from what is valued or perceived as valuable within these contexts (Hamman et al., 2010). The latter seems particularly useful in considering pre-service teachers’ mathematical identity work in different educational contexts.

### 3.4.3 Mathematical identity work and teacher change

Teacher education is a setting where pre-service teachers’ can form and become aware of their identities (Beauchamp & Thomas, 2009; Kaasila & Lauriala, 2010, 2012) as well as one in which they can engage in identity work (Lutovac & Kaasila, 2011). Over the decades, teacher change research in the mathematics education context has shown the importance of addressing pre-service teachers’ misconceptions, deeply rooted contradictory beliefs, negative views of mathematics as well as negative emotions and math anxiety (see Chapter 3.3.2). However, some teacher education programmes do very little to address this. Much has been discussed in the mathematics education context regarding the kind of learning is needed for change to occur (Gellert, 2000; Kaasila et al., 2008a; Liljedahl et al., 2007; Liljedahl, 2005, 2011; Rolka et al., 2007). I argue here that teacher change process, particularly in the mathematics education context, is related to mathematical identity work (see also Chronaki, 2013), which may promote change. In line with the earlier-discussed narrative perspective (see Chapter 2), narrating or doing identity work is a meaning-making activity and may alter how pre-service teachers evaluate their memories of school-time mathematical experiences, which may thus alter their mathematical identity (cf. Josselson, 2009).

It has been suggested that one way of dealing with the challenges that pre-service elementary teachers face in mathematics is by addressing their past mathematical experiences (Kaasila et al., 2008a; Swars et al., 2006; Wilson, 2009). Such efforts have been shown to be partially successful (e.g. Kaasila, 2006; Kaasila et al., 2008a; Liljedahl, 2005, 2011; Vinson, 2001). It is therefore
important to encourage pre-service teachers to reflect on their existing beliefs and other affective structures. In this regard, not only has reflection become an important topic, mathematics education research has also considered it as a useful tool for promoting change (Chapman, 2008a; Kaasila & Lauriala, 2012; Kaasila et al., 2008a; Wilson, 2009). As such, both retrospective and anticipatory reflection offer opportunities for pre-service teachers to become aware not only of their hindering beliefs and emotions but also of their mathematical identity, thus helping them build a more positive future identity as teachers of mathematics.

Reflection during teacher education has often been actualised through narratives, for example, through mathematical autobiographies (Ellsworth & Buss, 2000; Hauk, 2005; Kaasila, 2007a, 2007b; Lutovac & Kaasila, 2010; Sliva & Roddick, 2001). Here, I emphasise the importance of narratives as a way of reflecting on and handling pre-service teachers’ experiences of learning and teaching mathematics (see Kaasila, 2006; Kaasila et al., 2006; Kaasila et al., 2008a). Similarly, Hannula, Kaasila, Liljedahl and Rösken’s (2007b) investigation of therapeutic approaches to mathematics education found that narrative rehabilitation (cf. Hänninen & Valkonen, 1998), bibliotherapy (Lenkowsky, 1987; see also Hebert & Furner, 1997; Wilson, 2009; Wilson & Thorton, 2008), reflective writing and drawing schematic pictures (Pietilä, 2002) can be used as pedagogical tools to reduce pre-service teachers’ mathematics anxiety. Narrative rehabilitation is understood as telling and sharing stories about school-time memories in order to strengthen a person’s identity (Hänninen & Valkonen, 1998). Bibliotherapy is the use of reading for promoting affective change (Lenkowsky, 1987).

Reflective writing is often linked to a teaching portfolio comprised of reflections on mathematics lessons. Flores and Brittain (2003, p. 112) describe the use of writing ‘as a tool to help pre-service teachers reflect on their growth as they learn to teach mathematics’. Kaasila and Lauriala (2012) demonstrate how pre-service teachers’ portfolios in the context of mathematics education can promote the multi-contextuality of reflection. Their findings suggest that the nature of pre-service teachers’ reflection is dynamic. Moreover, Pietilä (2002) maintains that by drawing schematic pictures, students draw mind maps of their views of mathematics and can reflect upon them in groups (see also Kaasila et al., 2008a).

Furthermore, teaching practice has been considered as a setting that (re)shapes pre-service teachers’ mathematical identities (e.g. Kaasila & Lauriala, 2010). Teaching practice gives pre-service teachers the opportunities to question
their beliefs of mathematics, its teaching and learning, which they developed during their school years (Wilson, 2009). Di Martino and Sabena (2011) assert that despite feelings of anxiety, many pre-service teachers have experienced mathematics teaching positively (see also Gellert, 2000), which has altered not only their emotions but has also given them the confidence to be able to face mathematics teaching later (Lutovac & Kaasila, 2011). In addition, teaching practice has been shown as a setting where pre-service teachers can create new visions of what mathematics learning and teaching should be (Kaasila & Laurila, 2010).

Additionally, many pre-service teachers have been shown to have insufficient subject-matter knowledge in mathematics (e.g. Ball, 1990; Rech et al., 1993; Vinson, 2001). Many pre-service teachers are aware of this and prefer to teach lower-level classes where they feel more competent in terms of their knowledge (Wilson, 2009). In order to obtain improvements in this area, the research literature reports on ways to deepen pre-service teachers’ mathematical knowledge. Hands-on material or manipulative models have been seen as useful tools to improve the mathematical understanding of elementary teachers as well as to alter their views of mathematics (Gellert, 2000; Kaasila et al., 2008a; Phelps, 2010; Pietilä, 2002), including math anxiety (Vinson, 2001). Pietila (2002) showed that through the use of manipulatives, pre-service teachers get an opportunity to really understand the subject (see also Namukasa, Gadanidis, & Cordy, 2009). Liljedahl (2005) has advanced an approach which challenges students with mathematical problem-solving, thereby equipping them with opportunities for discovery and aha! experiences. During their courses in mathematics, students also write reflective journals, including their problem-solving strategies (see also Liljedahl et al., 2007).

In focusing on deepening pre-service teachers’ knowledge, the underlying notions in these approaches entail efforts aimed at providing them with positive mathematics-related experiences (Hannula et al., 2007b). Moreover, a conscious effort is made to keep the learning environment safe (Pietilä, 2002). In all, the various approaches considered in this chapter might facilitate identity work. They have the potential to change pre-service teachers’ mathematical identity by altering the meaning of their earlier experiences. Moreover, I build on the idea that by telling narratives (i.e. engaging in identity work), pre-service teachers can create new possibilities for their mathematical identities (cf. Markus & Nurius, 1986; Ricoeur, 1991b, 1992; Sfard & Prusak, 2005).
In sum, pre-service teachers’ mathematical identity and mathematical identity work are here understood through Ricoeur’s concept of narrative identity. Further, I approach mathematical identity work through past and future orientations. Past orientation involves recalling school-time experiences with mathematics; it is informed by the research on retrospective reflection, the constructs of affect in mathematics education as well as notions on belief or teacher change. Future orientation, on the other hand, involves anticipating future mathematics teaching; it is informed by the research on anticipatory reflection and possible selves. I acknowledge that identity work involves an interaction between past, present and future temporal aspects.

3.5 Focus of the study and research questions

This study explores mathematical identity work by drawing on the cases of Finnish and Slovenian pre-service elementary teachers. Importantly, all the cases reported having had negative experiences with mathematics during their years at school. In an attempt to gain an in-depth view of their mathematical identity work, it is important to understand their recollections of their past experiences in relation to mathematics as well as their future anticipations of teaching mathematics. This special interest thus focuses on understanding the role that educational settings play in pre-service teachers’ mathematical identity work. Due to the challenging experiences that pre-service teachers faced during their school years, knowledge about how to facilitate their mathematical identity work is fundamental. I therefore pose the following research questions:

1. Based on pre-service teachers’ memories of their negative experiences of learning mathematics, in what kind of mathematical identity work do they engage?
2. Based on pre-service teachers’ future anticipations of teaching mathematics, in what kind of mathematical identity work do they engage?
3. How is pre-service teachers’ mathematical identity work reflective of the mathematics and teacher education contexts they belong to?
4. How could identity work in mathematics education research be conceptualised?
4 Study Context

Contextual factors are considered to be of great importance to identity work; however, they have been poorly examined in existing research (Beauchamp & Thomas, 2009; Beijaard et al., 2004). I build here on Hamman et al. (2010) with the view that taking contextual factors into account may shed light on pre-service teachers’ identity work. The premise here is that knowing enough about how contexts influence pre-service teachers’ mathematical identity work may help teacher education programmes incorporate this knowledge into teacher training (cf. Beauchamp & Thomas, 2009). In my study, I consider pre-service teachers from two different elementary teacher education contexts, Finnish and Slovenian. Therefore, the focus will be on whether contextual factors influence their mathematical identities and identity work; what these are and the way in which they influence pre-service teachers’ mathematical identity work.

In this chapter, I consider the Finnish and Slovenian contexts by describing both educational systems, outlining mathematics in basic and upper secondary schools, and finally, I describe the main characteristics of elementary teacher education in both contexts. I focus on teacher education at the University of Lapland and the University of Maribor and these universities’ mathematics education courses in which the pre-service teachers in this study participated. Finally, I summarise my observations of the two contexts by highlighting some similarities and differences.

4.1 The Finnish context

Finland is a Northern European country of five million inhabitants and borders on Sweden, Norway, Russia and Estonia to the south across the Gulf of Finland. Historically, the Finnish territory belonged to Sweden. As a result of the

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1 In this chapter, I used various sources to describe the Finnish and Slovenian education contexts. Much of the information was obtained first hand as I am an insider in both contexts. General information about both contexts was obtained through various on-line sources, such as Eurydice and Eurypedia—the European Encyclopedia on Educational Systems and web pages of educational institutions in both countries, such as the Ministry of Education and Culture, Finland (Opetus- ja Kulttuuriministeriö), the Finnish National Board of Education (Opetushallitus), the Ministry of Education, Science and Sport, Slovenia (Ministrstvo za izobraževanje, znanost in šport) and the National Education Institute of the Republic of Slovenia (Zavod republike Slovenije za šolstvo). Much of the information was obtained from the web pages of Finnish (University of Lapland and others) and Slovenian universities (University of Maribor and others). These sources provide general information and are therefore not always cited in the text.
Napoleonic Wars, Finland was an autonomous Grand Duchy of Russia for one hundred years and declared independence in 1917. The majority of Finns are members of the Evangelical Lutheran Church of Finland, and a small minority of people belong to the Finnish Orthodox Church, both of which are national churches of Finland. Both have special roles, such as in state ceremonies and schools. Finland has been a member of the European Union since 1995 but does not belong to NATO.

In the context of education, Finland had gained much international popularity with the success of the 15-year-old Finnish pupils in the PISA (Programme for International Student Assessment) studies during the last decade. Consequently, questions regarding the main factors behind the Finnish success have often been raised, with the resulting rise in ‘educational tourism’ (Langfeldt & Trautmann, 2009, p. 734) and a surge in publications on the Finnish educational system.

Learning and education have always been considered an important resource for Finland (Simola, 2005). The Finnish society’s attitude towards education is thus highly positive (Niemi & Jakku-Sihvonen, 2006). Moreover, the entire Finnish education system is free of charge, as the central aim is equal opportunities for all (Sahlberg, 2010). In addition, Finland has ‘a strong top group of high-achieving pupils in basic school and only a small group of pupils not reaching the minimum standards’ (Langfeldt & Trautmann, 2009, p. 734). The high achievements of Finnish pupils are evident in PISA studies; Darling-Hammond and Rothman (2011, p. 1) exemplify this as ‘they are among the highest-performing in international tests of student achievement, and their results are among the most equitable in the world’. This means that the gap between the lowest-performing and the highest-performing students in Finland is much smaller in comparison to some other countries. The fact that the number of students with immigrant background is small also contributes to the more equitable results. As stated by Langfeldt and Trautmann (2009), unlike for many other countries, for the Finns, the educational system is a source of pride rather than worry. In TIMSS 2011 (The Trends in International Mathematics and Science Study), Finnish fourth and eighth grade pupils attained eighth place in the assessment of math knowledge. Recently, ‘the Survey of Adult Skills (PIAAC 2012) – the study on the level and use of basic skills of the adult population in 24 countries – showed that the Finnish adult population scored very well’ (FNBE, 2013). The survey assessed literacy and numeracy skills and the ability to solve problems in technology-rich environments among 16 to 65-year olds. Finland came second to Japan.
Education in Finland is the responsibility of the Ministry of Education and Culture. Educational aims, content and methods for basic, upper secondary and adult education are developed in cooperation between the ministry and the Finnish National Board of Education (Eurypedia-FI, 2014). Finland has a very extensive local autonomy in education; thus, municipalities provide most of the pre-school, basic and upper secondary education (Sahlberg, 2010). This results in schools having a greater level of autonomy, such as in designing their own curricula. One example of the autonomy of local schools is also in the fact that evaluation is carried out independently from the education ministry and that Finns do not have inspectorates (Langfeldt & Trautmann, 2009). Finally, Finnish higher education is autonomous but funded by the state.

4.1.1 The structure of the Finnish education system

Pre-primary education in Finland is voluntary; however, most children do attend it. Basic education has a nine-year duration and is compulsory for all children between the ages of seven and sixteen. It is provided by comprehensive schools (Finnish: peruskoulu Swedish: grundskola) incorporating primary and lower secondary level education (MEC-BE, n.d.). The objective of basic education is to support pupils’ growth towards a humane and ethically responsible membership of society and to provide them with the knowledge and skills they will need in life (Basic Education Act, 1998; FNBE-BE, n.d.). Further, its aim is to develop children’s willingness to continually develop themselves (Basic Education Act, 1998). Basic education in Finland is organised as class instruction in grades one-six and as subject-specific instruction in grades seven-nine. In grades one-six, pupils are mainly taught by one class teacher, and in grades seven-nine, they are taught by specialised subject teachers. In grades seven-nine, one teacher is assigned the overall responsibility of one of the classes. The number of weekly lessons varies between 19 and 30, depending on the grade and subject choices of the pupils (Eurypedia-FI, 2013a). Remedial teaching is also available. Basic schools are required to write their own school curriculum within the frame set by the national curriculum (FNBE-BE, n.d.; Eurypedia-FI, 2013a). Langfeldt and Trautmann (2009) assert that this is unique even in the Nordic context.

Upper secondary education for students between the ages of 16 and 19 is provided by general and vocational upper secondary schools. About half of this age group chooses the general upper secondary school, and the other half enrolls in vocational schools (Niemi & Jakku-Sihvonen, 2006). The curriculum of the
general upper secondary schools extends over three years, but it can be accomplished in longer or shorter timeframes. General upper secondary education in Finland has mainly course-based organisation. Hence, pupils may proceed with their studies either as a group or individually (MEC-US, 2014). Pupils have to pass a minimum of 75 courses before matriculation (Eurypedia-FI, 2013b, 2013c). One third of all courses are optional. The national matriculation examination consists of exams in the mother tongue (Finnish/Swedish/Sami), the second national language (Finnish/Swedish), the first foreign language, mathematics, humanistic sciences and science studies (Education in Finland, 2012). Pupils must pass four of the exams in order to obtain the matriculation certificate, which further provides eligibility for university and higher vocational education (Niemi & Jakkusihvonen, 2006). Almost 60% of graduates do not advance to further studies in the year of graduation; however, many continue their studies one year or a couple of years after graduation (Eurypedia-FI, 2013b).

Higher education in Finland is provided by universities and polytechnics. The latter are vocationally-oriented higher education institutions. Both universities and polytechnics grant bachelor’s and master’s degrees (Eurypedia-FI, 2013d). Equal access to higher education is ensured especially by free education, student financial aid and flexible pathways to higher education (FNBE-HE, n.d.). Higher education institutions decide on student intake and select their own students. They also draw up their own curricula and design instruction within the framework of national statutes (Eurypedia-FI, 2013d). Finally, adult education is arranged at all levels of the education system (Eurypedia-FI, 2012). It may lead to qualifications or may be related to general self-development.

4.1.2 Mathematics education in the basic and upper secondary school contexts

Compared to many other countries, Finnish basic schools devote a small number of lessons to mathematics. In fact, a total of 22 mathematics lessons are allocated to grades one-six; for grades seven-nine, there is a total of nine, the lowest in Europe (Lampiselkä, Meri, Ahtee, Eloranta, & Pehkonen, 2007). Generally, in basic school, mathematics is taught in three to four weekly lessons of 45 minutes (Pehkonen, 2009). In the core curriculum (FNBE, 2004), the subject matter to be taught in different grades is grouped into different categories: numbers and calculations, algebra, geometry, measurement, data processing and statistics in
grades one-two; probability is added in grades three-five; thinking skills and functions are added in grades six-nine. Further, objectives and core contents are decided in these various categories. The criteria for good skills in mathematics at the end of the comprehensive school are explained in general terms in the syllabus (FNBE, 2004). However, as Lampiselkä et al. (2007) note, problem solving, exploration, discussions about mathematics and dealing with problems arising from everyday life, are promoted in Finnish basic schools. Further, the premise is that students should have plenty of time for learning. Generally, it is important that students are able to apply what they learn in situations that are familiar to them (Pehkonen, 2009).

At the beginning of upper secondary education in Finland, pupils can choose whether to pursue the basic or advanced syllabus in mathematics (Pehkonen, 2009). The role of instruction in both syllabi differs. In the basic mathematics syllabus, instruction provides students with the capabilities to acquire, process and understand mathematical information and to use mathematics in different situations in life and in further studies (FNBE, 2003). In the advanced syllabus, instruction provides students with the capabilities required for vocational studies and higher education; students are given opportunities to learn to understand the nature of mathematical knowledge, the significance of mathematics for the development of society as well as its applications in everyday life, science and technology (FNBE, 2003). There are different courses offered to complete each syllabus. To complete the basic syllabus in mathematics, 228 lesson hours (6 compulsory courses) are needed, and 380 lesson hours (10 compulsory courses) are needed to complete the advanced syllabus (Eurypedia-FI, 2013b). The grade for the overall mathematics syllabus is determined as the average grade of the individual mathematics courses. Mathematics is not compulsory in the matriculation examination; therefore, students can choose whether to take the mathematics test. About 25% of all students do not take mathematics test (Paasonen, 2004).

The compulsory courses of the basic mathematics syllabus are: expressions and equations, geometry, mathematical models 1, mathematical models 2, mathematical analysis and statistics and probability (FNBE, 2003). These courses feature contents, such as second degree polynomial equations, geometry at a more elementary level than the long syllabus, exponential and linear modelling, differentiation of polynomials with applications and arithmetic and geometric sums (Paasonen, 2004). The two specialisation courses proposed are commercial mathematics and mathematical models 3 (FNBE, 2003). They deal with
mathematics for economics, vectors and trigonometry (Paasonen, 2004). The compulsory courses of the advanced mathematics syllabus are functions and equations, polynomial functions, geometry, analytical geometry, vectors, probability and statistics, the derivative, radical and logarithmic functions, trigonometric functions and number sequences and integral calculus (FNBE, 2003). The specialisation courses, which are taken by most students, are number theory and logic, numerical and algebraic methods and advanced differential and integral calculus (Paasonen, 2004). Schools also provide applied courses in mathematics.

4.1.3 The elementary teacher education context

The teaching profession is highly valued in Finland. Teachers are respected and trusted, hold of a high status in the society and are highly autonomous in their work (Darling-Hammond & Rothman, 2011; Sahlberg, 2010). ‘Teachers’ work is compared to that of medical doctors’ which is rarely observed in other countries (Darling-Hammond & Rothman, 2011, p. 6). According to the culture of trust, there are no school inspectors in the Finnish education system, no approval procedure for learning materials or national assessment system (Lutovac & Kaasila, 2009; Sahlberg, 2010). Teachers develop their own assessments of student learning based on the national curriculum. Darling-Hammond and Rothman (2011, p. 6) assert that ‘the country has signalled that teachers are professionals who can make sound judgments about student progress’. Therefore, teachers are truly responsible for pupils’ learning. Sahlberg (2010, p. 2) opines that the reasons why young people become teachers in Finland are particularly a ‘high social prestige, professional autonomy in schools and the ethos of teaching as a service to society and the public good’.

Research-based teacher education

Most Finnish universities with teacher education departments apply research-based teacher education2 (Kansanen, 2011; Jakku-Sihvonen & Niemi, 2006; Toom et al., 2010). Research-based teacher education has also been pinpointed by

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2 This and the following sub-sections draw heavily on my recent publication (Kaasila, Lutovac, & Lauriala, 2014) describing characteristics of Finnish teacher education, particularly teacher education at University of Lapland.
the Finnish educational and research community as one of the possible factors behind the Finnish PISA success (e.g. Jakku-Sihvonen & Niemi, 2006; Kaasila, Lutovac, & Lauriala, 2014; Laine & Kaasila, 2007; Sahlberg, 2010). Since the end of the 1970s, Finland has a master’s level teacher education programmes. At the beginning of the 1990s, teacher education units linked research studies to teacher education curricula to a greater extent than before (Kaasila et al., 2014; e.g. Toom et al., 2010).

The goal of research-based teacher education is to promote pre-service teachers’ reflective thinking by connecting theory and practice (Kansanen, 2011; Lauriala, 2013). This connection is essential in order to facilitate pre-service teachers’ identity formation processes (Kaasila et al., 2014). The objective of the Finnish elementary teacher education programme is to educate ‘innovative, reflective and collaboration-oriented teachers who can combine knowledge of educational science with knowledge of subject pedagogy, e.g. mathematical pedagogy’ (Lutovac & Kaasila, 2009, p. 415; see also Niemi & Jakku-Sihvonen, 2006). That said, and combined with the full responsibility that teachers have for pupils’ learning, research-based teacher education is of major importance (e.g. Jakku-Sihvonen & Niemi, 2006; see also Pehkonen et al., 2007).

The teacher education programme at the University of Lapland guides pre-service teachers in becoming aware of their professional identity from the very beginning of their studies (Lauriala, 2013). Pre-service teachers reflect on their identities in teaching situations (Kaasila et al., 2014). They become familiar with ethnography, phenomenology/phenomenography, action research and narrative research approaches during their studies (Lauriala, 2013). Lauriala further maintains that pre-service teachers also learn various tools that are essential for their future work: student interviews, participant observation techniques, reflecting on their own experiences, etc. Moreover, pre-service teachers reflect on their experiences by writing portfolios during and after each teaching practice. In each practicum phase, the focus of their inquiry varies, and they collect data and analyse the particular aspects of children’s life and learning and their own actions in response to the said children’s experiences (Kaasila et al., 2014; Lauriala, 2013).

Admission procedure

The elementary teacher education programme is consistently one of the most popular university level programmes among Finnish upper secondary school
students (Sahlberg, 2010). Among thousands of applicants, only 10–15% of all are accepted to teacher education programmes (Darling-Hammond & Rothman, 2011; Niemi & Jakku-Sihvonen, 2006). One policy of the teacher education programmes is to enroll the best students, which is why applicants undergo rigorous entrance examinations (Sahlberg, 2010). Successful applicants must have ‘good scores and excellent interpersonal skills but also a deep personal commitment to teach and work in schools’ (Sahlberg, 2011, p. 14).

The admissions procedure consists of two steps. In the first step, applicants complete a written exam on an assigned book on pedagogy – a collection of articles (Sahlberg, 2011). The book is published prior to the exam. Based on the score on the exam, candidates are invited to the second stage of examinations. The second step varies among teacher education departments throughout Finland. Here, I describe the procedure at the University of Lapland (Admission procedure, 2014; see also Kaasila et al., 2008b). The number of candidates at this stage is usually three times greater than available places. Applicants engage in an observed group activity where their interaction and communication skills are evaluated (Kaasila et al., 2008b; Laine & Kaasila, 2007; Sahlberg, 2010). They are also interviewed. In this step, their upper secondary school records are also taken into account. The chosen pre-service teachers are therefore highly motivated about their future profession.

Teaching practice

Teaching practice can vary in different Finnish universities, but the structure is more or less uniform: pre-service teachers take part in basic practice, advanced practice, field practice and final practice (Kaasila et al., 2014). The number of credits in teaching practice is usually 20–27 ECTS (see also Jakku-Sihvonen & Niemi, 2006). Teaching practice in Finland, unlike in many other countries, mainly takes place in teacher training schools. These are ‘experimental-developmental schools, which are in sustained interaction with teacher education departments’ (Kaasila et al., 2014, p. 31). In training schools, pre-service teachers practice and test innovative pedagogical ideas in a safe environment. Additionally, training schools ‘have higher professional staff requirements, and supervising teachers have to prove that they are competent to work with pre-service teachers’ (Sahlberg, 2010, p. 5). Pre-service teachers and teacher educators can also conduct their studies in these settings (Kaasila et al., 2014). The field practicum, however, is usually arranged in local municipal schools. The university courses in
general pedagogy and subject pedagogies (e.g. mathematics education) at the University of Lapland were directly connected to the practicum at the time that the Finnish cases were undergoing their studies.

Mathematics education courses

According to Finnish teacher educators and researchers, the content of mathematics education courses in the teacher education programmes are closer to future teachers’ needs (see Pehkonen et al., 2007). The emphasis in the mathematics education of future elementary teachers is on their professional knowledge, their personal beliefs and experiences (Laine & Kaasila, 2007). Generally, teacher education programmes tend to face challenges in trying to address pre-service teachers’ views of mathematics (Kaasila et al., 2008a), including challenges regarding mathematical understanding (e.g. Kaasila et al., 2010; Merenluoto & Pehkonen, 2002). Teacher change is therefore high on the agenda not only in the Finnish mathematics education research tradition but also in mathematics education courses. The number of credits in mathematics education courses is usually only about two-three percent of the total elementary education programme (Laine & Kaasila, 2007). Moreover, the organisation of the courses and the contents vary in different universities. Some faculties offer separate mathematics and mathematics education courses, and others combine them. Kaasila et al. (2014, p. 34) maintain that ‘on average, less than 10% of elementary pre-service teachers choose courses of 25 ECTS credits and even fewer of 60 ECTS credits’ (see also Laine & Kaasila, 2007). However, according to the Finnish National Board of Education (FNBE, 2012), more and more pre-service teachers choose mathematics as their subject of specialisation.

Due to the fact that Finnish pre-service teachers who participated in this study underwent teacher education at the University of Lapland, I describe the compulsory contents of the mathematics education courses3 for all students in the department. Additionally, the data was collected in 2009; therefore, I describe the course as it was conducted for pre-service teachers in that year. First, pre-service teachers with a ‘weak’ mathematical background had the possibility to take a mathematics course consisting of 16 lessons in the first year of their studies.

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3 Most of the information in this section was obtained from the web pages of Faculty of Education at University of Lapland (http://www.ulapland.fi/Suomeksi/Yksikot/Kasvatustieteiden-tiedekunta) or first hand.
Second, all pre-service teachers had taken the course *Development of Mathematical Thinking*, which included 22 lessons and amounted to two credits. The course contents focused on improving pre-service teachers’ mathematical proficiency in the domain of rational numbers (fractions, decimal fractions and percentages) and measurement. Third, the course *Development of the View of Mathematics* was arranged in the second year of study. It included 34 lessons and amounted to three credits. Based on the previously discussed issues, such as anxiety, low self-confidence and teacher-centred beliefs, the central aim of the course was to develop pre-service teachers’ views of mathematics (cf. Kaasila et al., 2008a) and, in a wider sense, to promote and support their identity development. The goals of the course highlight an affective dimension, and a safe learning atmosphere.

The principles of research-based teacher education were also applied in the mathematics education course (Kaasila et al., 2014; Laine & Kaasila, 2007). The main contents of the course were connected to recent international research and the strong Finnish research tradition of studying beliefs, views of mathematics, mathematical identity and mathematical understanding (see Hannula, 2007; Kaasila et al., 2008a, 2012; Pehkonen & Hannula, 2004). The course contents focus on pre-service teachers’ mathematical biographies whereby teachers discuss and learn about positive and negative emotions towards mathematics as well as about their own school-time experiences. Students are also introduced to different forms of constructivist learning theories and their use in mathematics education; mathematical understanding; the relationships between mathematical contents; the relationships between the different representations of mathematical concepts; problem-based teaching in mathematics and exploring mathematical contents with concrete materials or manipulatives (e.g. Kaasila et al., 2008a). Like in other Finnish teacher education departments, the main contents in the mathematics education course at the University of Lapland are the number concept and the place-value system, operations, geometry, measurements, statistics and mathematical concepts in everyday life. Further, student collaboration is emphasised in a way that pre-service teachers can work in groups in order to be able to think together about the contents learnt.

In all, various tools are used during the mathematics education course that enable pre-service teachers to a) handle their school-time memories by sharing their experiences with others in smaller groups (narrative rehabilitation; Lutovac & Kaasila, 2011); b) write their mathematical autobiography and identify with one of the six cases of Kaasila’s (2000) dissertation (bibliotherapy; Lutovac &
Kaasila, 2011); c) reflect on two self-chosen scientific articles from the required course reading and d) mathematics tutors help pre-service teachers who have challenges in mathematics.

Furthermore, at the time that pre-service teachers’ were undergoing their studies, there was a strong link between the mathematics education course and teaching practice (Kaasila et al., 2014). This means that during their second year, immediately after the mathematics education course, the pre-service teachers taught the Subject Didactic Practicum 2 (SD 2) in training school (see also Lutovac & Kaasila, 2011). During their practicum, they also further developed the pedagogical content knowledge they acquired. The goal of the SD 2 was to familiarise pre-service teachers with planning and teaching mathematics lessons and with evaluating pupils’ development in mathematics. The connection between the course and the practice gave them opportunities to develop a personal practical theory of the mathematics teaching process (Kaasila et al., 2014). The pre-service teachers in this study taught up to five lessons in mathematics. They were guided by university lecturers specialising in the subject pedagogy and by a supervisory class teacher in the training school. Emphasis was also placed on collaboration (Kaasila & Lauriala, 2010). Finally, the bridge between the course and the practice enables the materialisation of research-based teacher education. During the teaching practice, the pre-service teachers analysed their and others’ teaching. Students reported in their portfolios also on the manner in which they related their experiences in teaching practice with theoretical knowledge.

4.2 The Slovenian context

Slovenia is a country in south Central Europe with two million inhabitants. It borders on Italy, Austria, Hungary and Croatia. Historically, Slovenia was part of Austria (Austria-Hungary) and after the First World War part of Yugoslavia. Slovenia is traditionally a Roman Catholic country, with a small traditional Lutheran minority. Slovenia declared independence in 1991 and joined the European Union and NATO in 2004.

The Slovenian educational system does not seem to stand out neither for being particularly successful nor for its failures. Moreover, national publications display a tendency to describe the system from the viewpoint of policy and statistics rather than dealing with particular educational issues in an in-depth manner. These issues will therefore be reflected in this chapter.
Education at all levels in Slovenia is in the domain of the Ministry of Education, Science, Culture and Sport. The government thus plays several roles: it is the regulator, the founder, the main finance contributor and the supervisor (Eurypedia-SI, 2014b). The education system has a strong tradition of free public schooling, including higher education. Public schools are secular. The freedom of choice in education is stipulated by the constitution as well as the autonomy of higher education institutions (Eurypedia-SI, 2014b). The government has to approve the curricula for the entire school system. Accordingly, Šorgo (2010, p. 197) asserts that this allows for ‘only limited autonomy to individual schools and teachers in choosing elective content and subjects’; however, teachers can choose their teaching methods.

Over the past decade, the main priorities in Slovenia have been to improve the population’s educational achievements and create equal educational opportunities for all (Barle-Lakota & Gajgar, 2008; Eurypedia-SI, 2014b). In 2010, 70.4% of youth aged 15–24 participated in formal education, which was considerably above the then EU average (60.1%); Finland with a 69.9% share was right after Slovenia (Education in Slovenia, 2012). Similarly, entry rates into higher education in Slovenia are the highest among EU members (Barle-Lakota & Gajgar, 2008). In the year 2010/2011, almost half of all young people aged 19–24 enrolled in higher education (Education in Slovenia, 2012). The latter reflects wide access to higher education (Eris, 2011). A report by Eris (2011) shows that the Slovenian education system also fares well by international comparison. Slovenia has one of the highest shares (almost 90%) of the population aged 25–64 to have completed at least upper secondary education (Eris, 2011; see also Barle-Lakota & Gajgar, 2008). According to OECD data in 2010, the upper secondary graduation rate in Slovenia was ranked the highest while second place was taken by Finland (OECD, 2013).

Additionally, a report by Eris (2011, p. 5) shows that ‘Slovenian pupils achieve relatively high scores in international achievement tests’ such as PISA and ‘compare favourably against their peers’ in TIMSS. It also appears that the TIMSS scores and other assessments, particularly in science and mathematics, have improved substantially. The main problem asserted in the report, however, is the equitability of the results. Achievement seems to be strongly influenced by the socio-economic background of pupils (Eris, 2011). In this sense, pupils with an immigrant background (10% of the pupils in the relevant age cohort) ‘perform significantly worse than native students, even after accounting for the socio-economic status of parents’ (Eris, 2011, p. 7). The report also confirms a large gap
in the share of top performers between the two groups. In addition, TIMSS results confirmed that at least 70% of fourth-grade pupils in Slovenia had very positive attitudes towards mathematics, however, eighth-grade pupils had the least positive attitudes towards mathematics among participating EU countries (more than 50% were negative towards mathematics) (Mullis et al., 2008).

4.2.1 The structure of the Slovenian education system

Pre-school education in Slovenia is optional and can be attended by children over one year of age up to enrolment into basic school.

Basic education (osnovna šola) in Slovenia overlaps with compulsory education and consists of primary and lower secondary education. It is attended by pupils aged six to 15 years and goes on for nine years (NEIRS-BE, 2014). The implementation of the nine-year basic school began in the school year 1999/2000, and since 2003/2004, all schools have been running the nine-year programme (Valenčič-Zuljan, Cotič, Fošnarič, Peklaj, & Vogrinc, 2011). Prior to that, compulsory basic education ran for eight years. Basic education is provided by public and private schools; however, less than one percent of pupils are enrolled in private schools (Eurypedia-SI, 2014c). The main basic education objectives include, among others, enabling pupils to acquire knowledge and skills in accordance with their abilities and interests; supporting personal development and developing the ability for life-long learning and further education (Elementary School Act, 2006; NEIRS-BE, 2014). Basic schools also provide morning and after-school care for younger pupils (Eurypedia-SI, 2014d).

Basic school comprises three three-year cycles. In the first cycle from one–three, children are taught by a general (class) teacher, who usually teaches the class for all three years. In grade one, a pre-school teacher is also present. The maximum weekly number of lessons varies between 24 and 30, depending on the grade of the pupils. At the end of the second cycle from four-six and in the third cycle from seven–nine, lessons are delivered by specialist subject teachers. (Elementary School Act, 2006) After the second cycle, pupils take non-compulsory state-wide examinations in Slovenian language, mathematics and a foreign language. At the end of basic school, pupils take external examinations. Nowadays, both sets of examinations merely provide feedback about pupils’ achievements for schools, parents and pupils (Elementary School Act, 2006; RNEES, 2008). In addition, the reformed system includes ability grouping in the second and third cycles (Štraus, 2004). Therefore, students are assigned to ability
levels based on the results of a national test at the end of the sixth grade, achievement in a particular subject in the seventh grade and based on their desires. Students can also transfer from one ability level to another (Mathematics Education in Europe, 2011; Štraus, 2004).

**Upper secondary education** goes on for two to five years. Educational programmes include vocational, professional and general (gimnazija) variants. At the time of enrolment, students are generally 15 years of age. Education is organised in a single cycle of two-to-five-years duration, depending on the type of the programme (Eurypedia-SI-organisation, n.d.). Pupils in the same class are of the same age and have to proceed in their studies as a group, unless they are to repeat the year in the same educational programme due to being unapproved for more than three subjects (Eurypedia-SI-assessment, n.d.). The curriculum differs slightly for specific types of general (gimnazija) programmes; however, they all have the basic structure of compulsory and elective components. The compulsory component comprises 81% to 93% of all hours; students may decide on the remainder (Eurypedia-SI-teaching, n.d.). Compulsory four-year subjects are usually Slovenian language, mathematics, the first foreign language, the second foreign language and physical education. In all general programmes, students learn at least two foreign languages, the first of which is the one that students began learning in basic school (NEIRS-US, 2014). Most often, it is either English or German. In the final year, students take the matura exam. The matura is a national, externally assessed examination. Pupils in general upper secondary schools have to write exams in five subjects; Slovenian language, mathematics and the first foreign language are compulsory (Matura Act, 2007). Therefore, two of the subjects are electives. Pupils in vocational upper secondary education do the vocational matura (this opens the door to higher vocational education) which consists of four subjects: Slovenian language, mathematics and two elective subjects (Matura Act, 2007; NEIRS-US, 2014).

**Higher education** includes higher vocational education and higher education study programmes. Higher vocational education is offered by colleges that provide only the first-cycle programmes; universities provide study programmes of all cycles (Eurypedia-SI, 2014a). The selection criteria in the event of limited access are determined by the individual study programmes (Higher Education Act, 2012). Applicants are chosen on the basis of their upper secondary school grades and the matura exam. In the year 2010, the so-called ‘Bologna process’, incorporated Slovenia into the unified European higher education system.
(Valenčič-Zuljan et al., 2011, p. 299). Finally, adult education in Slovenia is considerably diverse.

4.2.2 Mathematics education in the basic and upper secondary school contexts

Mathematics in Slovenian basic schools is organised as a single compulsory subject that runs throughout the nine years. In the first and second cycles, pupils have between four and five mathematics lessons per week, and in the third cycle, they have four mathematics lessons per week (Basic school curriculum, 2014). With the exception of Slovenian language, no other subject receives as many weekly hours. In total, throughout the entire basic school, this means 1318 hours (Učni načrt, 2011). According to the curriculum (Učni načrt, 2011), all mathematical content throughout basic school is divided into three topics: geometry and measurements, arithmetic and algebra and other contents. These topics are further sub-divided into smaller units, such as in grades one–three, the topic of geometry and measurement includes orientation, geometrical shapes and the use of geometry tools, transformations and measurement. This is followed in the curriculum of all grades. In the reformed basic school, students are divided according to three ability levels in mathematics (Elementary school act, 2006). In grades four–seven, a form of ability grouping is flexible. The flexibility of the differentiation means that students spend a maximum of a quarter of the time in homogenous classes where instruction is based on ability level (Štraus, 2004). Štraus (2004, p. 27) further maintains that ‘in grades eight and nine, the formal external differentiation into classes according to ability is carried out in at most three subjects, mathematics being one of the compulsory subjects for differentiation’. Moreover, Štraus explains that the learning objectives do not differ between ability levels; rather, all students learn the whole range of contents but can follow different paths that are best suited to their abilities.

There are some minor variations in how mathematics is organised in general upper secondary education (gimnazija). Usually, it is organised as a single compulsory subject that runs for four years. According to the curriculum (Učni načrt, 2008), students have four mathematics lessons per week which consists of 140 lesson hours each year; thus, 560 lesson hours are needed to complete the mathematics curriculum for general upper secondary education. The level of mathematics taught is the same for all pupils. The goals and contents in the curriculum for mathematics in the general upper secondary school are organised
according to thematic units. The thematic units are the basics of logic; sets; number sets; algebraic expressions; equations and non-equations; potency and roots; geometry in two and three dimensions; geometrical shapes and bodies; vectors in the plane and space system; rectangular coordinate plane; functions; conics; sequences and series; differential calculus; integral calculus; combinatorics; probability and statistics (Učni načrt, 2008). The curriculum also makes distinctions based on basic knowledge, advanced knowledge and elective contents. Basic knowledge is obligatory for all students, and thus, teachers must teach the contents that fall into this category. The advanced knowledge contents are additional, and therefore, teachers can decide whether to teach them on the basis of the students’ capabilities and interests. Elective contents go beyond the goals of the general upper secondary school and are meant only for individuals with a special interest in mathematics. Accordingly, the matura can be done at two levels: basic and advanced. The basic level corresponds to what is taught as obligatory mathematics content (e.g. basic knowledge) in upper secondary schools. The advanced level includes contents agreed upon by the matura committee each year (Matura Act, 2007).

In order to successfully complete each school year, Slovenian students have to pass all subjects, including mathematics. If a student is not proven to have sufficient mathematical knowledge, he/she is negatively evaluated. A student can then take a repeat exam, however, if he/she fails the repeat exam in mathematics, he/she must repeat the year in the same educational programme (Eurypedia-SI-assessment, n.d.). Therefore, the stakes to successfully complete the mathematics curriculum each year are high. As mentioned earlier, whether pupils are enrolled in vocational or general upper secondary education, mathematics is a compulsory subject in the matura (Matura Act, 2007). Mathematics teaching in upper secondary schools is greatly influenced by the matura examinations (Ivanuš-Grmek & Javornik-Krečič, 2004). As stated by Šorgo (2010, p. 197), the ‘Mathematics syllabus demonstrates expectations for students to be able to calculate/solve limits, functions, derivatives, integrals, and infinite series, to solve a variety of equations, define extremes and plot graphs, convert one trigonometric function into another, and many other tricks from the magic hat of mathematics, just to pass the matura examination’. In all, mathematics is one of the determinant subjects for entry into higher education programmes. In order to be successful at mathematics, many upper secondary students have a tutor or private teacher who instructs and helps with studying.
4.2.3 The elementary teacher education context

In 1986/1987, teacher education in Slovenia was moved from colleges to university departments (Valenčič-Zuljan et al., 2011). Since then, all teachers have been undergoing four-year university programmes with one additional year to prepare a diploma thesis (Zgaga, 2006), which is nowadays equivalent to a master’s thesis. Slovenia is a small country, and thus, the education of elementary teachers takes place across three faculties of education. Valenčič-Zuljan et al. (2011) assert that in the school year 2009/10, all the education faculties enrolled students into reformed Bologna study programmes. According to the reform, all pre-service teachers must pursue a master’s degree. The authors further argue ‘that the modernisation of study programmes relies on a change in paradigm’ (Valenčič-Zuljan et al., 2011, p. 300). Accordingly, Tancig and Devjak (2006, p. 9) maintain that this change ‘indicates a shift from a study program design that is based on contents and objectives as determined by a teacher, to output study program design that is performance and competence oriented’. The starting points for the modernisation of study programmes in the field of education were provided by the Common European Principles for Teachers’ Competences and Qualifications (Zgaga, 2006), which posit teaching as a highly qualified profession in the context of lifelong learning. Zgaga also notes that teachers’ competences, such as the ability to work with others, the ability to work with knowledge and the ability to work with and in society are thus highlighted.

There are some variations between the teacher education study programmes at the three Slovenian universities; however, they all contain components, such as the study of the subject discipline, educational sciences (e.g. pedagogy, didactics, pedagogical and developmental psychology, andragogy, pedagogical methodology, theory of education, selected topics from philosophy and the sociology of education) and pedagogical training. In the previous teacher education study programme, ‘educational sciences and pedagogical training lasted a minimum of one semester (375 to 450 hours), but they have been extended under Bologna to the equivalent of one year or 60 ECTS’ (Valenčič-Zuljan et al., 2011, p. 302). Despite all the changes to the programmes, Marentič-Požarnik and Šteh (2013) maintain that teacher education in Slovenia lacks a unifying concept. Arguably, perhaps like the research-based teacher education concept in Finnish teacher education.

After obtaining a university degree, teachers must also pass the State Teacher Certification Examination. This test consists of an oral examination that includes
a) the constitution of the Republic of Slovenia, the constitution of the European Union and its legal system and regulations specifying human and children’s rights and basic privileges, b) legislation in the area of education and c) Slovenian written language (Valence-ić-Zuljan et al., 2011, p. 310).

The Slovenian participants in this study went through the teacher education programme at the University of Maribor’s faculty of education. This was a class teacher programme prior to the reform and comprised of four study years and one additional year of work on the diploma thesis. The diploma thesis is a monograph describing individual research that students conduct on a self-chosen topic. Mostly, it involves empirical research; however, it can also be theoretical or practical or a combination of the three. The programme consists of the following number of hours: 765 hours in the first year, 750 hours in the second year, 810 hours in the third and 720 hours in the fourth years of study (Class teacher programme, 2014). Only 180 hours of the entire programme are devoted to elective subjects. During teacher education, the Slovenian pre-service teachers in question were becoming familiar with didactical principles, focusing on understanding the manner in which theoretical knowledge can be applied in practice. They learned how to plan and execute a lesson as well as how to assess and analyse it. Important emphasis was on student monitoring and the analysis of one’s own work as a future teacher, the meaning of reflection and action research. Pre-service teachers were supposed to develop interest and competence in the teaching profession. Various tools were used to reach the mentioned aims, such as problem solving, microteaching and cooperative learning. (Teacher training study programme, 2014, pp. 14–15) The pre-service teachers wrote separate portfolios related to subject-specific didactics.

Admissions procedures

As in many other countries in Europe, admission to teacher education studies in Slovenia is governed by general entrance requirements for higher education (Key Data on Teachers and School Leaders in Europe, 2013). In order to begin their studies, students must successfully complete their upper secondary schooling and matura examinations. The matura results are, in this sense, a prerequisite for entering university. Currently, elementary teacher education programmes do not have other specific selection criteria. However, when the Slovenian pre-service teachers in question enrolled to begin their studies at the University of Maribor, they were evaluated on the basis of their records from their upper secondary
school, their matura scores and additional specific selection criteria, that is, the music skills test. However, if the candidates were not successful in the music skills test, they could not begin their studies even if they were successful in the matura and the upper secondary school.

**Teaching practice**

Since the Bologna reform of the teacher education study programmes, pre-service elementary teachers have had practical training throughout all four years of study, 10 weeks total. The number of credits in teaching practice in schools is at least 15 ECTS. It is ‘carried out according to the principle of reflective practice and must allow students to integrate subject-content and pedagogical-professional knowledge through gradual introduction into teaching and the teaching profession’ (Valencič-Zuljan et al., 2011, p. 303). With the programme reform, the amount of required teaching practice in school has increased; however, as Marentič-Požarnik and Šteh (2013) point out, students still do not have sufficient teaching practice.

The Slovenian data for this study was collected in 2009 before the reforms of the programmes took place. Consequently, the pre-service teachers in this study underwent the following practical training: the first and second years of their studies did not include teaching practice. Practical training was planned hand in hand with subject didactics courses, which started in the third year of their studies, and therefore, practical training started that year (Class teacher programme, 2014). However, teaching practice was not continuous; instead, each pre-service teacher had one separate teaching experience within each of the subject didactics courses. This amounted to six teaching experiences (lessons) in the third year. In addition, the pre-service teachers taught in pairs. A similar system was applied in their last year of study; however, they conducted their lessons individually while some of their colleagues observed. Moreover, the fourth year consisted of practice for three consecutive weeks. This teaching practice took place in the field schools of the pre-service teachers’ choice. In most cases, this field school was the one they attended as pupils in their hometowns. During the practice, they observed as well as taught the subjects in the certain class. They were supervised mainly by school teachers. This teaching practice also allowed pre-service teachers to participate in all the activities occurring in the school (Valencič-Zuljan et al., 2011). During the practice, they also wrote a
pedagogical diary for every subject they taught. The diaries included lesson plans and their own reflections on the lessons.

**Mathematics education courses**

The organisation of mathematics education courses and contents might vary between faculties, however, faculties usually offer separate mathematics and mathematics education (referred to as *mathematics didactics*) courses. The number of credits for mathematics education courses within the different elementary education programmes varies from 240 to 315 lesson hours, that is, from 17 to 24 credits. In addition, pre-service teachers can take elective mathematics subjects at all teacher education departments. Elementary teacher education programmes in Slovenia do not include divisions into minor and major studies; therefore, specialising in mathematics is not possible. Hence, students have to enrol in a mathematics programme to become math teachers.

Considering the programme before the reform, the Slovenian pre-service teachers in this study took three compulsory mathematics courses over a total of 225 lesson hours (a lesson hour lasts 45 minutes), which was about seven percent of the total programme (Class teacher programme, 2014; Teacher training study programme, 2014). First, in the second year of their studies, they take the mathematics content course *Mathematics for Primary Teachers* with the objective of acquainting students with basic mathematical concepts and reasoning strategies (Teacher training study programme, 2014, p. 91). Some of the course contents included are problem solving strategies; sets, relations, functions and operations; number sets; mathematical modelling; place value; combinatorics and probability; geometry and measurement; algebra etc. (Teacher training study programme, 2014, p. 90). In the third year of study, they take the *Mathematics Didactics I* course, which aims to develop knowledge of mathematics education for the successful teaching of primary-level school mathematics (Teacher training study programme, 2014, p. 27). The course contents include perceptions of school mathematics, developing understanding in mathematics (learning theories, types of mathematical knowledge, the role of models and strategies for effective teaching), teaching through problem solving, curricular goals, contents and methodical principles in early school mathematics and communication in the

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4 Most of the information in this section was obtained from the web pages of Faculty of Education at University of Maribor (http://www.pef.um.si/) or first hand.
Finally, in the fourth year of study, pre-service teachers take the *Mathematics didactics II* course with the objective of preparing students for teaching mathematics at the primary level (Teacher training study programme, 2014, p. 29). The listed contents represent only part of the course: developing early number concepts and number sense, developing understanding of the operations (addition, subtraction, multiplication and division problem types), computational problem-solving strategies, geometric thinking and geometric concepts, algebraic reasoning etc. (Teacher training study programme, 2014, p. 28).

All three courses focus on developing subject-matter and pedagogical-content knowledge. Collaborative work is also emphasised. All courses aim to enhance students’ confidence in their own mathematical ability, knowledge and critical attitude towards school mathematics as well as students’ self-evaluation. In addition, both mathematics didactics courses are connected to teaching experience. (Teacher training study programme, 2014, pp. 26–29) Therefore, in the third year, the pre-service teachers in this study taught one mathematics lesson in tandem, and in the fourth year, they taught one lesson individually.

In the mathematics didactics courses, some of the tools used to promote pre-service teachers’ learning include: a) pre-service teachers plan and implement ‘math club’ activities, which involves teaching mathematically promising pupils during one year; b) they reflect on the assignment regarding mathematics pedagogical and content knowledge; c) they construct a strategic mathematical game and reflect on its use in the mathematics instruction; and d) they conduct an interview with a parent regarding his/her child’s mathematics education. Finally, while this study was being conducted, the writing of the mathematical autobiography was piloted in the mathematics education course (Lipovec & Antolin, 2014; Lipovec, Antolin, & Lutovac, 2010) due to the sharing and transfer of the knowledge inspired by this research. However, mathematical autobiographies were not used as a tool; they were used to obtain more information on students’ school-time experiences with mathematics. This seemed relevant, particularly because of the lack of research in this domain.

### 4.3 Summarising the contexts

Here, I provide a comparative summary of some of the contextual characteristics; however, I leave room for a discussion on other similarities and differences within the findings of the study. Despite their geographical positions, both Finland and
Slovenia were, at some point in their histories, torn between two differing cultures—East and West. Finland was between Sweden and Russia, and Slovenia found itself between the Austrian monarchy and Yugoslavia. These cultural influences can be felt in Finland and Slovenia today. While Finland became independent about 100 years ago and assumed the role of a Western country, Slovenia’s path began a little over 20 years ago. Moreover, regarding the number of habitants, both countries are considered small, with their own distinct languages and their first written words dating back to the sixteenth century. Similarities can also be found in terms of the landscape; both are among the top European countries with a share of territory covered by forests. Both Slovenians and Finns value diligence and punctuality and share passion for sports (Embassy of Finland, 2013).

Educational systems and school curricula

There are also many similarities in the educational domain. Both countries pride themselves on a free system of education, including higher education. Both have a single structure of compulsory basic education lasting nine years. However, Slovenian pupils start schooling one year earlier than their Finnish counterparts. Both educational contexts highlight foreign languages. Finnish and Slovenian language are limited to only a few million speakers and are therefore not popular for others to learn (Hytonen, Pučko, & Smyth, 2003). Both countries have a high rate of upper secondary graduation (OECD, 2013) as well as above EU average shares of youth participating in formal education (Education in Slovenia, 2012).

Regarding the curriculum, Finland seems to allow for more freedom than Slovenia (Hytonen, Pučko, & Smyth, 2003). For example, the mathematics curriculum for basic school in Finland proposes objectives, core contents and descriptions of good performance in only 10 pages. However, the Slovenian curriculum (Učni načrt, 2011) is a guide containing 86 pages of learning objectives for mathematics in grades one to nine. The objectives are given in the form of contents and processes that students are expected to master from instruction. In addition, the objectives are accompanied by didactical recommendations and concrete examples of items to guide teachers in their implementation. Cross-curricular linkages are often indicated (Štraus, 2004). Finally, the curriculum time during which students are taught mathematics in basic school helps to explain the relative importance of the subject compared to others (Mathematics Education in Europe, 2011). In this sense, the teaching time
for mathematics in Finland is 14.4% of total teaching time while in Slovenia, it is 15.5%. These proportions are similar; however, Slovenian students do spend more time learning mathematics.

Admissions procedures for teacher education and contents of studies

The status of the teaching profession in Finland and Slovenia differs. While Finnish teachers enjoy a high societal status as well as professional autonomy, Slovenian teachers seem to be viewed as passive recipients of knowledge created by others (see Barle & Bezenšek, 2006). This means that teachers are faced with implementing ‘objective’ knowledge that has been established for them by others (Lauriala, 2013). Moreover, there seems to be a link between the status of teachers in the society and admissions procedures for teacher education. Generally, in Finland, students undergo rigorous entrance examinations in order to begin their studies in teacher education programmes. At the University of Lapland, the entrance examinations include an evaluation of candidates’ knowledge, communication, collaboration skills and motivation for the profession. According to the Eurydice report, only one-third of all European countries have specific selection methods for initial teacher education (Key Data on Teachers and School Leaders in Europe, 2013); Finnish rigorous selection methods to become a teacher are thus rather the exception than the rule.

This is the case in Slovenia. Students at the University of Maribor were evaluated on the basis of their overall performance in upper secondary school and the matura examination. Additionally, the music skills of each candidate were evaluated; however, this did not give any indication of students’ motivation for the teaching profession. Every year in Finland, the number of applicants greatly exceeds the places available, thereby increasing the stakes to enter teacher education (Sahlberg, 2010). Only about 10–15% of applicants are accepted (Kaasila et al., 2008b; Sahlberg, 2011). However, even though many Slovenian students apply for elementary education studies, usually, about 50% or more applicants are accepted (Higher education admissions, n.d.).

Regarding the contents of teacher education, some aspects are similar, such as combining educational science disciplines on which specific school subjects are based, subject-specific didactics and teaching practice. However, it seems that based on the number of hours devoted to various courses, the Slovenian students received a more intensive education. Notwithstanding, the Finnish students conducted more teaching practice, which was distributed throughout their
programme. Also, when analysing the mathematics (education) courses in both programmes, differences were again found in the number of hours devoted to them as well as in the extensiveness of the contents considered. Regarding these issues, Slovenian students again underwent considerably more mathematics learning. Despite the Finnish success in PISA studies, Kaasila et al. (2010, p. 248) assert that not all Finnish pre-service elementary teachers ‘have the level of proficiency in mathematics at the beginning of their studies that will best serve their future career needs’ (see also Merenluoto & Pehkonen, 2002). The same phenomena can be observed in Slovenian pre-service teachers despite the matura examination, which also evaluates their mathematics performance. However, based on studies by Kaasila et al. (2008a) and Lipovec et al. (2010), it seems that the share of pre-service teachers with a negative view of mathematics is much higher among Slovenians than among the Finnish.

The role of research paradigms in teacher education

Lauriala (2013) has examined the meaning of research paradigms in terms of teacher education programmes. Marentič-Požarnik and Šteh (2013, p. 60) state that ‘It is the positivist ideology of technical rationality, of quality to be achieved only by curricula with well-defined measurable standards, the transmission of “objective” knowledge and external testing. And this ideology still guides the decisions of many leading experts and school policy makers in Slovenia’. Lauriala (2013) similarly discusses that the focus of such teacher education programmes is limited to modelling effective teaching and on fostering performance-based teacher education. Thus pre-service teachers’ are evaluated based on particular performances. As I will attempt to demonstrate, teacher education at the University of Maribor appears to be guided by the positivist research paradigm as a technical approach to teaching skills and methods is emphasised.

Conversely, it appears that at the University of Lapland, teacher education is guided by the interpretive paradigm, which implies giving voice to pre-service teachers and appreciating their personal experiences (Lauriala, 2013). Therefore, according to Lauriala, the entire teacher education programme is understood as a reflective process, and its guiding approach is student-teacher-as-researcher. Thus, pre-service teachers are actively involved in constructing their knowledge and their teacher identities. Furthermore, the differences in paradigms are also evident in that pre-service teachers’ autobiographical context has not been given
much attention in Slovenia; for example, narratives as a method or as an educational tool have neither been considered in mathematics education courses (see Chapman, 2008b; da Ponte, 2001; Lutovac & Kaasila, 2009, 2011; Smith, 2003, 2006) nor in research (see Lutovac & Kaasila, 2010).

The role of research methods in teacher education

Both teacher education programmes stress the input from research. In the Slovenian educational context, ‘objectivist analytical quantitative methodology was – and still is – prevalent in educational research and publications, mainly under the influence of psychology which is regarded as the measuring stick of what represents “real science”’ (Marentič-Požarnik & Šteh, 2013, p. 53). Qualitative methods are gaining popularity, however, they are still considered time-consuming and ill-equipped at generating ‘objective’ results. Particularly in mathematics education research in Slovenia, this methodology is only just starting to take shape. In the Finnish educational context, both types of research methodologies are appreciated, however, qualitative research has considerable value. The use of qualitative methodologies appears to be widespread in mathematics education research. These differences are evident in the research methodology that pre-service teachers become acquainted with during their studies. At the University of Lapland, versatile research methods are appreciated. In line with the teacher-as-a-researcher approach, qualitative methods are understood as beneficial for classroom research. Therefore, the majority of master’s theses are conducted as small-scale studies using, for example, case studies, ethnography, phenomenography or narrative research. The Slovenian pre-service teachers in this study were mainly acquainted with a quantitative methodology during their studies. Most master’s research theses at the University of Maribor employed quantitative methods. However, this has slowly begun to change.

Finally, one might question the significance of comparing pre-service teachers’ identity work in two different contexts when much of the contextual similarities and differences seem to be known. However, comparative educational research has often compared the ‘facts’ about the different contexts in a descriptive manner (cf. Crossley, 2002). For example, despite the fact that Finnish classrooms have hosted a myriad of foreign researchers, educators and policymakers and that much has been written about Finnish education, the so-called ‘Finnish miracle of PISA’ has still not been explained in a straightforward
manner. Arguably, therefore, contextual knowledge can only be truly useful if paired with empirical evidence of relevance (cf. Langfeldt & Trautmann, 2009). As such, despite the knowledge about both educational contexts in question, we do not have the knowledge about what kinds of roles these contexts play in pre-service teachers’ identity work. We might know much about the approaches and tools of teacher education programmes, and particularly mathematics education courses. In fact, we might even have a good understanding of pre-service teachers’ identities. However, we do not know how the approaches and tools used shape pre-service teachers’ identities and the identity work they engage in during teacher education and how what is being learned shapes them as future teachers. I am thus interested in what we can learn about pre-service teachers’ identity work by taking into account contextual factors and how can we facilitate their identity work and transform their negative relationships with mathematics. This knowledge should help us to better design mathematics education courses within elementary teacher education programmes.
5 Methodology

5.1 Research design

This study can be characterised as a qualitative comparative study with a narrative research design. I discuss briefly these terms in the following chapters.

5.1.1 The qualitative comparative approach

Qualitative research can be considered as ‘an umbrella term under which a variety of research methods that use languaged data are clustered’ (Polkinghorne, 2005b, p. 137). The decision to use the qualitative approach was driven by the nature of the research questions (Patton, 1990) as well as by the theoretical perspective of the study. I am interested in the depth of pre-service teachers’ experiences with mathematics and their mathematical identity work. Applying Gillham (2000), I argue that pre-service teachers’ feelings and thoughts can only be understood if we get to know their world. Consequently, a qualitative methodology has been deemed adequate for capturing the richness and fullness of an experience and for gaining adequate understanding (cf. Gillham, 2000; Polkinghorne, 2005b).

Comparative approaches within educational research are used as ‘a method of inquiry and as a frame of analysis’ (Nóvoa & Yariv-Mashal, 2003, p. 424). I position this study as comparative as it examines two entities by juxtaposing them and looking for similarities and differences between and among them. Further, the comparison is conducted between the two educational contexts, including one other than the author’s own. Like Jablonka, Andrews and Pepin (2009), I maintain that looking at practices in another educational context will provide a new perspective for looking at one’s own. Comparative studies as this one can also help to better understand the nature of the relationships being examined, such as pre-service teachers’ mathematical identity work and educational context. Such findings can assist in the development of educational practices (cf. Crossley, 2002). Comparative studies in a cross-cultural context in mathematics education can also assist with theory construction (Jablonka et al., 2009). In this study, two different contexts will assist in conceptualising mathematical identity work. However, in line with qualitative studies, I emphasise here that my aim is not to generalise my findings, in terms of representativeness, to the wider Finnish and Slovenian (teacher) education contexts; rather, I aim to provide accounts about an
experience from different perspectives (Polkinghorne, 2005b) and generalise in theoretical terms.

There is a body of comparative research in teacher education and mathematics education; however, comparative qualitative studies focusing on the issues considered here are scarce. Additionally, existing comparative studies in cross-cultural contexts in mathematics education are seldom qualitative. This study will therefore contribute not only to the body of knowledge on identity work in two different contexts but also to the cultural story collection in these contexts.

5.1.2 Narrative inquiry

Narrative inquiry is a qualitative research approach and is considered part of the interpretive turn in the social sciences (Denzin, 2001; Riessman, 1993). Narratives have been used much as a method in research on the biographical experiences (Connelly & Clandinin, 1990; Denzin, 2001). As suggested by Josselson (2009, p. 651), ‘the focus of narrative research is on the experience of life as lived (and understood) by the participants, in their own terms, rather than in a framework offered by the researcher’. Further, the underlying premise of this narrative study is that individuals make sense of themselves and their lives through storytelling (Bruner, 1991; Connelly & Clandinin, 1990; Ricoeur 1992; Riessman, 1993). The narrative approach, like that applied in this study, includes or emplotment process and a retrospective explanation (Polkinghorne, 1995). This means acknowledging that narratives can change the meaning of events after the outcome is known (Polkinghorne, 1988). Lieblich et al. (1998) maintain that the strength of the narrative inquiry is its capacity to combine storytelling with theoretical analysis.

The research literature alludes to many different ways of applying narrative inquiry (e.g. Connelly & Clandinin, 1990; Labov & Waletzky, 1967; Lieblich et al., 1998; Riessman, 1993; Polkinghorne, 1995). What seems to be in common though is a storied text (Riessman, 1993). In this study, I mainly apply narrative inquiry as suggested by Polkinghorne (1995) and Lieblich et al. (1998). According to Polkinghorne (1995), there are two constitutive parts of narrative inquiry: ‘narrative analysis’ based on narrative reasoning and ‘analysis of narratives’ based on paradigmatic reasoning. Further, when analysing narratives, one can focus on the content (e.g. experiences that are recounted) or the form (e.g. the structure of the narrative) (Elliot, 2005; Lieblich at al., 1998; Riessman,
1993). However, it is possible to focus on both aspects. Lieblich et al. (1998) distinguish the following main dimensions of narrative analysis: holistic versus categorical and content versus form (Chapter 5.3 on data analysis will describe in detail how the ideas of these authors have been applied).

Narrative studies on teacher identity in general and in the mathematics education domain in particular have mainly focused on the content of (pre-service) teachers’ narratives. However, in order to reach pre-service teachers’ implicit understandings of their experiences, we must also examine the form of pre-service teachers’ talk. The latter studies are still rare in mathematics education (Kaasila, 2007a; Kaasila et al., 2012; Oslund, 2012). In this study, the content and form of pre-service teachers’ identity narratives will be examined in order to understand their mathematical identity work.

5.2 Research persons and data collection

5.2.1 Research persons

This comparative study includes research persons from two different education contexts, Finnish and Slovenian. Pre-service elementary teachers who developed a negative view of mathematics during their school years were selected for participation. Therefore, all the cases meet the latter criterion and were chosen based on ‘criterion sampling’ (Patton, 1990, p. 177). At the end of March 2009, second-year elementary education students from the University of Lapland were informed about and invited to participate in research on ‘negative experiences and view of mathematics’ at the mathematics education course exercises and via electronic mail. Six of 64 students voluntarily agreed to an in-depth interview about the topic. At the end of September 2009, fourth-year elementary education students from the University of Maribor were informed about the research by electronic mail. Up to mid-October 2009 when the autumn/winter semester of studies officially starts in Slovenia, no participants volunteered. Later, they were personally invited to participate in the study at one of the lectures on the mathematics education course. The details of the study were explained, and out of 120 students, 13 agreed to participate.

Altogether, 19 pre-service teachers participated in the study. The Finnish participants included five females enrolled in the second year of the study programme and one male enrolled in the first year. The thirteen Slovenian
participants were all female; 12 were enrolled in the fourth year of the study programme, and one was enrolled in the third year. To assure the anonymity of the participants, all were assigned a pseudonym. I took into account their teaching practices or teaching experiences during their teacher education studies, that is, the fact that the Finnish and Slovenian participants were enrolled in different years of study. It seemed relevant to take into account those who had at least one teaching experience since the teaching practice might have important meaning for their views of mathematics, their mathematical identities and that it may influence their mathematical identity work. The Slovenian pre-service teachers had their first teaching experiences in mathematics in the third year while the Finnish pre-service teachers began earlier in the second year. By the time the interviews were conducted, the Finnish pre-service teachers already had a second year of teaching practice in training school while the Slovenian pre-service teachers mostly had one teaching experience in mathematics in their third year.

An additional important element in the selection of participants was the mathematics education course which pre-service teachers had undergone before the interview. The Finnish pre-service teachers do the mathematics education course in their second year of study; therefore, by the time the interviews were conducted, they had already completed the course. Conversely, the Slovenian pre-service teachers are required to take two mathematics education courses, one in their third and one in their fourth years of study. By the time the interviews were conducted, 12 Slovenian pre-service teachers had completed the third-year mathematics education course and had just started the fourth-year course. However, one participant had just started the third-year course.

Finally, it was clear beforehand that only some cases could be described in detail and included in the dissertation report. In narrative studies, findings are commonly reported through detailed analyses of ‘key informants or critical cases’ (Patton, 1990, p. 176; see also Elliot, 2005). Therefore, I will present the mathematical biographies of four pre-service teachers: two Slovenian and two Finnish. Additionally, to present the results of the categorical analysis or the analysis of narratives, I focus on ten central cases in the study: five Slovenian and five Finnish. The cases included in the research report were selected on the basis of sampling rigour (Patton, 1999). Accordingly, I used the critical case strategy (Patton, 1990; see Chapter 5.3.2.).
5.2.2 The in-depth narrative interview

Building on Josselson (2009, pp. 650–651), I am of the view that the in-depth narrative interviews must begin with ‘a respectful, ethical, non-judgmental, responsive and empathic research relationship in which participants are invited to narrate aspects of their lives that are of interest to the researcher’. Mishler (1986) maintains that commonly, interviewees will tell stories even if they are not asked to do so. Arguably, and building on Schütze (1984), the basic idea of an in-depth narrative interview is to reconstruct happenings from the interviewee’s perspective. Like Mishler (1986), I note that the interview is also a site where people jointly construct meaning. Thus, the data collected ‘reflects the trust and rapport the interviewer is able to create with the participant’ (Josselson, 2009, p. 651).

Based on the purpose of this study, the in-depth narrative interview is an adequate method of data collection (Kaasila, 2007a; Mishler, 1986). Following Mishler (1986), I consider pre-service teachers responses as narratives. I was particularly interested in conducting in-depth narrative interviews because they provide information-rich data based on emotions (Kvale, 2007). Additionally, in the narrative interview participants reflect on the changes over time. The latter was of importance in this study due to the interest in how pre-service teachers’ identities developed and how they continue to work on their identities. Thus, I was aware that the collection of narratives in relation to mathematics elicited remembering of the past and anticipating of the future (cf. Flaherty & Fine, 2001; Mead, 1934).

The data was collected in the year 2009. The interviews with the Finnish participants were conducted in English and were held in April 2009 in the Faculty of Education, University of Lapland, Rovaniemi. The interviews with the Slovenian participants were conducted in the Slovenian language and were held in October, November and December 2009 in the Faculty of Education, University of Maribor. Each interview lasted 40–70 minutes, depending on the talkativeness of the interviewee. All interviews were audio-recorded. At the beginning of each interview, I assured the pre-service teacher’s confidentiality and explained the purposes of the interview. Interview questions were only used as an orientation and to encourage the pre-service teachers to talk freely about their school-time experiences with mathematics. I used open-ended prompt ‘tell me ...’ (cf. Mishler, 1986); for example, I started interviewing with an open question ‘Tell me about your school-time experiences with mathematics’ (see
appendix 5). This question encouraged pre-service teachers to talk about the experiences which were meaningful to them. Furthermore, I asked about experiences during specific stages of schooling (e.g. elementary school) to obtain narratives of their mathematical paths and in order to be able to understand how their mathematical identities developed and how their view of mathematics turned out to be negative. The order of the questions depended on pre-service teachers’ answers. Arguably, and building on Gudmundsdottir (1996), theory also shaped my interview questions. During the interview, leading questions were avoided, and sensitive issues were treated in a delicate manner. Even though the in-depth narrative interview is seen more as a conversation, my role was primarily that of a listener (cf. Josselson, 2009).

The study was conducted with a very small number of research persons; however, as Sandelowski (1995, p. 183) points out, ‘determining an adequate sample size in qualitative research is ultimately a matter of judgement and experience, and researchers need to evaluate the quality of the information collected in light of the uses to which it will be put, the research method, sampling and analytical strategy employed’. Due to the specific requirements for participation in the study—pre-service teachers’ negative experiences and negative view of mathematics—it seemed that a data saturation point was reached very early in the process of data collection. Although only six interviews were conducted with Finnish pre-service teachers, after the fourth interview, no new information in terms of understanding pre-service teachers’ identity work was gathered. This was also the case in the interviews with the Slovenian pre-service teachers.

After the interviews were conducted, they were all transcribed verbatim. I decided on where punctuation and paragraphs would best fit. The transcriptions remained mostly uncorrected during the analysis (i.e. there was no spell or grammar check). Additionally, I translated the transcriptions of the interviews with the Slovenian pre-service teachers into English for the analysis and research report. The translations were as literal as possible (for more on translations, see Chapter 10).

5.2.3 Restrictions on data collection

I encountered some restrictions while collecting the data (see for more, Chapter 10). For instance, it was challenging to conduct a greater number of interviews with pre-service teachers. Based on the research task, I was only interested in pre-
service teachers’ negative experiences with mathematics and, consequently, who had adopted negative views of mathematics during their school years. As discussed in the theoretical chapters, the view of mathematics is one of the central research topics in teacher education in Finland. Based on the results of a research project by Kaasila et al. (2008a) on three Finnish universities, 22% of pre-service teachers began their studies by displaying negative view of mathematics. Taking these findings into account, approximately one-half of the students attending teacher education at the University of Lapland who had a negative view of mathematics and who were in the same course year participated in this study. Further, taking into account that the research persons had a negative view of mathematics and that the reasons for developing such a view could be found in previous, sometimes very traumatic experiences, the willingness to talk about those experiences might have been reduced. Therefore, I expected beforehand that the number of students willing to participate in this study would not be high.

Additionally, I conducted research interviews with research persons from both countries; therefore, the language spoken during the interviews with the Finnish students could not be their mother tongue, and English was used instead. This also hindered participation in the study. However, the English proficiency of the Finnish pre-service participants was very good; they spoke fluently. Further, some misunderstandings were clarified with additional questions. The Finnish pre-service teachers also seemed very familiar with the topic and could discuss their views using proper English vocabulary. Interviews with the Slovenian students were conducted in the Slovenian language. In terms of the difficulty of obtaining participants for this study, conducting interviews with Slovenian students in English would have likely resulted in no participants at all. Personally, I also find the use of English, rather than the Slovenian language, with Slovenian participants odd as Slovenian is our mother tongue. I assumed that due to the lack of experience of participating in qualitative studies (i.e. being interviewed), the number of persons willing to participate was low.

Furthermore, although a significant amount of effort was put into explicating the research topic to the participants (in written as well as oral form), some of the interviews with the Slovenian students were ultimately unusable for the study (e.g. when a pre-service teacher had only positive experiences and had developed a very positive view of mathematics). Such cases were not analysed further, neither were they included in the dissertation report. Furthermore, on the basis of the interaction with the Slovenian students before or immediately after the interview, I realised that the research topic was quite new to them. Some of them
explicitly said at the beginning of the interview ‘Oh, I did not know it was possible to study these kinds of issues’ (I discuss more about language in the data collection in the section on the trustworthiness of the study in Chapter 10 as well as in the discussion section in Chapter 11).

5.3 Data analysis

The data analysis consisted of two phases (see Table 1). The first phase involved a holistic approach to data analysis (Lieblich et al., 1998). This ‘seeks to preserve a narrative in its entirety and understand it as a complete entity’ (Elliott, 2005, p. 38). Each interview was read holistically and narrative analysis (Polkinghorne, 1995) was applied. The outcomes of this phase were the pre-service teachers’ mathematical biographies (see Chapter 6) as well as a summary in which the focus was on the content and on the form of the narratives. In the second phase, a categorical approach to data analysis (Lieblich et al., 1998) – the analysis of narratives (Polkinghorne, 1995) was applied. I systematically compared the pre-service teachers’ identity narratives. The comparisons and contrasts pertained to the content as well as the form of the identity narratives (Kaasila, 2007a, 2007b; Lieblich et al., 1998). The outcomes of this phase were the similarities and differences identified in the data and the notions on identity work that were consequently obtained (see the Chapters 7 and 8). Similarly, following Lieblich et al. (1998), the distinction between the form and the content is not clear-cut. In presenting the data analysis, I refer to both, the analysis of the content and the form.

Table 1. Data analysis process.

<table>
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<th>Phases</th>
<th>Approach to data analysis</th>
<th>Procedure</th>
<th>Outcome</th>
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<td>Phase 1</td>
<td>Holistic approach to data analysis: ‘narrative analysis’</td>
<td>Holistic reading of each interview; constructing mathematical biographies (content) and summaries of mathematical biographies (content and form)</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Categorical approach to data analysis: ‘analysis of narratives’</td>
<td>Systematically comparing and contrasting the content and the form of the Slovenian and Finnish pre-service teachers’ narratives</td>
<td>Chapter 7 and 8</td>
</tr>
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</table>
5.3.1 A holistic approach to data analysis: narrative analysis

As suggested by Lieblich et al. (1998, p. 12), ‘in the holistic approach, the life story of a person is taken as a whole, and sections of the text are interpreted in the context of other parts of the narrative’. This approach was used because of my focus on examining pre-service teachers’ narratives as a whole. I also applied narrative analysis (Polkinghorne, 1995), which is based on narrative knowing (Bruner, 1986) and finding uniqueness of the experiences. As Polkinghorne argues (1995), narrative analysis displays the complexity and the emotional meaning of the experiences. The story is actually built through the process of narrative analysis. Consequently, I constructed pre-service teachers’ mathematical biographies. I emplotted all the cases considered in this report; however, in order to eliminate overlapping with the categorical analysis and repetitiveness of the data (Ritchie, Lewis, & Elam, 2003), I present two Finnish and two Slovenian cases (see Chapter 6). Two emplotted biographies – Reija’s and Ulla’s cases – were also published earlier (see Lutovac & Kaasila, 2010, 2011). For the purpose of presenting the four biographies, I chose two cases from each context that were, in comparison to others, on a more negative side of the continuum regarding challenging experiences with mathematics encountered during their schooling (i.e. Pia and Barbara), and two cases from each context that were, in comparison with others, on a more positive side of the continuum (i.e. Mari and Ema).

A holistic analysis of the content: emplotment

First, I applied the holistic content mode of reading (Lieblich et al., 1998; see also Kaasila, 2007a) and read the interviews several times ‘until a focus of the entire story emerged’ (Lieblich et al., 1998, p. 62). While reading each interview, I wrote down my views and paid attention to the aspects which were meaningful for the entire story, such as particular episodes in the pre-service teachers’ mathematical experiences. Again following Lieblich et al. (1998), I was especially interested in how the pre-service teachers’ narratives would evolve from beginning to end as this would give an insight into how their mathematical identities had evolved and continue to evolve. This phase is of particular use for continuing with the narrative analysis.

Second, I applied narrative analysis by the process of ‘emplotment’ (Polkinghorne, 1995). I first defined the outcome of each mathematical biography (Polkinghorne, 1995; see also Kaasila, 2007a; Lutovac & Kaasila, 2010, 2011).
The biographies in my study had primarily two outcomes. The first outcome related to negative experiences during school time and thus negative views of mathematics. I asked myself: ‘How did this outcome come about? What events and actions contributed to this outcome?’ I searched the interview data for essential events, the pre-service teachers’ choices and actions and those of others that might have had great meaning for their negative experiences and negative view of mathematics (Kaasila, 2007a; Lutovac & Kaasila, 2010, 2011). The second outcome was usually related to some kind of change in their experiences and views. Their stories were therefore stories of change, so in order to emplot the biography, I also took into account ‘How the change happened? Who or what influenced the change?’ (Kaasila, 2007a, 2007b). This is how I chose all the events to be included into the narrative. I also ensured that the chosen events contribute to the meaning of the entire story. In the next step I arranged the data elements chronologically and then wrote the story. Therefore, emplotment gave a story, a meaning.

Although the data obtained through the interviews was considered as narratives, I nevertheless emplotted the pre-service teachers’ mathematical biographies to account for how their mathematical identities had developed (cf. Polkinghorne, 1995; see also Kaasila, 2007a; Lutovac & Kaasila, 2010) and for how their earlier experiences had influenced their past and present mathematical identities and might also influence their future ones.

A holistic analysis of the form

To analyse the form of the narratives holistically, I focused on the structure of the narrative (Lieblich et al., 1998; see also Kaasila, 2007b). Similarly, like Lieblich et al. (1998), I observed that the progression and cohesiveness of the narrative, also expressed the pre-service teachers’ identity. A narrative’s progression refers ‘to the development of the plot over time’ (Lieblich et al., 1998, p. 89). In this sense, Lieblich et al. further maintain that the story can advance steadily (progressive narrative), there can be a course of deterioration (regressive narrative), or the plot can also be steady (stable narrative). The latter seems to be important to this study as the progression of the narratives also spoke to the progression of identities. Finally, I was also interested in the cohesiveness of the narrative or how well the narrative was constructed. In order to find answers about the structural aspects of the pre-service teachers’ narratives, I thought about the development of the plot thematically, reflections from the pre-service teachers
on a specific phase of schooling as well as their use of particular terms related to the form of the narrative (e.g. ‘turning point’). As suggested by Lieblich et al. (1998, p. 110), applying the holistic analysis of the form may help with better understanding of pre-service teachers’ ‘deeper identity’. The results of the form being analysed holistically are evident in the summary of the biographies (see Chapter 6.2).

5.3.2 A categorical approach to data analysis: analysis of narratives

In order to systematically compare and contrast the Finnish and Slovenian pre-service teachers’ identity narratives with respect to the cultural context, I applied the categorical approach (see Lieblich et al., 1998) or the so-called ‘analysis of narratives’ (Polkinghorne, 1995). This means that ‘the original story is dissected, and sections or single words belonging to a defined category are collected from the entire story or from several narrators’ (Lieblich et al., 1998, p. 12). Similarly, Polkinghorne (1995) labels the categorical approach as an analysis of narratives, which is based on paradigmatic reasoning (Bruner, 1986). Further, the goal of comparison is to find commonalities among the narratives and to conceptualise them. The strength of this analysis is in developing general knowledge about the collected narratives; however, the uniqueness of each story is lost (Polkinghorne, 1995). Further, the data analysis was a data-driven process. The findings were connected to the theoretical framework only in the final stage of the analysis.

To present the results of a categorical approach to data analysis in Chapters 7 and 8, I systematically selected 10 cases, five from the Finnish and five from the Slovenian contexts, which will be examined during the course of a study (Patton, 1990, 1999). Here, I used the critical case strategy (Patton, 1990), that is, selecting a small number of ‘cases that are likely to yield the most information and have the greatest impact on the development of knowledge’ (Patton, 1990, p. 174). The cases selected made a point clearly, were particularly information rich (Patton, 1990) and expressed themselves vividly. The critical cases thus allowed me to gather relevant information about the pre-service teachers’ mathematical identity and contributed the most towards understanding and conceptualising their mathematical identity work. Although a few critical cases may not have yielded broadly generalisable findings, they may have allowed the development of logical generalisations. Patton (1990, p. 175) exemplifies such generalisations with the statement: “if it happens there, it will happen anywhere,” or vice versa, “if it doesn’t happen there, it won’t happen anywhere”. For example, if we show that
particular approaches during particular teacher education settings promoted the identity work of pre-service elementary teachers who had earlier experienced mathematics negatively, this would mean that the same would be possible elsewhere. Finally, the Finnish cases presented in the report are referred to as Heli, Mari, Pia, Reija and Ulla while the Slovenian cases are referred to as Ana, Barbara, Darja, Ema and Ines.

**Categorical analysis of the content**

The collected data was treated as narratives or stories, and the next step was to carefully examine it in order to find categories describing common themes appearing across the narratives. Here, the emphasis is on the content, on ‘what’ is said in narratives (Riessman, 1993). This process is more familiarly known as ‘content’ or ‘thematic’ analysis (Lieblich et al., 1998; Riessman, 1993). Importantly, while the research questions guided the analysis, I did reformulate them in light of the data that I had collected.

The process of ‘categorical analysis of the content’ (Lieblich et al., 1998) or the ‘analysis of narratives’ (Polkinghorne, 1995) started with separating and arranging the data in meaningful chunks, to form a ‘subtext’ (Lieblich et al., 1998, p. 112). Considering the temporality of identity narratives, I first divided the data from each pre-service teacher in such way that the data pertaining to the past, present and future were separated. I then continued with the process of identifying the emerging themes in the data (cf. Polkinghorne, 1995). I carefully examined the data sentence-by-sentence and even word-by-word. I labelled meaningful sentences or paragraphs. Afterwards, I identified the themes in the narratives by summarising the content with the help of labels. For example, numerous labels describing similar content indicated a theme. First, preliminary themes found in the data were closely related to the interview topics and questions. Some examples of themes identified in the Slovenian and Finnish data included difficulties with math, not understanding math, lack of motivation and effort, beliefs of oneself, low grades, dissatisfaction, bad teachers, good teachers, beliefs of mathematics, insensitive classmates, parents’ role, siblings’ role, math anxiety, frustration, disappointment, the role of self, mathematics education courses, teaching experiences, etc.

In the next step, I started the process of sorting the data into the categories (Lieblich et al., 1998). This meant grouping the themes into categories. First categories were also quite close to the data, however, the reading of the relevant
literature from the field of teacher and mathematics education informed the labelling of the categories. Some examples of the preliminary categories included the view of oneself as a learner; the view of mathematics learning; the view of mathematics as a subject; the view of oneself as a teacher; the view of teaching mathematics and the view of mathematics education courses. I also searched for potential changes or facilitators of change in the data.

Later, I identified more conceptual categories which would illuminate the research problem and focus on characterising pre-service teachers’ mathematical identity work as much as possible. In so doing, I tried to get an overall sense of the data, separating essential from non-essential data and distinguishing categories and sub-categories. I also searched for relationships between the categories. Riessman (1993) asserts that narratives need interpretation when used as data. In order to interpret the data, I searched for the meaning of pre-service teachers’ thoughts, emotions, attitudes, behaviours etc., but still remaining faithful to the pre-service teachers’ perspectives. Further, to theorise about the data, I aimed to identify the meaning of the data with wider educational and theoretical relevance.

Finally, the data and interpretations were synthesised for the research report. For the purposes of readability, I reduced certain expressions from the data, meaning that the spoken language was transformed into a more readable form, including expressions, such as ‘em’ or repetitive expressions of ‘I’ or ‘I think’. At this point, I also used correct spellings and some other grammatical corrections to make the data excerpts as understandable as possible. The data excerpts were also shortened. Although fairly common in order to categorically analyse the content of narratives, I did not employ a quantitative treatment of the narratives (Lieblich et al., 1998). Further, the process of data analysis was iterative, so I moved back and forth between the steps in the analysis.

**Categorical analysis of the form**

Arguably, and building on Pennebaker, Mehl and Niederhoffer (2003, p. 548), ‘the ways people use words convey a great deal of information about themselves, their audience, and the situations they are in’. Therefore, it is important to address also the ways narratives are told (cf. Riessman, 1993). In this study, identity work was understood as storytelling. This means that the talk was an important part of the identity work (Kaasila et al., 2012; Schwalbe & Mason-Schrock, 1996), hence the reason I confined my focus to comparing the pre-service teachers’ talk (cf.
The focus on the talk in the pre-service teachers’ narratives might be of great importance in a search for differences which arise from the two different contexts.

The categorical analysis of the form of the narratives was conducted simultaneously with the steps used to analyse the content. By reading the narratives word-by-word and sentence-by-sentence, I first tried to identify those rhetorical aspects which were closely related to the content. Kaasila et al. (2012) state in their recent study that in order to analyse pre-service teachers’ identity talk, we need different methodological approaches. Thus, categorically analysing the form of the narratives overlaps with linguistic and rhetorical analysis. For that reason, I applied certain aspects of these domains.

To analyse the linguistic features of the narratives, I applied some ideas described by Tannen (1979). Consequently, to analyse the data, the especially useful data excerpts were the ones in which pre-service teachers used evaluative language, repetition and qualifying words or expressions (see also Kaasila, 2007b). In these data, I searched for the use of metaphors, extreme utterances, the use of personal pronouns (first or second person singular pronouns) and the use of positive and negative ‘identity’ statements (Kvale, 2007; Lieblich et al., 1998; Pennebaker et al., 2003; Tannen, 1979; see Table 2). In examining identity work, what one says one is is as important as what one says one is not (Lieblich et al., 1998). Here, the linguistic features of the narrative were used to assess its emotional content (Lieblich et al. 1998; see also Pennebaker et al., 2003). I thus focused on categorically examining the incoherence in the narrative data as well as the choice of vocabulary (see also Kaasila, 2007b; Kaasila et al., 2012).
Table 2. Examples of linguistic features found in the data.

<table>
<thead>
<tr>
<th>Linguistic features</th>
<th>Descriptions</th>
<th>Examples</th>
</tr>
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<tbody>
<tr>
<td>Metaphors</td>
<td>A metaphor is a means to understand one kind of thing by means of another, thereby highlighting perhaps new aspects of a kind (Milles &amp; Huberman, 1994). The use of metaphors can display different understandings of and emotions towards the topic in question.</td>
<td>‘[…] the teacher in secondary school was the final straw’. (Ulla, Finland)</td>
</tr>
<tr>
<td>Extreme utterances</td>
<td>An utterance is a unit of speech under study. Here, utterance can consist of single words and phrases spoken in context. (Kaasila et al., 2012; Potter, 1996).</td>
<td>‘I felt like throwing up when I saw my mathematics notebook’. (Ines, Slovenia)</td>
</tr>
<tr>
<td>The use of pronouns: changes from the first person pronoun ‘I’ to the second person pronoun ‘you’</td>
<td>I see the change in the use of the first person pronoun ‘I’ to the second person pronoun ‘you’ as generalising the experiences in question (Pennebaker et al., 2003). Thus, one is also linking oneself to similar others.</td>
<td>‘But on the other hand, you can ask for help and you have the teacher’s guidebook. I would somehow manage’. (Ines, Slovenia)</td>
</tr>
<tr>
<td>Positive &amp; negative ‘I’ statements</td>
<td>Positive statements were understood as a person in question identifying with what she is whereas negative ‘I’ statements where those where a person identifies with what she is not (cf. Lieblich et al., 1998).</td>
<td>‘[…] I am so bad at math’. (Heli, Finland)</td>
</tr>
<tr>
<td></td>
<td>‘I am not good at math’. (Mari, Finland)</td>
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According to Potter (1996), rhetoric is argumentative discourse which aims to persuade. In the domain of mathematics education, Kaasila (2007b) focuses on the rhetorical construction of mathematical identity articulated in the autobiography of one Finnish pre-service teacher – Sirpa. In the current study, I searched for various rhetorical devices in the pre-service teachers’ narratives (see Table 3). Rhetorical devices that pre-service teachers use to convince an audience of the meaning that their experiences have for them might give a deeper understanding of their mathematical identity work (cf. Kaasila, 2007b; Kaasila et al., 2012). Further, as suggested by Kaasila et al. (2012, p. 992), ‘we need a rhetorical methodology because through the rhetorical devices that pre-service
teachers use, we can better understand that their mathematical identity talk is always directed to some audience’, namely, myself as the researcher of this study and the readers of the dissertation report. Building on Kaasila et al. (2012), I found the following rhetorical devices in the pre-service teachers’ identity talk: category entitlement, categorisation, active voicing, the use of disclaimers and the use of rhetorical questions (see Table 3).

Table 3. Examples of rhetorical devices found in the data.

<table>
<thead>
<tr>
<th>Rhetorical devices</th>
<th>Descriptions</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category entitlement</td>
<td>It obviates knowledgeability by showing that a person is a member of some specific category—professor, etc. (Potter, 1996).</td>
<td>‘My dad was helping me with the homework and explaining things to me [...]. He’s an engineer [...].’ (Ulla, Finland)</td>
</tr>
<tr>
<td>Categorisation</td>
<td>Constructs the specific sense of something: it is a complex social accomplishment rather than a banal naming process (Potter, 1996, p. 177).</td>
<td>‘I don’t know; generally I think I am not cut out for mathematics [...].’ (Barbara, Slovenia)</td>
</tr>
<tr>
<td>Active voicing</td>
<td>It means reporting someone else’s speech within a narrative (Wooffitt, 1992).</td>
<td>‘[...] and when I didn’t do so well, my teacher asked “are you studying math at home at all?” and “don’t you understand this?”.’ (Reija, Finland)</td>
</tr>
<tr>
<td>Disclaimers</td>
<td>Statements used in narratives when people know that what they are saying may attract criticism (Billig, 1988).</td>
<td>‘I have a feeling that I don’t have the ideas [...]. But on the other hand, you have other teachers next to you who you can ask for help [...].’ (Ines, Slovenia)</td>
</tr>
<tr>
<td>Rhetorical questions</td>
<td>It is a question that is asked without the expectation of a reply. It is used as a rhetorical device in order to encourage its listener to consider a message or a viewpoint (Potter, 1996).</td>
<td>‘How will I teach it at all if I don’t understand?’ (Barbara, Slovenia)</td>
</tr>
</tbody>
</table>

The form of the narratives was particularly useful for interpreting that data. I thought about certain linguistic and rhetorical aspects which might contribute to
generating and verifying the meaning of statements (cf. Kvale, 2007). Further, the hidden meanings of pre-service teachers’ words or sentences revealed important information about their identity work. Often, particularly when analysing the form, I was able to find nuances which were important for interpreting the meaning of the statements and, overall, for explicating the differences in the pre-service teachers’ mathematical identity work.
6 Pre-Service Teachers’ Mathematical Biographies as Identities

In this chapter, I present four mathematical biographies on two Finnish and two Slovenian cases. Arguably, constructing pre-service teachers’ biographies is the first step towards comparing and contrasting their mathematical identity work. Given that in this study narrative is equated with identity, and telling a narrative is equated with identity work, a closer look at the development of the plot (see Lieblich et al., 1998) might give important information about the pre-service teachers’ mathematical identity work as well directions for further, more detailed analysis.

6.1 Mathematical biographies

6.1.1 The case of Mari (Finland)

*Motto: ‘I was hard on myself. I pressured myself to get good grades’.*

Mari is a Finnish pre-service elementary teacher in the second year of study. She started recalling her school-time experiences during basic school: ‘They were mainly positive. First and second grade were very easy and quite nice. Exams went very well too’. Mari’s teacher was ‘very tough, but she was a very good teacher’. Mari told that her difficulties started to appear in ‘the third grade’: ‘It became a little bit...not so difficult, but there were some problems’. Mari recalled an early episode of having to repeat one of the tests: ‘I remember that I once did a test twice because it went badly the first time. We got grades from four to ten, and I got a five. There were a lot of other pupils who got the same grade as I did, so the teacher decided “you must do the test again”. It was quite difficult to tell my parents that I failed the test’. Mari’s parents were very understanding: ‘They said that I would do it again and practice a lot’. Also, her teacher at that time was supportive: ‘The teacher helped a lot, and the second time, it went quite well’. Despite the fact that this was a one-time experience for Mari, failing that test significantly affected her: ‘It was very hard on me the fact that it went so bad because I was a hardworking student, and I did a lot of work and all of my homework. I corrected a test and practiced a lot. I did all that I could’. Mari said that she was very thankful to her sister who is older by one year who always helped her: ‘I had an older sister in fourth grade at that time. She always helped
me a lot with mathematics, and without her help, I would be much worse in math
than I am right now’. Overall, Mari was satisfied with her teachers; however, she
recalled that ‘one teacher wasn’t so good. Mainly he was the reason for the
negative experiences from basic school’. Mari told that ‘he would make mistakes,
but he always said he was right’. Mari emphasised: ‘Mostly it was the teacher, not
math’.

In secondary school, around ‘seventh and ninth grade’, Mari’s experiences
with mathematics grew worse. She told how much she pressured herself to do
dwell: ‘I think when I started at the school, I was quite pressured by school
because I was so hardworking, very nice to the teacher and an active pupil’. Math
performance was very important to Mari: ‘I practiced a lot for the math tests
because it was very important that I get a good grade. I had high expectations of
myself. I wanted to do well. I used to work so hard just so I wouldn’t get bad
grades’. However, the level of difficulty of the content increased: ‘I think it was
quite difficult for me to learn math. It took a lot of time to understand something,
but when I understood it, then it was easy. Unfortunately, we didn’t have a lot of
time for one content. Everything went quite fast’. Mari also recalled her math
teacher and the responsibility she got at that time: ‘The math teacher was our
class teacher who took care of things, such as when we went on class trips. I was
chosen as the pupil who takes care of the money and all the stuff, so I was taking
care of things that he should have been doing, and I think it was convenient for
him that I took care of those things’. This role greatly affected Mari, particularly
her relationships with her classmates: ‘They were quite rough with me because I
was responsible for the money and everything else. They just thought I was the
teacher’s pet. Sometimes, when I got a bad grade, other pupils were just amazed
that “Mari got a bad grade, Mari got seven on the test”. I was just “rrrrrrrrrrrrrr
angry. But I didn’t show it’.

In addition, Mari felt she did not get the help she needed form her teacher:
‘He didn’t realise that I had problems in math because all the while, he assumed
that I was a good pupil; I also got very good grades in other subject, and of
course, there were pupils who had worse problems than me. But I didn’t like that!’
Mari also told that her teacher only favoured and encouraged students who were
successful: ‘There were two very good, very talented classmates, and the teacher
was always commenting on how good they were’. Because of the teacher, her
responsibility and the turn of events, Mari did not like math. Her father was ‘good
at mathematics and he was saying that mathematics is useful’; on the other hand,
as she told, her mum ‘did not have any special opinion about math’. On the basis
of her grades, Mari was an excellent student; thus her parents also had many expectations of her. This put additional pressure on her: ‘When I got some bad grades, about six or seven, they were quite shocked because I used to get such good grades. I think...they were very worried’. She was afraid of telling them about her difficulties: ‘I was just waiting for the right time. I was afraid that my mum would call my teacher to speak about my problems. I didn’t like the idea that my mum would be solving my problems’. Mari told: ‘I was pressured about the grades. And my sister was getting good grades in math – nine and ten – and I think it was quite hard for my parents to understand that I was not so good’. In addition, Mari felt she was often ‘compared’ with her sister. Although her parents did not know about her difficulties, Mari’s sister ‘knew the problems’. Luckily, as she told, ‘I got help from my sister’. Mari described her sister as ‘very talented in math, and she was teaching much better than my real teacher. And I had the courage to ask her anything while I didn’t have the courage to ask my teacher. I think I could have been better if I had also asked the teacher’. However, overall, Mari mainly blamed herself for the negative experiences during that time: ‘I think it was me because I made it harder on myself. I wasn’t relaxed at all. I put a lot of pressure on myself’.

At the beginning of upper secondary school, Mari decided to take advanced mathematics courses: ‘My sister was in the same upper secondary school, and she was very good, so when I started upper secondary school, she said that I should take the same course, and I did that. But I always thought that I could change it. I could do the first course, and if it didn’t go well, I would change it’. She made her decision with her sister’s and parents’ influence: ‘They were also saying that I could be...in the advanced level, which is more useful that general...and they were also saying that my sister would help me...when I had problems’. Mari told that the advanced syllabus was difficult for her, but she did have the support she needed: ‘The first course was very hard for me, but my sister was helping, and the teacher was also very good and supportive’. However, Mari felt she did not do well enough in the exam: ‘When the test came, I got seven and a half. And I said to the teacher that I must change it because it was a bad grade for me, but the teacher said “no you can't change it, you must be here. I'm sorry, but you will have to manage with the advanced syllabus”’. Mari liked the teachers in upper secondary school: ‘Teachers were very good and supportive. I think that all the teachers thought that I would be as good as my sister. On the other hand, it was quite easy to start the school because my sister was so nice and active, and teachers were nice to me too’. Mari could not change her decision to continue
with the basic syllabus, but she felt that the second course became ‘easier’. She gained confidence and motivation and ‘was working very hard’. This was also noticeable in her performance: ‘I got a good grade, it was nine. And I thought that I could be at this level’.

However, Mari’s negative experiences soon started to resurface: ‘The first courses went well, and math was very good, but the later courses were just...too difficult. I didn’t have any motivation to do math because it was quite hard. I just learned some things for the test, and I practiced them. But I think it could have been easier for me if I had chosen the basic level’. Despite the fact that ‘math was too hard’, Mari ‘continued to try to understand it’, however, she recalled ‘I lost my motivation and I didn’t do my homework. My classmate, a good friend, also had some problems, and we used to think about math tasks together, and we lost motivation together’. Mari experienced negative emotions: ‘I was frustrated and I spent a lot of free time practicing. I was tired, and sometimes, I was so angry at myself because I was so bad’. She experienced math test anxiety: ‘I was afraid of tests, and I was spending a lot of time thinking about what the teacher could ask. I wasn’t so enthusiastic to go to the lessons. But I was not so afraid during the lessons because it was easy to just be in the class and not say anything’. Mari summarised her experiences from upper secondary school as: ‘I think it’s all about me because I should have accepted some bad grades. I didn’t have to be so good at all the subjects and pressure myself so much’. She also emphasised: ‘But without my sister’s help, I wouldn’t survive’.

Mari’s experiences changed during her university studies. In the mathematics education course, she was chosen as a math tutor as she was one of those students who went through the advanced math syllabus in upper secondary school. At first, Mari was terrified about this: ‘While on the course, we had to choose two math tutors from our group, and there were only a few students who had taken the advanced level in upper secondary school. So I was chosen. And I was like “no, not me because I’m not as good as you think”. It was really negative when I was chosen to be a tutor’. However, it seems that Mari succeeded in her role: ‘I think that the teacher was very good, I understood all things very well, and it wasn’t such hard work for me. My experiences got better’. Mari ascribed her positive change to giving up on perfectionism as well as to the teacher: ‘I’m no longer so hardworking, and I don’t have so much pressure to get good grades. Also, the teacher was positively influencing my experiences because there was this other math teacher. In his course, we were always just doing the exercises, and the test was quite difficult. I think he enjoyed it when someone failed the test. I also think
he did not concentrate on the useful points, especially for math in the lower classes of basic school

The fact that Mari took the advanced math syllabus made her feel that the math content in the mathematics education course was ‘much easier’.

Her first experience of teaching mathematics in teaching practice after the mathematics education course was positive because of the good group preparation in the course: ‘It was very nice. And the course helped a lot in terms of starting to think about the lessons, and we had a good group. And we did the lesson plans for maths together. It was easy to start when you have already taught what you will teach’. She was confident before teaching and was also ‘excited to teach’. Mari also told that she prepared herself significantly more for math lessons than for other teaching experiences. She concluded that she had ‘positive feelings’ about teaching mathematics in the future: ‘I have to work hard, and I have to concentrate on teaching rather than on me’.

6.1.2 The case of Pia (Finland)

Motto: ‘Why don’t I understand this? Is there something wrong with me?’

Pia is a Finnish pre-service elementary teacher in the second year of study. She began recalling her school-time experiences with mathematics: ‘The first and second grades, I actually don’t remember so much from that time, but maybe after that...’ Pia thought that in terms of mathematics, she was ‘quite average, there weren’t any problems’. Her difficulties began somewhere in third or fourth grade: ‘I didn’t like mathematics at that time because I didn’t understand what we were doing, and our teacher didn’t explain that well. So I think I have a big gap in my knowledge from that time’. Pia emphasised that her negative view of mathematics originates from the experiences with her teacher: ‘I especially remember that my teacher wasn’t so good, and that’s why I got this...really negative view’. In her opinion, the teacher did not succeed at teaching, so the students ‘didn’t really learn’. She told that she had been ‘talking about this teacher many times’ with one of her friends from school: ‘She said that she had the same feelings from that time’. Pia also recalled her low performance in mathematics: ‘I didn’t get very good results from the exams. One time, I got six [on a 1–10 scale]. For me, it’s not that good because in other subjects, I was ok; so that was really negative’. Pia said that her math performance ‘wasn’t that bad, but it wasn’t like in other subjects’, but she felt her ‘negative attitude’ was a bigger problem: ‘It’s not that
I’ve been very bad because before the exams, I usually studied. For example, in the report, I usually got seven or eight, but it was more that I had a negative attitude because I didn’t understand and got annoyed about it.

Pia always doubted herself and her math ability: ‘If we had to go to the board to solve tasks, I always wondered “am I doing this right?” I didn’t want to go to the board because I wasn’t sure about myself and whether I was doing something right. I’m also really slow at, for example, thinking of...how do I solve this problem or when calculating big numbers’. At the same time, she was concerned about what her classmates were thinking of her: ‘It takes time, so it feels like the others are saying “oh, why isn’t she doing it fast?”’ Pia said she felt ‘insecure’, and she always sought the approval of her classmates as to whether she was doing something correctly and whether the result was correct: ‘When we had to do homework on the board, I usually always checked to see whether my friends had the same results so it would give me more security to go on the board’. Pia’s mother was helping her a lot with mathematics: ‘Well, it’s always been like that; my mum was helping a lot with school, and only when my mum was not at home, I would ask my dad, but he was not very good at explaining things in a way that children would understand’. Especially before the exams, Pia would study with her mum: ‘When I had to practice for exams, my mum helped a lot. But not my dad. But when my mum was helping and explaining something, I got really angry if I didn’t understand. If I couldn’t understand something, I got annoyed about it’. There were times when Pia was in conflict with her mother who would want to help her: ‘We had fights with my mum because she was trying to help. But I think it was sometimes difficult for her because I got annoyed because I didn’t understand’. Pia has a brother who is older by one year who ‘likes mathematics, and he usually did all the mathematics homework first. I’ve always known that my brother was good, and while I wasn’t jealous, it’s a little bit strange because he understood everything and I didn’t, but we are siblings’. Despite the fact that her brother was more successful at math, Pia never asked him for help, mainly because her mother was usually helping her.

She pointed out that the reason for her negative experiences and attitudes was the inability to understand the math content: ‘I think the reason is that I don’t understand. I would like to understand because I think mathematics is really important. I wish... oh, it would be great to understand everything, but I don’t have it. I just don’t know how to, for example, start and what kind of calculation rules I have to use, and that is so negative. I don’t understand, but I would like to understand’. She had negative beliefs about her own talent: ‘My brain...I think it’s
the fact that I’m not so fast, for example, when calculating’. Still, Pia thought that she ‘could practice that’. However, she also recognised that ‘it’s also the teacher because I think I have some gaps in the basic rules, and I think it’s important to learn that at an early age, so I think that’s also...’ In addition, Pia emphasised that she did not ‘want to blame’ teachers but that a good teacher would have contributed to more positive experiences: ‘I would probably be better at mathematics. Because I’ve noticed that now, during the studies, there is one girl in the class who is very good. If I don’t understand something, she knows how to explain it in another way, and she always asks about how I think and why I think something. I think that’s really good. I think that a teacher in basic school should ask why a student thinks as she does and then he or she can correct the student. I think that’s what I needed in basic school’.

However, Pia’s experiences improved slightly in secondary school: ‘I think the teacher was better, but sometimes, he taught new contents too fast. For others, it was probably ok, but for me, I wasn’t so good’. She also felt that she ‘probably learned more than in basic school’. She filled some of the knowledge gaps, but ‘because there were new things coming, it wasn’t enough. I think I needed even more because I still feel that I needed more to fill those gaps’. In addition to not understanding the content, Pia felt that the most challenging aspect was the overly abstract nature of the content, and she ‘didn’t see any relation to everyday life’. She wondered: ‘Why do we do this at all? I didn’t see the point. And that was also the reason I didn’t like mathematics’. Pia did not have the motivation to deal with mathematics, and she gave up easily, especially when it came to difficult homework: ‘When I was doing homework, I usually did not know how to do it. I didn’t ask my parents for help; instead, I usually just didn’t do it’. Her fear and insecurity of going in front of the class to solve problems on the board continued throughout secondary school: ‘We had lots of calculations on the board. I was insecure about doing those, and I still am when I have to calculate on the board because I’m “oh, I have to check if this is correct”’. Beliefs about her own talent manifested in Pia’s talk: ‘I also don’t want to make mistakes as I feel very bad if I make a simple mistake. I feel like “oh, I’m stupid or something”’. Pia further explained that her insecurity was also due to the social context of learning mathematics, thus doing mathematics in front of others, such as her classmates: ‘If there is no one else, than it’s ok’.

At the beginning of upper secondary school, Pia chose the general syllabus ‘because I didn’t think that I could manage the advanced level; I didn’t have enough skills. It was a very obvious decision’. During that time of her schooling,
she continued to wonder why she had to learn certain contents: ‘I wasn’t at that level, there were many gaps, and I couldn’t go to that level. I remember asking the teacher, “why do we do these kinds of things”’. Pia recalled one episode where she was solving a task, and ‘the result was ok, but she didn’t use the formulas’ that she was supposed to. She recalled that her teacher was not satisfied with that and preferred only one way of solving problems: ‘She said I have to use this formula. You can’t do it like this. I didn’t understand why. But I probably did it in a very long way’. Pia did not like one of her teachers in upper secondary school. She did not feel any connection to the teacher: ‘She knew a lot of things, but when she was speaking, she would never look in the eyes. She did explain, but sometimes, I didn’t feel any connection to her. But I needed that. She was just giving the knowledge, but not anything else. And if I didn’t understand, she left me alone’. However, Pia did see mathematics as an important subject, ‘but also that it’s something for other people, like for scientists who need that, and I thought that I didn’t. I only needed the basics, nothing else’. She described herself as ‘too lazy’ when it came to doing her homework: ‘I wasn’t so keen on mathematics, and maybe I could have studied more myself. At first, I was trying... once and that was enough for me. If I didn’t understand, I said “OK, I don’t understand this; it’s too difficult for me”. Had I been really keen on mathematics, I would think “oh this is real problem solving, I really want to solve this, how to do this”? But I didn’t have that thing in me’. Pia experienced frustration due to her difficulties: ‘It was usually really frustrating. Why don’t I understand? I don’t know where to start’. Again, it seems that Pia’s problems with motivation and easy surrender continued; however, since she wanted good grades in mathematics, she studied before the exams: ‘I didn’t want to get a bad grade, so before the exams, I had to fill those gaps. I had to know how to solve the tasks; I had to catch up. I remember that before the exams, I did a lot of work. I really had to do a lot of work!’ She reflected on what could have helped her with more positive experiences during her school time: ‘Maybe there could have been more explanations to students; why they were learning mathematics and connecting it to real life. And teaching could have been different. For example, I play lots of chess. I like it, and I think I’m quite good at playing it. And during chess, I have to think... “If I move this here, then how many different kinds of moves the other can make, and how many I can make”. So I think that would have been useful’.

Pia’s experiences changed during her university studies: ‘I think they are somewhere in the middle; neither positive nor negative. It’s gone a little bit up’. She described the mathematics education course as ‘something really like new
doors opening in understanding. There really are different ways of doing mathematics. There are different kinds of paths to the result, and for me, that’s really important to notice’. She was satisfied with the teacher encouraging ‘different paths to the result’. She realised during the course ‘that there are also other people who don’t understand so well’. Moreover, one of her school-time beliefs changed: ‘I realised that I could go deeper in mathematics; that it’s not something only for those who understand mathematics, but it is also for me. And I think that the idea that mathematics is an important subject has grown’. In addition, Pia learned that ‘it is important to understand the way pupils think’. She asserted ‘that’s something that mathematics teaches’. One of her fellow pre-service teachers was an ‘ideal’ that Pia would like to reach one day in the future: ‘There is this girl in my class that I think will be a really good teacher in the future because she really goes into the mind of the other and tries to understand why he or she thinks in a certain way. I think I can handle teaching, but I don’t have so many different kinds of paths regarding how to help students. But I would like to’.

Pia’s teaching experience in teaching practice after the mathematics education course was positive: ‘I was quite nervous before teaching. That was the most difficult subject to teach in the practice, but I got positive things out of it. It went quite OK in the end. There were no bad things. But I did quite a lot of work beforehand’. Moreover, her experience with the course exam was very positive: ‘I was studying a lot, and I got the highest grade. That was really positive. But on the other hand, it is also negative because I know that even though I’m studying, there’s always the aspect that I don’t understand’. Pia concluded: ‘If I think about the future, if I’m going to be teaching mathematics, I have to do the work to understand mathematics and to give the knowledge to the students. I’m still a little insecure about the teaching. But I think mathematics is an important subject, and the teacher should be very good at it’.

6.1.3 The case of Barbara (Slovenia)

Motto: ‘I thought mathematics was a waste of time. I was being choked by everything’.

Barbara is a Slovenian pre-service elementary teacher in her fourth year of study. She did not remember many early experiences with mathematics, but she emphasised that the ones she recalls were positive: ‘Actually, mathematics was
not like mathematics. We were just adding, learning multiplication tables, subtracting. It was great!’ She was an excellent student, but mathematics was not her strongest subject. Her difficulties with mathematics started in the sixth grade when she received ‘for the first time grade two’ [on a 1–5 scale], which continued in secondary school. Barbara did not perceive mathematics content as ‘too abstract because everything is more or less general. It is a bit hard, but you just have to study’. She thought that she simply could not understand it but felt the need to understand what she was learning: ‘I always have to know why, why, why. Adding and dividing and similar things, this was clear; but later, when the content advanced...this...’. Barbara told that she ‘was in a dilemma’ about whether to devote her time to understanding the content or memorising it: ‘either I will learn things by heart and not think why this is like that, or I won’t have the time to memorise formulas’. As a learner, Barbara believed that mathematics was not her strong point: ‘I don’t know; generally, I think I am not cut out for mathematics. I don’t have a clear picture of bodies and areas and all these formulas. This was never clear to me’. In secondary school, she was mostly affected by math anxiety. Everytime she expected new mathematical content, she worried and feared she would not understand it and would not be able to learn it. This affected her learning process: ‘I did study, but it was like some fear in me would dominate over studying, and it was just getting bigger and bigger. First, I didn’t understand one thing, and I was already afraid. Then we would undertake new content, “what if I also don’t understand that”’. This was always present in me “what if I don’t...?”. I was always nervous ‘oh, I won’t understand, I cannot follow, why?”. Immediately as one question came to my mind, I was not able to follow anymore; I did not feel like it. I had a fear in me beforehand’.

Teachers were the main characters in Barbara’s school-time memories; they were either very positive or very negative. She emphasised that the mathematics teacher who taught her from sixth to eighth grade was a ‘good teacher’ with characteristics like attentiveness, willingness to help, encouragement and the ability to present the content in different ways. Barbara described her as someone who ‘...tried to encourage me to practice different tasks. She was great because she put emphasis on explaining the content in different ways, so we did not have to just memorise them. ...she was able to notice who understood and who didn’t, like me. It was obvious that there were a lot of things I didn’t understand. To some of us, she tried to explain the content in different ways’. Because Barbara was a good student with excellent grades in all other subjects, she faced many social difficulties in math lessons due to her impaired ability to follow the lesson and
understand the content: ‘I was always popular, but when math class started, I was excluded from the group. I was one of those students who others made fun of because we were not good. I always felt very lonely in math lessons. I think I was pushed aside in mathematics. “How come, if you have fives in other subjects...how come you don’t understand mathematics?”’ Barbara tried to reach out for help, but she often felt ‘ashamed’ because ‘the reaction I got was always bad. I tried, but it seemed like I wasn’t heard. If I was looking at the task and asking “how about this?” it was too much for them that I didn’t understand and I was asking. “Be quiet and write!” It was not pleasant at all. I felt rejected by classmates because I needed more time’. Barbara told that her classmates might have ‘even felt good like “yes, she needs more time, and I need less, so I know more than her” even though I was a good student’. Barbara experienced shame and fear from being rejected by her classmates. ‘I was always ashamed and afraid to admit that I needed more time to do my homework or to finish the exam’. Her brother was good at mathematics, and he ‘helped a lot’ with understanding the content: ‘...vegetables, fruits...he used everything but numbers, and I still did not understand’. Barbara emphasised that her brother inherited all ‘mathematical genes’: ‘He was really good at mathematics. He took from me all that ability’. Barbara recalled many negative experiences with mathematics in upper secondary school. The main character at that stage of schooling was her mathematics teacher. She labelled him a ‘bad teacher’ and emphasised his ineffective teaching style: ‘I still think about this sometimes. I wonder why he taught in upper secondary school. He was too smart, too big a scientist. I did not understand anything. Sometimes, he liked to go off content. He would write a title on the board and would draw and talk, and everything was like a chaos on the board. Nothing was systematically divided. He just talked, talked and talked, and even if you had a question, you did not have the opportunity to ask’. In addition, Barbara told about the teacher’s inappropriate attitude towards students: ‘Everyone was afraid, and so was I. I didn’t dare ask, so he would call me names...everything but students. I like when people are joking, but not at my expense and especially not about the things I don’t understand. He made fun of everyone not knowing, like “you will not pass”, “nothing will ever come out of you”. That was not funny!’ It seems that Barbara’s teacher was not attentive and encouraging towards students: ‘A couple of times when I failed the test, there was no encouragement from him; he just made me feel smaller. Because if the teacher is good, I have the will to study even though I don’t understand something. I am more willing to put an effort to understand, unlike when the teacher just brings
out my bad feelings. He didn’t encourage me’. Based on Barbara’s talk, the entire class had negative experiences with this teacher, and even though the students tried to solve the problem together with their parents, they were unsuccessful: ‘No one could change anything, but we had to adjust. Sadly!’

Barbara described an event in which the teacher acted unfairly towards her; his actions were discriminatory, and he applied double standards in his treatment of some students: ‘He started with an unannounced oral examination and called on my classmate who had straight fives. She said that she was not prepared and that she didn’t want to get a bad grade. He said “OK” and then called me. At that time, I had already received two failing grades, and I said that I also did not want another bad grade. But he didn’t care, and of course, I failed again. I was really angry, not because of the grade, but because of the differences in treatment. Why was it not OK for her to get a lower grade, but in my case, it was OK?’ Then I took my stuff and left the classroom in the middle of the session; from then on, he gave me some weird nicknames’. After that negative event, Barbara started ‘regularly avoiding math class’. She told it was due to fear: ‘I was really afraid to come because I knew that when I showed up, he would ask me’. Barbara’s avoidance behaviour greatly influenced her already existing difficulties with understanding the content: ‘I realised in the second year that I had a lot of problems because of avoidance’. She felt that she was not supported in these experiences, not by the class teacher and neither by her parents. Moreover, she felt alone in her problems, that no one cared and that no one actually noticed that something was wrong: ‘No one asked why I was avoiding math classes. And if only they had checked and saw that it was only mathematics. There was no conversation. The more I explained why, the less they understood. I only heard “you are avoiding math classes”, “you shouldn’t, and that’s it”. When my parents went to talk to the class teacher, she just said “Barbara was absent 50 hours this semester”. Had it been me, I would ask why. There were patterns, but no one asked’.

Barbara was affected by her parents’ passive role: ‘They were working. My father sometimes said something like “how come you don’t understand this”. Really typical of him. “You have to study!”’ And this was basically it. They knew what was going on, but they were like “what can we do?”’ They took the easiest way out, “you can’t do anything”, “that’s life”. Once my father told me that it didn’t matter how the teacher was; you have to know this content. On one hand, I can agree with this’. Barbara began to take a more active role to face her problem and end the avoidance behaviour. She took the initiative to solve her problems on
her own; however, she returned to the mathematics classroom as a passive learner: ‘I realised I had to do something, I had to go to the classes. I had to stop with avoidance. I was sitting in the last row, and I tried to be as invisible as I could. I always avoided eye contact; I always looked away so that I would be left alone. He would always address me in some way. He had this sarcastic humour’.

Barbara also compared herself to her other classmates and expressed how much the classmates’ ‘cheating’ affected her, especially the behaviour of her best friend: ‘I had a best friend in class. We sat together, and during the tests, she always let me down, always! Because when we had exams, people would always copy from those few who knew what they were doing. She did not know everything, but she cheated. And I am not that type of a person who cheats. I always preferred to have a failing grade than to copy. I could maybe ask her to help me, but she always said “leave me alone, I am copying”. She always succeeded that way’.

Barbara explained that in a way, cheating behaviour was supported by the teacher because those students who were cheating usually got good grades. After she failed, it was even harder to face the teacher: ‘For the teacher, it was enough that you passed the test, and he would leave you alone. But if you failed the test, then he went deeper and deeper, and you could just collect those bad grades. Classmates with good grades could keep them, but we had to collect ones’. From the present perspective, Barbara felt proud of not cheating. She struggled, yet she believed she probably learned much more. She believed that her grade, however low, was worth more than the good grades of the students who cheated: ‘Now when I look at it, I see that some people went through upper secondary school mathematics by cheating. But I believe they understand less than I do because I had to study alone. They copied, and I barely managed, but still I think I achieved more’.

Based on the negative experiences, Barbara developed a negative view of mathematics and gave up on it. Many times, even though she tried, she did not find the will to learn: ‘I did not know at all what we were doing in mathematics. I did not understand at all. I just thought mathematics was a waste of time. It was a waste of time to sit there. I could hardly prepare myself to start studying. There was no motivation to do that. So I always needed a lot of time to convince myself that I have to do this. But I never had good feelings; there was always something in the background, fear; even at the point of studying. I was being choked by everything. I didn't have the will to study! Too bad! I shouldn't have let this happen, and I should have practiced’. Barbara experienced many negative emotions towards mathematics, such as anger and feelings of confusion. ‘I was
angry. Really angry at everyone! Even more, everything was worse with avoiding, and no one understood me, but I was even angrier because no one asked “why”. Angry, but also confused. Sometimes with myself, sometimes with the teacher, sometimes just because mathematics existed. Many times with myself, like “why don’t you understand? How come?” Barbara also described her fear of mathematics: “Most of the time, I was afraid that I would not understand, that I would not know how to solve a task. Like they say, for mathematics, you have to practice, practice and practice, and if you don’t understand something, then more and more, you don’t understand… and the next day, I will get this, and I won’t be able to solve that, and then I will have so many things to solve. Fear of not finishing or not knowing in general”. Barbara also experienced math test anxiety, which was especially driven by her doubts about how the teacher would assess the tests. She was most worried about whether or not the opinion the teacher had of her would influence the fairness of a grade: “I felt awful! Because I think I was always thinking about the teacher, whether he would focus on me. I was always afraid that he would …he should search for knowledge and not think of how I am as a person, if he likes me or not, or because he thinks I have said things I shouldn’t have”.

Barbara’s school-time experiences left a mark, and she started elementary teacher education studies with a negative view of mathematics: ‘First year of university...mathematics...what is this...why?’ But Barbara managed to guide herself through the struggle: ‘I didn’t care much, I was there. I told myself that I would make notes and that I would pass what I would have to and that’s it!’ In the first year, she was faced with the mathematics course which she did not find ‘interesting’: ‘I did not feel it was useful either. I remember exercises. I know she [teacher] tried to do something interesting, but I know we were not interested. We were working in groups, and we got manipulatives, and we had to discover some things, and no one was too excited about it. We played, we discussed, but it was not interesting’. In the third year of university, Barbara had her first mathematics teaching experience. She was teaching alongside another pre-service teacher in the second grade. She tried to prepare herself as much as possible and wanted to avoid teacher-centred teaching: ‘I had in mind all the time that there wouldn’t be someone like me…who wouldn’t understand and would remain quiet and who would feel alone. Because of that, we went through activities to make it easier and more interesting for pupils, and if a pupil didn’t understand the calculation, he/she can use manipulatives. I was surprised that I was not afraid before the teaching experience’. Barbara described the lesson as full of versatile tasks for
pupils and the teaching experience as successful and positive. She emphasised that the highlight of the teaching experience was pupils’ aha! experience: ‘We had different tasks with linx, abacus. Pupils worked in groups. They also had to work on puzzles. They had different activities, not just simple adding. When I saw that pupils had this aha! experience, this was so good. This was such a pleasure; really, this was the highlight, this was the goal. When you see that they understand, everything goes in a positive direction. We really managed well’.

Barbara liked learning mathematics in groups or working in pairs mostly because learning in such a way improved her understanding of mathematical content: ‘In my exercise group, we understand each other quite well. It is much easier for me if there is group work, especially when it comes to mathematics. We would discuss, and I was really able to understand. I am listening to them, and I am thinking “yes, that’s right”. If I work alone and I come home and I have mathematics homework to do and I don’t know how to do it, I will just push it aside somewhere. I didn’t ever try hard enough’. Due to the content of the mathematics didactics course in the fourth year, Barbara’s view of mathematics became more positive. ‘The content became very interesting, and I decided to attend lectures regularly. And we also went to the mathematical trip around Maribor during our practices. This was really good and interesting! I think we were missing these kinds of things...observing, finding out things on our own. Not just “it has to be like this and that”. I am still not completely there. I don’t understand everything. But I am slowly getting there. I am more motivated’. Here again, teachers were important characters, especially their teaching style. Barbara emphasised the meaning of student-centred teaching that they had applied during the course: ‘And lecturers also... the teacher is anyway a bomb. She really is. She knows how to make us laugh; also, this new assistant and the old one also changed the style. She had some good ideas. You can really see that they tried to make us think on our own, like “how would you teach this to pupils?” That is really great to think about’.

Barbara experienced a turning point due to course readings: ‘The article is a bomb! I was really surprised that it was possible to make these lessons interesting. In the article, the idea was that pupils came to the conclusions alone. I thought “aww, some teacher had an idea that pupils would figure out what area is by themselves”. They figured out everything alone, the teacher just guided them. This was “aww”. This was a turning point for me’. Barbara thus realised the importance of teachers’ creative ideas and student-centred teaching for the learning process. She also told that her motivation improved: ‘This article raised
my motivation high for the whole year. Now I am just waiting so we can get more of these kinds of articles. I can see that mathematics is not boring. There can be nice things in mathematics’. The belief that ‘math can be fun’ was present in Barbara’s talk: ‘I just know I am so proud that I am in my fourth year and that I would never in my life think that mathematics can be fun for me, but it became really nice’. Barbara sees her future as a mathematics teacher in a positive, optimistic way although she expressed fear towards it. Because she does not understand all the mathematical content, she is worried about how this will affect her teaching and her pupils. ‘Sometimes, I am afraid of mathematics. How I will teach it at all if I don’t understand, how I will be able to explain so someone else will understand?’ She once again recalled the experience with her teacher: ‘On the other hand, I know I will not be like my teacher who made my life miserable because I see how long negative feelings can last’. She concluded by saying that her negative experiences would not ‘be an obstacle’ for her as a teacher. She wants to ‘forget what happened and get the best out of it’.

6.1.4 The case of Ema (Slovenia)

Motto: ‘Why is it that one is not allowed to fail? Are you a bad person because of it?’

Ema is a Slovenian pre-service elementary teacher in her fourth year of study. She began recalling her mathematical experiences: ‘I don’t know… I cannot remember much from elementary school. I don’t think there were problems, otherwise, I would remember’. She mostly remembered positive experiences and told that she was an active student. Moreover, she was going to math competitions – ‘calculating is playing’ – which were meant for high-attaining children, and she received ‘acknowledgment’. Participation in these competitions was voluntary, but usually, they were meant for pupils who had good grades in mathematics. Ema’s experiences with mathematics became negative in secondary school when she developed a fear towards the subject ‘because if you don’t know something in first grade, it is ok...you can afford that in first grade; but if in seventh grade you don’t know how much is four multiplied by five, you just cannot afford that. This is how the society functions!’. Ema told about the common practice in mathematics instruction when each pupil would go to the blackboard to solve a mathematical task: ‘I started to have this fear when we started to go to the board... Oh, this was a catastrophe! ...anyway, I didn’t have a clue what we were doing, and then I even
had to go to the board, oh no...’ Memories of these practices were very emotional for Ema: ‘if you say to me now that I have to go to the board, I will start crying...this was awful for me...my whole day was ruined when I knew I had mathematics. This system is really wrong...’ Ema told how she developed a fear of failure and a fear of not reaching the standards: ‘because it is always a question of whether you are reaching the standards or not, and if not, you are stupid’. There is no balance’. She was afraid that when exposed in front of other pupils, she would not be able to solve basic tasks, and her classmates would make fun of her: ‘even if I knew everything, I would always wonder if other pupils would make fun of me, if I would make a fool of myself...in fact, I was also afraid that I would not know how to calculate up to ten...in seventh grade; because you actually can get such a blackout, you don’t know how much is one plus one’. Ema’s fear of solving tasks in front of others became stronger, particularly due to the perceived importance of the subject: ‘This fear was most present in mathematics because, for example, in the Slovenian language, if you don’t memorise some text, this is not so bad, you are not considered to be stupid. But if you don’t understand 275 - 134, this is strange. How come you don’t know that? Mathematics in society...mathematics can show how much someone is able to think logically much more than other sciences’.

Ema had difficulty with learning mathematics: ‘If I didn’t understand something 100%, I could not continue, and that is what was destroying me in mathematics because there were really few opportunities when I could say “everything is in order, so I can continue”. But I needed this! And in mathematics, I could never say that. And then I usually threw the pencil and said “that’s enough”’. Ema developed a negative view of mathematics and especially of herself as a mathematics learner: ‘When I saw mathematics on the timetable, I really didn’t feel like going because during the lessons, I didn’t know what to do’. She always felt that she was slower than other pupils, that she did not understand the content and that she was not able to follow the lessons: ‘I told myself many times “now you will follow”, but I was already lacking so much, so I could not follow. I had beforehand in my head a belief that I wouldn’t be able to follow. I simply always had the feeling that I was slow because I didn’t get it, that I didn’t understand the content and I was somewhere in the air and that nothing was clear to me’. During mathematics classes, Ema experienced ‘boredom...feelings in me were like “look, again you are behind, you are slow, you are unsuccessful, you are not able to follow, again you are the black sheep that doesn’t know and is asking all the time and looking at what others are doing”’. Due to her difficulties
understanding, Ema thought lowly of herself: ‘Anyway I am not smart, so I will be stupid, there’s nothing to be done’. This further affected her performance: ‘And then my grades started to drop lower and lower, so I even had two, lots of twos’.

Ema was a pupil with good grades ‘between four and five’ in all subjects except in mathematics where she usually got ‘three, two or sometimes one’. She felt pressured to obtain good grades in mathematics: ‘My mum was saying “this is not OK, the grades are not OK”, and with this she hindered me a lot’. Ema told how her parents ‘did not have the real picture of what was going on for a long time’. She was successfully hiding her failure in mathematics in order not to disappoint her mother: ‘I would not tell the truth to my mum about my grades, so she did not have the real picture because I did not want to hurt her’. In seventh grade, Ema’s mother found out about her real accomplishments in mathematics and was indeed ‘really disappointed’ and decided to hire a mathematics tutor: ‘She saw my grades, and she said “you will have a tutor”’.

A tutor was a turning point for Ema: ‘a lot changed then for me in terms of mathematics...’ For the first time, she felt she could actually learn the content and understand it: ‘After I went to my tutor, I had a feeling “aha! I will go to her, and I will understand. Without a problem!” Then I was able to gladly do mathematics. Everything was great, and my grades were one, two, two, two, and I remember one day, my teacher assessed me, and I got five. I realised that if someone could explain things to me and if I sit and work, I could do it. I can really do it!’ She realised for the first time that she was not the only one to blame for her own failure: ‘I came to the conclusion that I am not that stupid at mathematics, that I can learn it but that there must also be some external cause’. She described her tutor as a good teacher and emphasised her ability to explain the content in a simple way: ‘even now she explains to me like I was in the first grade. She explains everything in everyday language. She explains to me the content as if I didn’t know how to count to five. And this is great!’ For Ema, expectations of others had always put pressure on her, so she especially liked that the tutor never expected her to have any prior knowledge, and she never made her feel small: ‘We always start with mathematics from the beginning like I had never done it before; that is great because it is so simple. I don’t like the sentence “you should have known this already”. I can’t stand it! When she showed me that she didn’t laugh at me when I didn’t know trivial things, I went there really gladly’. Ema developed a new learning style; she was passive in mathematics lessons and was no longer worried when she did not understand the content as she knew that she would visit her tutor before the exam. ‘Then I was doing things like that; when I
was at school and I said to myself “aha! I am not following. I cannot follow that quickly. I will go to my tutor and this will be it”. And still today, I don’t follow! This has been going on since the seventh grade. Fourteen days before the test, I go to my tutor...’ With the tutor’s help, Ema’s grades in math got better: ‘It was easier for me, however, I still didn’t feel like going to solve the tasks on the board’.

Ema’s experiences with mathematics also improved in the vocational upper secondary school she attended. She was a student athlete, which meant that she was often absent due to sports competitions and training. For that reason, she was not required to actively participate in mathematics lessons (e.g. solving the tasks on the blackboard). ‘There was finally no fear, and I was really happy. This was my solution. I didn’t have to go in front of the board. And then I was able to learn things with my tutor’. Her athlete status also brought her some benefits in evaluative situations. She knew exactly when she would be assessed, whether orally or in a written exam. This further influenced her learning, which became very tutor-dependent: ‘Again, I wasn’t able to follow. I learned quite fast but only before tests. I didn’t follow. For me, it was too fast! When I lose the connection, everything is over’. With her tutor’s help, her grades got better: ‘in secondary school, I obtained two or three, and in upper secondary school, I got four. Usually, everybody’s grades dropped, mine went up’. Ema’s mother’s role changed significantly. She understood Ema’s problems in mathematics and changed her attitude towards Ema’s grades: ‘She said “Nothing Ema, it doesn’t matter how many times you repeat”, and when she said this, this saved me. That I can allow myself to fail! So there is no outside pressure!’ Ema felt less pressured, which in her opinion made her want to be much more successful at mathematics. She also explained that her test anxiety was much lower when she had her mother’s permission to fail: ‘We had a test in mathematics, and my mum said “look, if you get two or one, it doesn’t matter”; when she said this to me, I didn’t have any fear, and I got the best grade. It is possible that some time before, I knew much more, but now I had no fear. I got four or five. When I allowed myself to fail, I usually got the highest grade’. Ema emphasised that permission to fail ‘is what I lacked during my school time’. She wondered: ‘Why is it that one is not allowed to fail. Are you a bad person because of it? Just the question of whether you are afraid or what you are afraid of is already a lot. If the teacher told me that I could allow myself to not know something, she would do everything with that. Because no one says that to you! No one gives you permission to fail!’
Ema wanted to apply to a university programme and was required to do the matura examination for students who want to continue to general upper secondary programmes. For that reason, she enrolled into the mathematics course that prepares students for the matura: ‘There were 40 of us, and every year, just four to seven pass the course. This course is really difficult! This course is like a ticket to the matura. If you pass it, you can go to the matura. The demands are high’. The course differed from the courses in school, especially in the objectives and in teachers’ attitudes towards students: ‘We were treated differently...not like upper secondary school students. There were also older people on the course. Everything was focused on the result, on the grade. There was no pressure of going to the board’. Ema told that one of the teachers had a similar teaching style and similar expectations as her tutor, which was a major benefit to her: ‘We had a teacher who actually explained things really slowly, like I didn’t know how to count to five. He didn’t expect much. Maybe he didn’t expect much because he knew we came from vocational school and that we left out a lot of content, but this helped me a lot’. During the course, Ema was able to follow the lessons without the fear of having to solve tasks on the blackboard, which was especially important for her: ‘the teacher didn’t call us to the board, and that was just great for me! And I could follow afterwards. I was always going to the classes, following everything regularly. I took the course really seriously’. She became a more active learner: ‘I was trying to ask more. I had my hand raised all the time, and my tutor also helped me’. Ema successfully completed the course and passed the matura exam: ‘Because the course was so difficult, the matura was easy in the end. I passed it with three. This was really a success for me even though I didn’t get the highest grade. I was happy when I was solving tasks, and I realised that I knew these things, so I am not stupid. I also had an excuse in my head that it would not be surprising if I did not pass the matura as I went to vocational school’.

At the beginning of her teacher education studies, she did a mathematics content course and again experienced math anxiety: ‘when we had to go to the board to solve a task, I don’t even have to explain more, you know what kind of nightmare this was for me. Complete fear!’ Ema’s story from secondary school started repeating itself: ‘I didn’t know anything at lectures because it was too fast for me. It was going too fast!’ She realised that ‘anyway, no one knows what we are doing’. She wondered how teachers did not notice that the majority of students did not understand the content: ‘I don’t understand why no one asks themselves what is wrong. There are a lot of students who don’t know what they
are doing. Out of 80, there are three who actually understand, and those three are acting as teachers’. She continued to seek help from her tutor. In the third year of study, Ema conducted her teaching experience in pairs. She taught in fourth grade. Even though mathematics was never her strongest subject, she did not have any fear connected to teaching mathematics: ‘I was not afraid; I was a bit nervous, which is normal before the teaching experience’. She felt that all the contents of elementary mathematics were quite easy; the only thing she perceived as difficult was ‘how to explain the content to pupils in order for them to understand’. Ema’s teaching experience was successful, and she felt like she ‘learnt new things’.

However, in her fourth year of study, she was not satisfied with the mathematics didactics course: ‘It bothers me a lot that we are going so fast, and this is not just my opinion. Some students who understand mathematics really well also said that all this is so confusing’. Ema does not consider the course bad, but she feels it does not arouse her interest: ‘I don’t think it is like that because of the subject. I like sports, but I don’t like the lectures in physical education at all, and I didn’t like physics before, but at university, I enjoyed the physics lectures very much. But I also think you have to put a lot of effort to make this kind of subject, like mathematics, which is not interesting for most students, actually interesting. But I think it is possible!’ Ema is also not satisfied with the teachers: ‘My personal opinion is that teachers here are not as they should be, but I don’t know what I would change. I don’t want to say that the teacher is bad, not at all; it just doesn’t work for me’. Moreover, she believes that teachers are more focused on reaching their own objectives than actually caring about how the content is affecting students and whether it is actually useful for their future profession: ‘The most important thing should be how much we actually gain out of it. This knowledge that we gain here is just a couple of percentage points of what you really need and do in practice, especially with young children’. Because of that, Ema decided not to attend lectures anymore: ‘I have to admit that I am not going to lectures because I have come to the point where I follow my own opinions, and if I don’t want to go, I am just not going. Anyway, I don’t learn anything. But I know that I will pass the exam because I passed all of them already, and I believe that if I am there doing something else, such as solving sudoku, I will not pass the exam any easier’. Ema believes that her fellow pre-service teachers have similar views: ‘I also asked other students how they felt about the courses because I wanted to know if, again, it was me. And when you draw the line, negative opinion seems quite common’. In some way, Ema’s learning style from upper
secondary school continues, and she still has her tutor as a backup: ‘I will definitely go to see my tutor, also because I always have a better feeling afterwards’.

Nowadays, Ema’s view of mathematics as a subject is quite positive: ‘I respect mathematics as a subject’. She no longer connects failure in mathematics to intelligence: ‘I want to emphasise that mathematics is not a measurement of someone being stupid or smart; this I know today, but in secondary school, I didn’t know that. Even adults don’t know that. So how will they teach their children if they don’t know? If you allow a child to not be successful, he or she will want to be successful because there will be no pressure’. However, she sees her own mathematical experiences negatively: ‘I still didn’t solve things by myself. Probably, when I will be teaching, I will have problems because of it. I don’t blame teachers. Everything is some kind of mixture between my fear, a belief that I cannot follow and a bit of speed on the side of teachers. Because of that, it is what it is’. Ema concluded her talk by saying: ‘I don’t think my experiences will affect me negatively, not more than other things’.

6.2 Comparing pre-service teachers’ mathematical biographies as the starting point of an analysis of their identity work

Here, I used narrative analysis (Polkinghorne, 1995) or the holistic approach (Lieblich et al., 1998) and presented four pre-service teachers’ mathematical biographies as a whole. This step of the analysis aimed to give voice to pre-service teachers who identified themselves as having had negative experiences with mathematics and thus developed a negative view of the subject. The analysis revealed other important aspects in terms of the content and form of the identity narratives. The content of the biographies offered insights into their world and thus included their personal experiences of learning and teaching mathematics as well as the ways in which they dealt with those experiences (Kaasila, 2007a, 2007b). Further, these biographies not only described and connected events, but pre-service teachers also evaluated these events in meaningful ways (cf. Hinchman & Hinchman, 2001; Riessman, 1993).

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5 Two emploted biographies of the cases considered in this report can be read in the following publications: Reiija’s biography in Lutovac and Kaasila (2010) and Ulla’s biography in Lutovac and Kaasila (2011).
The mathematical biographies confirmed that the pre-service teachers in this study had indeed developed a negative view of mathematics during their school time (see Kaasila et al., 2008a; Lipovec, Antolin, & Lutovac, 2010; Lutovac & Kaasila, 2010, 2011; Pietilä, 2002). While this was the criterion for participation in the study, it was also one of the outcomes of their stories. This holistic analysis yielded two kinds of information: a) the unique experience of each pre-service teacher and b) important shared patterns across cases (cf. Patton, 1990, p. 173). In this sense, the holistic analysis generated a categorical analysis of the pre-service teachers’ mathematical identity work as it helped in identifying the key concepts in their biographies.

Each biography revealed central but specific elements that contributed to negative school-time experiences with mathematics for each pre-service teacher. These are crystallised in the motto of each biography. The central elements in Mari’s story were her own perfectionist demands on herself – a desire to attain excellent grades – and parental pressure. In Pia’s story, this was manifested in a lack of understanding, but there was also the desire to understand and an emphasis on rules and procedures in mathematics teaching. In Barbara’s story, these elements were characterised as teachers’ negative attitudes and actions, peer rejection and fear. In Ema’s story the central elements were fear of exposure, social beliefs about mathematics and a desire to be under no pressure (e.g., ‘permission to fail’). In the details of the experiences reported, the stories displayed heterogeneity across the Finnish and Slovenian cases, including heterogeneity within the Finnish and within the Slovenian cases.

Despite the fact that all the pre-service teachers in the study recalled negative experiences with mathematics and identified themselves as having a negative view of the subject, it seems that the nature of the negative view of mathematics differed between the Finnish and Slovenian cases. Based on the biographies presented, Ema’s and Barbara’s experiences were more challenging and emotion-laden (references to fear, anxiety and public shaming), and consequently, they appeared to have a more averse view of mathematics (Di Martino & Zan, 2010). When confronted with challenges, they utilised strong emotional utterances to express negative emotions related to mathematics (Britner & Pajares, 2006). Conversely, as we read Mari’s and Pia’s biographies, while it seems that they did have difficult and unpleasant experiences, their biographies show dissatisfaction with the situation during school time as opposed to emotion-laden episodes. It also appears that the negative experiences of the Finnish and Slovenian cases
differ in terms of quality and intensity. A categorical analysis will present a more
detailed picture of these issues.

Notwithstanding, the stories showed a great deal of homogeneity across the
Finnish and Slovenian cases. It was evident that all the biographies dealt with
issues, such as the perception of math as difficult, the lack of math ability and
lack of motivation, dissatisfaction, a desire to understand and labelling (see
Boylan & Povey, 2009; see also Boaler & Greeno, 2000; Boaler et al., 2000; Di
Martino & Sabena, 2011; Di Martino & Zan, 2010; Hannula et al., 2006). As
acknowledged by Dutton and Dutton (1991), this study also identified pre-service
teachers’ talk about the lack of emphasis in mathematics instruction placed upon
understanding, teaching detached from real-life experiences and paper-and-pencil
drills as significantly shaping pre-service teachers’ mathematical identities. The
pre-service teachers’ negative view of mathematics also included a negative view
of their own teachers (see also Hannula et al., 2006; Hoskonen & Pehkonen,
2005). These latter issues have been well documented in the literature on school-
time experiences with mathematics. Considering that these biographies were
understood as identities, these components therefore constitute the pre-service
teachers’ mathematical identities.

As part of the holistic analysis, I examined the form of the biographies and
looked at the structure of the plot. According to Lieblich et al. (1998), there are
three basic formats of the development of the plot, depending on the progression
of the narrative: a progressive narrative in which the story advances steadily; a
regressive narrative characterised by a course of deterioration or decline and a
stable narrative in which the plot is steady. These three basic formats can be
combined to construct more complex plots. Considering these notions, all the
biographies in this study had more or less complex plots. The narratives usually
began with positive experiences of mathematics in elementary school. The
elementary level therefore represents a high point; however, the converse was
also found among the cases. In the transition from elementary to the lower-
secondary level of education, the narratives became regressive with a
deterioration in the experiences. They revolved around struggles with difficulty,
failure, challenging relationships with others and negative emotions.

Based on the plots in the Finnish cases, the secondary level represents a low
point. In telling about their experiences from upper secondary school, however,
some Finnish identity narratives became slightly more progressive. However,
some changes at that level did not have important meaning for the pre-service
teachers. Meanwhile, the Slovenian identity narratives deteriorated, reaching their
lowest point in upper secondary school. Based on the progression of the plots, the experiences relating to teacher education seemed to be significantly less unified. For the Finnish cases, this was another high point. On the other hand, the Slovenian narratives were progressive at this point, but for some cases, their experiences did not represent a high point. Still, most of the cases in this study experienced a turning point during teacher education (cf. Drake, 2006). The turning points led to enhanced views of mathematics and less emotion-laden experiences, which seemed to have important meaning for the pre-service teachers’ mathematical identities. These turning points provided useful information that might signal possible facilitators during teacher education.

The form of the biographies between the Finnish and Slovenian cases differed a little in terms of the complexity and coherence of the narratives. The Slovenian cases told narratives that were more complex, including several meaningful episodes, and in this sense, they were also lengthier (see Barbara and Ema). However, the coherence in the narratives was stronger in the Finnish cases; all the events and characters in their narratives were tightly connected and important for the meaning of the story they told. Their narratives included fewer meaningful episodes and were, in this sense, more straightforward. I believe this influenced the lower complexity of their plots (see Mari and Pia).

In all, the narrative analysis revealed specific and unique mathematical experiences for each pre-service teacher. The holistic analysis of the content helped to detect the central constructs in the pre-service teachers’ mathematical identities, including the concepts needed for further analysis. The content also explicitly showed that understanding a mathematical biography as an identity brings together various complex and interrelated concepts, such as beliefs, attitudes, emotions, knowledge, views of mathematics etc. A focus on mathematical identity as a story thus means that these concepts can be considered simultaneously as they are all part of the nature of pre-service teachers’ mathematical identity. In addition, biographies as identities offered a contextualised understanding of these concepts. The holistic analysis of the form, such as the progression of the plot, helped in detecting the focal points in the pre-service teachers’ past, present and future mathematical identities. It was the starting point for further questioning about the similarities and differences in the pre-service teachers’ identity work and the extent to which this identity work was reflective of the two education contexts.
7 Past-oriented Mathematical Identity Work

This chapter considers pre-service teachers’ mathematical identity work in the context of their past-oriented identity narratives, that is, their school-time experiences. More precisely, the dialogue between their past and present mathematical identities is considered. Based on the past-present dialogue, I identified the types of mathematical identity work that the pre-service teachers’ engaged in and the similarities and differences between these types. This chapter (as well as Chapter 8) is structured so that it presents the Finnish cases as one group and the Slovenian cases as another. However, this is not to say that the groups are internally coherent. I use this contrasting structure in order to make the differences regarding educational/institutional contexts more visible. However, in my interpretations, I acknowledge the heterogeneity between the cases within each group. The latter had also been discussed in Chapter 6.

7.1 Past-present dialogue: ‘Outsider’ identity work

7.1.1 ‘Imperfection’

Failure: self-oriented perfectionism

In terms of grades, I kind of did a good job in mathematics, but I have been a very, very good student. From the sixth grade, I had a 9.4 average grade, so math was always my lowest grade although it was good. (Reija, Finland)

I think I got seven or eight. It’s not very bad, but everyone else got good grades, like nine or ten, and I thought that I was very bad because I only got seven or eight. (Heli, Finland)

And then my math grade went down; I think I got six or seven on the tests. I had negative feelings because of the failure of not getting good grades... (Ulla, Finland)

The data excerpts from Reija, Heli and Ulla show that for the Finnish cases, performance in mathematics represented their lowest grades throughout their entire schooling. From the present perspective, Reija and Heli realised that their achievements were not low; however, not being as successful as in other subjects was an issue for Reija. Heli’s classmates were more successful at math, which led
her to be less satisfied with her achievements, thus shaping her view of herself as a mathematics learner. Additionally, Ulla mentioned negative feelings due to the grades she received. An interesting rhetorical component in Ulla’s talk is the use of the word ‘failure’. She labelled her performance as a failure although this is not visible in her overall achievements.

Heli, Mari and Reija were particularly dissatisfied with their math performance and made reference to a level of failure which was not evident in their overall achievements.

Actually, I thought I could manage the advanced level, but then I chose the general because my friends chose it, and I went with them. Maybe because I’m such a perfectionist, I wanted to be the best in everything. I would have liked to be good at mathematics. [...] I think that because I was very good at every other subject and I was not that good at mathematics, I was waiting to be good, and then I wasn’t, so I compared mathematics to the other subjects in which I got better grades. (Heli, Finland)

In the beginning of upper secondary school, Heli was in the process of deciding whether to enrol in the general or advanced level of mathematics. Her consideration for taking the advanced level in mathematics seems rather unusual, particularly due to the difficulties in terms of lack of understanding that she encountered during her elementary education. The perfectionism manifested in her utterance ‘I want to be the best in everything’. It seems that Heli’s success in other school subjects made her rather vulnerable in the face of her difficulties with math, thereby leading to negative emotions.

I was quite pressured in school because I was so hardworking and nice to the teacher, and I was an active pupil. When the math test came, I practiced a lot because it was very important to get a good grade. I used to work so hard so that I wouldn’t get bad grades. I think I played a huge role because I put a lot of pressure on myself. I was frustrated, and I spend a lot of free time practicing. I was tired. Sometimes, I was so angry with myself because I was so bad. (Mari, Finland)

Mari set high personal standards and put emphasis on attaining good grades in mathematics despite the difficulties in understanding the mathematical content. She pointed out that her hard work and perfectionism were driven by fear, thus seeking to avoid failure. Retrospectively, Mari recognised that she pressured
herself over mathematics achievements. Further, she often experienced negative emotions and disappointment in herself.

I’ve always tried to be the best in the class, and I was in other classes, but in maths, I didn’t do so well. I tried to be a good student, a good math student. My parents were always like “we know you do your best, and you don’t always have to be the best in the class; you just have to be as good as you are”. So, I didn’t have any pressure from my parents. I just had it inside me. (Reija, Finland)

Reija told about her performance-related strivings to be ‘the best in class’, however, math seemed to be a more challenging endeavour for her. Her struggle for perfection resulted in negative emotions. She emphasised self-pressure rather than pressure created by parental expectations or parental criticism (cf. Frost, Marten, Lahart, & Rosenblate, 1990).

In Heli’s, Mari’s and Reija’s identity talk, self-oriented perfectionism was manifested (Besser, Flett, & Hewitt, 2004; Lundh, 2004). These cases were driven by beliefs in achieving perfection, and poor performance in math was not in line with these beliefs. Accordingly, only the highest grade was regarded as successful; they seemed to be striving for flawlessness and for avoiding failure in mathematics. This is in line with the literature on perfectionism. A central premise of perfectionism is difficulty accepting failure and responding to it in a maladaptive way (Hewitt & Flett, 1991; Lundh, 2004).

Studies indicate that perfectionists place great importance on attaining standards for themselves (Hewitt & Flett, 1991) and are highly sensitive to the perceived importance of their performance (Frost et al., 1990). Arguably, therefore, Heli’s, Mari’s and Reija’ perfectionism was linked to the tendency to view math performance as highly important. Accordingly, they showed a strong dissatisfaction with their performance in math, especially because they continuously attained lower grades than they strived for. Grades are therefore of great importance and play a central role in narratives of perfectionism. Although these pre-service teachers seemed to be quite successful at math, their high standards undermined their satisfaction and resulted in disappointment. As suggested by Besser et al. (2004), the latter may be internalised into a negative self-view. Indeed, Heli, Mari and Reija consequently developed negative views of themselves as mathematics learners, as evident, for example, in Mari’s utterance ‘I was so angry with myself because I was so bad’. Moreover, for these pre-service teachers, it appeared particularly difficult to handle failure as they
attributed a high relevance to excellent grades and success. Accordingly, reports of negative affect were common in their identity narratives.

**Assessment- and evaluation-related fear**

*I was afraid of the tests, and I wasn’t so enthusiastic to go to the lessons, but I was not afraid of the lessons. It was easy to just be in the class and not say anything. When the math test came, I practiced a lot because it was very important to get a good grade […] I was spending a lot of time thinking about what the teacher would ask. (Mari, Finland)*

*I didn’t like tests because I knew that I was not going to succeed, that I was not going to get a good grade from this; I was perhaps also afraid of the grade I would get… (Ulla, Finland)*

*Sometimes, I was afraid of taking tests, especially if I felt that I wouldn’t do well. Before the test, I had stomach ache. I was sitting there and looking at the paper and thinking “oh my god, I don’t know if I can answer that”, but usually, I just started and tried my best. Studying math was more stressful than, for example, languages because I liked them. It was like a hobby to me, but in math, it was very serious. (Reija, Finland)*

The talks of Mari, Ulla and Reija reflect aspects which were common to all the Finnish cases. In line with the desire to perform well and to avoid failure, the Finnish cases experienced negative emotions, particularly in relation to evaluations or assessments. They were worried and afraid of math tests, and according to Wigfield and Meece (1988), elementary and secondary school students commonly experience such emotions.

Moreover, they also feared being exposed in front of other classmates and their answers being publicly evaluated:

*If we did some kind of exercise and then started checking them and the teacher would begin from that corner and everyone said it, I would be waiting: “oh no, I don’t know the answer”, and that was awful because I was afraid that I wouldn’t know it and maybe everyone else would laugh at me or say something like “why didn’t you do it” or “why didn't you know it” because it’s so easy for the others. (Heli, Finland)*
We had lots of calculations on the board. I was insecure about doing those, and I didn’t want to make mistakes because it felt very bad if I made a simple mistake. I’d feel like “oh, I’m stupid or something” [...] because if there was no one else, then it’s ok [...] And I didn’t want to go to the board to do it because I wasn’t sure about myself doing it right; I’m really slow. It takes time, so it feels like the others are saying “oh, why isn’t she doing it fast”.

(Pia, Finland)

Like Heli and Pia, the other Finnish cases reported doing math exercises on the board or reporting results in front of classmates as a common component of mathematics instruction during their school time. Heli and Pia were worried about how they would be seen in the eyes of others. Similar issues were reported by college students in Perry’s study (2004) on math anxiety. Pia’s worry was also manifested because she thought of herself as a slow learner and was very insecure about her mathematical ability. This insecurity was heightened when she solved tasks in front of peers.

I think the hardest part was when bullies were in the same class, and I had to say the answer; I was very afraid of whether I knew the answer or not, and I was afraid to say it out loud. (Reija, Finland)

Reija reported having had tough experiences of being bullied in secondary school. It seems that her classmates perceived her as a teacher’s favourite, thereby leading to their antipathetic attitudes and relationship with her. This is well in line with Martin’s (1984) discussions on teachers’ pets and class victims. She felt weak in math, and the derogatory comments also negatively affected her. The circumstances under which pupils had to report on the results of mathematical tasks were challenging for Reija. She was afraid of making mistakes as her classmates would laugh at her and scorn her.

External recognition of inability

Importantly, the school context shaped the pre-service teachers’ perceived math ability and emotions. The pre-service teachers’ identity narratives were replete with reports on teachers and classmates.

He didn’t like those pupils who needed support. He always asked those pupils who were good at mathematics. Because I needed the support, I asked him if he could help me. He always just said to look in the book and read it from
there. [...] Then (in upper secondary school) we had one male teacher who taught at the advanced level; he always told us “you can’t do anything because you are only at the general level”. (Heli, Finland)

I think I didn’t get the kind of help that I needed from the teacher. [...] But she was really focused on those who were really good. I remember that she was helping them very much and talking to them and giving them more challenging tasks. She didn’t encourage weaker pupils. [...] I think the teacher in secondary school was the final straw. I felt like the teacher was also looking at me like “you cannot do this, you don’t learn”. (Ulla, Finland)

Heli and Ulla told about teachers’ favouritism of ‘good’ pupils. Teachers would often praise high-attaining pupils and underestimate others. They would even act in a condescending manner towards mathematically ‘weaker’ pupils. Ulla used an extreme metaphorical utterance ‘the teacher was the final straw’ in her evaluation of her secondary school teacher. The pre-service teachers felt that some pupils in the class got more help than others (cf. Martin, 1984). In line with much of the research literature, the pre-service teachers believed that their teachers did not demonstrate care for pupils (e.g. Hamlin, 2004; Muller, 2001). They felt like they did not get help or support and particularly encouragement from their teachers (Krzywacki, 2009; see also Brophy, 1983; Zeldin & Pajares, 2000).

She threw chalk at pupils if they didn’t know the answers; I think it was funny for her, but it wasn’t funny for us [...] and when I didn’t do so well, my teacher said “Are you studying math at home at all?” and “don’t you understand this?” (Reija, Finland)

Some teachers, like Reija’s, displayed a negative attitude and behaviour towards pupils who were mathematically weaker. This has been considered by Muller (2001) as one aspect relating to the lack of care in the teacher-student relationship. Reija often felt reminded of her own difficulties.

When I went to secondary school, the same teacher used to teach my sister. So I think first she said something like “you must be very good in math because your sister was so good”. And I was like “I don’t think so”. (Ulla, Finland)

Ulla’s teacher had set high expectations for her because of her earlier teaching experience with Ulla’s sister. This teacher judged Ulla’s math ability on the basis
of her sister’s. Such judgments may have insinuated in Ulla a belief about the role of genes in talent related to mathematics.

However, the importance of respect in the mathematics classroom was emphasised in the following narrative by Ulla (see also Lutovac & Kaasila, 2011).

*Math lessons were really encouraging and nice because she herself... she was really excited about math. She was telling us different stories; how she became a math teacher. She was so different than the other math teachers, really joyful and encouraged us in math. I think she was the first teacher in a long time who actually believed in me, and she actually said “you can, you can do this!” and did not make me feel stupid. I think there were some of my friends who also started to like math, and they said “it’s not that difficult”. Somehow, I started to have positive experiences with math. (Ulla, Finland)*

Ulla described the meaning of the interactions with her upper secondary school teacher, which were positive for Ulla’s view of herself as a learner and her view of mathematics as a subject. Her teacher was encouraging towards pupils; she helped them; and she was enthusiastic and joyful about her occupation. Furthermore, what seemed to be of great importance to Ulla was that her teacher believed in her. The lack of belief in pupils has been discussed by Schorr and Goldin (2008) as having a devastating impact on students’ affect. However, Ulla felt she could succeed in math after all. She used active voicing, such as ‘you can, you can do this!’ to convince the audience of teachers’ persuasions. She also emphasised that not only had her experiences changed for the better but also those of her classmates.

*Classmates were important aspects in external recognitions of inability.*

*My classmates were always very good in every subject in school, including mathematics; I thought that they were so good, and I was not. I was a little bit sad about it. [...] They tried more than me. And they got better grades than me. (Heli, Finland)*

Heli’s data excerpt shows how she was affected by the negative social comparison feedback related to her performance (see Hewitt & Flett, 1991). She talked about the comparison and competition relating to math performance, particularly in assessments. She noticed that she was not as successful as some of her peers, which led to negative emotions.
Other pupils... were quite rough on me because I was responsible for the classroom money and all the stuff, so they just thought I was the teacher’s pet. [...] Sometimes when I got a bad grade, other pupils were just amazed that “Mari got a bad grade”, “Mari got seven on the test”. I was just, rrrrrrrrrr, angry. But I didn’t show it. (Mari, Finland)

There were a few boys and maybe two girls who bullied me. They were always the loudest and were yelling things in the middle of the class, and because I was so quiet and all the teachers liked me, they chose to bully me. [...] When I answered incorrectly, they yelled at me. It also affected my math results. They laughed at me and yelled something like “you suck!” [...] (Reija, Finland)

For some pre-service teachers like Mari, experiences in math were even more challenging due to their success in other subjects. Reija, who was bullied, told how her classmates’ behaviour affected her performance in mathematics.

My father taught mathematics for a bit when he was younger. So he likes mathematics and tried to teach me some, but I think we are both very strong characters, so it didn’t work for us. And my mum doesn’t really know anything about math. She’s not good at it, so maybe she was kind of like “OK, you can do this, I don’t know if I can help you”, but she also tried. But I think both my mum and I don’t like math so much. (Reija, Finland)

My dad was always good at math, so sometimes he helped me, and it went better. [...] He helped with homework, explained things to me, and that really helped. He’s an engineer, and in a way, he’s very good at math, and it was very easy for him. He liked to help me because he likes math. (Ulla, Finland)

Family context played an important role in how the pre-service teachers perceived their ability to do mathematics. Reija and Ulla considered their fathers to be successful at mathematics (cf. Zeldin & Pajares, 2000) and used category entitlement (Potter, 1996) to emphasise their fathers’ professions or occupations to support their claims. On the other hand, as Reija told, her mother’s math abilities were lower, and Reija seemed to identify herself with her mother, as seen in the utterance ‘we both don’t like math so much’.

I remember when I had to practice before the exams; my mum was helping a lot, not my dad. I remember those times that we had fights with my mum because she was trying to help. It was sometimes difficult for her since I got
annoyed because I didn’t understand. Well, it’s always been like that, that my mum was helping a lot with the school and my dad more when my mum was not at home. I would ask my dad, but he’s not very good at explaining things in such a way that children would understand. (Pia, Finland)

Pia got help with mathematics from her mother. Additionally, she told that her father would seldom help. To justify her father’s lack of help with school, Pia used the following categorisation (Potter, 1996): ‘...but he’s not very good at explaining things...in a way that children would understand’. Clearly, reflecting on the experiences from the present point of view and as a future teacher, she recognised in retrospect that her father’s explanations would not be appropriate for a learner of her age.

In some cases, parents’ expectations generated additional pressure, or parents simply transmitted their beliefs onto their children.

I remember I once did a test twice because the first time, it went so badly, and it was quite difficult to tell my parents that I had failed the test. [...] When I got bad grades, six or seven, they were quite shocked. Because I used to get good grades, I waited for the right time for them to sign the paper. I think they were very worried. [...] My parents said that I could be in the advanced level, which is more useful than general. They also said that my sister would help me when I had problems. (Mari, Finland)

Mari’s parents would have liked her to take the advanced upper secondary mathematics syllabus. She seemed to be pressured by her parents, mainly by their belief that the ‘advanced level in math is more useful’. Mari’s parents also had similar expectations of her sister, and since her sister was doing well in math, her parents also wanted her to do well.

My mum and dad always thought that mathematics wasn’t as important as, for example, languages. And they always said that they didn’t understand why we did, for example, equations. Maybe they just raised me that way, so I started to think in that way. [...] I think they supported me, but they always said ‘it’s ok if you don’t get the best grade’. Maybe because they didn’t have that kind of mathematics, they didn’t know how to do it. So they couldn’t help me. (Heli, Finland)

Heli felt emotionally supported, but she wished that her parents valued mathematics as a subject more. Her parents’ belief was that ‘math is not
important’ (Hannula et al., 2007a), and eventually, due to her difficulties in math and her ‘poor’ performance, she accepted the belief as her own. From the present viewpoint, Heli told that her parents’ belief might have been only one justification for their own lack of mathematical ability and consequential inability to help with mathematical content. Overall, the talk in both cases shows very well how parents can transmit their beliefs to their children (Raymond, 1997).

The data also showed that some siblings were considered as ‘successful’ math role models.

I have an older sister, and she has always helped me a lot with mathematics. Without her help, I would be much worse in math. [...] She knew my problems, and she was very talented in math. She taught much better than my actual teacher. And I had the courage to ask her questions. (Mari, Finland)

My big sister has always been very good [...] like gifted in math. I just thought that we were really different, but I didn’t feel jealous or anything. (Ulla, Finland)

Both Mari and Ulla had sisters who were successful at mathematics. As seen in Mari’s talk, the importance of her sister’s role was manifested in the utterance ‘...without her help, I would be much worse in math...’ She presented her sister in a role of what Krzywacki (2009) has labelled a ‘good’ teacher. She also felt safe while learning mathematics with her sister and felt comfortable to ask questions. Perry (2004) asserts that students who experience math anxiety commonly have a fear of asking questions in class. However, Ulla pointed out that she did not compare herself to her sister and hence did not experience negative emotions due to unfavourable comparisons.

My brother likes mathematics, and he said that in the first, second and third grades, he usually did all the mathematics things first. Well, I’ve always known that my brother was good. I haven’t felt any jealousy. But it’s a little bit strange because he understands everything, and I don’t...and we are siblings. (Pia, Finland)

Pia’s brother was successful at math. In her talk, a belief that siblings should be equally successful in school manifested through the utterance ‘...it’s a little bit strange because he understands everything, and I don’t...and we are siblings’.
7.1.2 'Inadequacy'

**Failure: inadequate performance**

Well, it was a bit of a shock because my first grade in mathematics (in class four) was… I think two. [...] I felt inferior because I thought it didn’t matter how much effort I put in, it was never enough. (Darja, Slovenia)

When I was questioned [oral assessment], I got a failing grade, but I didn’t stress over it. It was most important for me that I get a positive grade on the test. [...] When you see that you get a positive grade, the higher it is, the happier you are. But the satisfaction was already great if it was two. I was getting failing grades in no other subject but in math. (Ana, Slovenia)

I didn’t have fives, but I had threes. For me, that was enough because I knew if I had a three, this would be big for me in terms of the great level of difficulty this represented for me. Otherwise, I was an excellent student, and everything went smooth for me. [...] Then (in upper secondary school) I got a lot of failing grades. First year was really a painful period. I usually had the desire to just get two... (Ines, Slovenia)

All the Slovenian cases struggled significantly with their math performance during their school years. The talks of Darja, Ana and Ines reflect this issue well. Darja emphasised how inferior she felt when her performance simply bordered on acceptable. Ana told about her struggle with failure during upper secondary school; she would continuously shift between insufficient and sufficient performance in assessments. Therefore, she was very satisfied when she did pass the assessment. In her talk, she used the second person singular pronoun (cf. Pennebaker et al., 2003). With this linguistic feature, she also generalised her experiences to other pupils. Similarly, Ines was satisfied with her average grade in math throughout her comprehensive education, especially considering how difficult she had perceived the subject. Moreover, she struggled in upper secondary school with insufficient performances to passing math assessments.

Despite the severe difficulties in mathematics, all the cases performed excellently in other school subjects. In order to be able to attain a sufficient level of knowledge to succeed in math assessments, some pre-service teachers needed to enlist the help of tutors. Mathematics tutors (private teachers) were, in this sense, invaluable to their math experiences.
I studied only with my tutor, and then everything was so clear and easy. I worked just with my tutor because of my hatred for math. [...] I had my way (of studying). Because she (the teacher) saw that if she asked me three weeks before, I would get a bad grade. I always had an appointment with my tutor, and we started working. My only task till then was to make notes, and then we would work together. (Ana, Slovenia)

This started in seventh grade and has continued since; fourteen days before a test, I go to my tutor...and she explains everything in everyday language. When I was at school and could not follow, I said to myself “aha! I am not following, I cannot follow that quickly, I will go to my tutor and this will be it”. It was really good because she explained the content as if I did not know how to count to five. (Ema, Slovenia)

Ana and Ema told how they studied only before the assessments with their tutors’ help. Ana felt she understood the math content better and attained better grades in math. Ana rhetorically refers to this learning strategy as ‘my way’. Ema was satisfied that her tutor explained the content in a simple, understandable way. Further, knowing that she would get help from her tutor, she stopped making an effort to understand during math instruction.

**Math anxiety**

When I actually came to the test, my thoughts were everywhere, and I was so nervous because in my mind, “I won’t know; I will get a bad grade again”. I was sick before the test, I didn’t eat anything. I was psychologically exhausted [...] I had a fear of exams, definitely, that I would not know, that I would get a bad grade again. [...] There is this fear present that you will not pass it even though you have been struggling [to learn] for one week, and then everything is for nothing. (Ines, Slovenia)

Ines described her overwhelming feelings (e.g. psychological exhaustion) when faced with mathematics. She told about not being able to concentrate and having intrusive thoughts of failing during the tests (e.g. Ashcraft & Kirk, 2001).

I started to have blackouts in math assessments. I had nightmares about math. First three months I was sure that I would not pass upper secondary school because of that. At home, I knew everything, and when I went to school and he was asking us and giving us pluses or minuses....when I went
to the board, if you asked me then what my name was, I probably wouldn’t
know. I was shaking; I was red in the face. I was afraid, I was sweating.
Awful! I was afraid that he would not like me because I didn’t know and that
he would think badly of me. (Darja, Slovenia)

Before the tests, I was nervous. “What will happen, will I know, did I learn
this, what if I get that?” This fear of whether I’d actually be able to show
what I had learnt. Because it is possible that you know the content but that in
that nervousness you forget. …and then explain this at home and to your tutor
because you knew that she was putting in effort and you were making an
effort […] Because it is a pity when you know for yourself, when you are
disappointed in yourself; “how come I didn’t know this when I was learning a
lot”. (Ana, Slovenia)

Darja experienced severe levels of fear whenever she had to do mathematics in
front of the teacher. She remembered ‘blank mind’ moments during the
assessments. She worried and feared what the teacher would think of her failure.
In Ana’s talk, worry was also manifested in her thoughts about disappointing
others, such as her tutor.

Most of the time, I was afraid and sometimes angry – a lot of times at myself,
like “why don’t you understand? How come?” – and fear that I would not
understand, that I would not know how to solve a task. Like they say, for
mathematics you have to practice, practice and practice, and if you don’t
understand something, then there’s just more and more that you won’t
understand. And the next day I would get some task, and I wouldn’t be able to
solve it, and then I would have so many things to solve. Fear of not finishing
or not knowing in general. But I never had good feelings; there was always
something in the background – fear even while studying. I was being chocked
by everything. (Barbara, Slovenia)

Barbara told about the fear that would dominate while learning mathematics. She
was afraid of not understanding the content and of the vicious cycle in which a
lack of understanding would prevail. She captured those overwhelming feelings
in the emotional utterance ‘I was being chocked by everything’.

Before mathematics, the fear of failure was present. During mathematics,
boredom, feelings in me were like “look, you are behind again, you are slow,
you are unsuccessful, you are unable to follow. Again you are the black sheep
Ema told about her fear of failure. She also told about boredom and a whole spectrum of negative self-talk relating to how she perceived her mathematical ability (cf. Trujillo & Hadfield, 1999). She used the metaphorical utterance ‘black sheep’ to label herself as an outsider in relation to mathematics and the social context of learning mathematics (Kaasila et al., 2012). Her self-talk shows that she was not able to guide herself through the difficulties, what Usher (2009) has shown is often the case for lower secondary school students who report difficulties with mathematics.

As instantiated through all the above-considered data excerpts, the pre-service teachers’ narratives revolved around intense, sometimes even severe fear. Moreover, the episodes in which anxiety was experienced were explicit, described in great detail and strongly present in their memories. Different dimensions of math anxiety were identified. First, the pre-service teachers vividly described the physiological symptoms of math test anxiety, such as shaking, sweating, not eating, feeling sick etc. (Trujillo & Hadfield, 1999). Second, the circumstances involving mathematics learning also evoked anxiety. This anxiety was displayed while taking part in mathematics instruction or just thinking of future math classes. Therefore, mathematics learning anxiety (cf. Newstead, 1998) was also identified in the pre-service teachers’ talk.

Like the Finnish, the Slovenian pre-service teachers were also afraid of doing mathematics on the board, which meant that they were being exposed in front of others.

*When I was in front of the board, even if I knew everything, I would always deal with the worry of whether other pupils would make fun of me, if I would make a fool of myself. In fact, I also feared that I would not know how to calculate till ten in class seven. Because if someone in class seven didn’t know how much is three multiplied by three, it was really funny, especially for children. Now, it is not funny, not funny at all...* (Ema, Slovenia)

Ema’s data excerpt shows that her intense fear was propelled by other pupils’ behaviour. She was worried about being laughed at and of ‘loosing face’.

*Sometimes, when we were solving tasks in upper secondary school, when you could not avoid the situation of going in front of the board and when you couldn’t avoid solving the task, this was always awful for me! I always hoped*
that I would not have to go or that if I did, I would know how to solve the task. [...] First, because you feel uncomfortable in front of others, embarrassed, and then because of the teacher’s strict attitude. [...] Since we were all in the same position, no one dared to say anything [to make fun of others] because the teacher would call him/her right away. But still, you have that something in you that they will look at you thinking “look, she doesn’t know that”. You are embarrassed in front of others. (Ana, Slovenia)

Ana told about her negative feelings towards solving tasks on the board during mathematics because she feared she would solve the task incorrectly. She felt uncomfortable in front of other classmates, but she was afraid of her teachers’ attitudes. She wanted to avoid those situations.

If he saw that you didn’t know, he would give you a minus. So everytime you went to the board, you were at risk. So I was afraid. We were always this kind of class that we helped each other. So I was not bothered about going to the board. If I made a mistake, I made a mistake, but if you [referring to her classmates] think you can do better, you can come to the board and solve the task. When the teacher called me, I went. I didn’t have any complexes or shame. (Darja, Slovenia)

Darja told that solving mathematical tasks on the board was a common part of math instruction. When pupils did not solve the tasks correctly, the teacher would assess their performance. Overall sums of minuses would lead to a low or even failing grade. To describe the fear of going to the board, Darja used the utterance ‘you were at risk’. She emphasised that classmates would help one another and no one would laugh at others’ mistakes, especially because everyone was afraid of the teacher’s punishment. Both Darja and Ana felt less threatened by their classmates because the teacher was the biggest ‘treat’ to all pupils as well as a site of anxiety.

I never asked if I didn’t understand because I had this fear due to the teacher’s attitude. If you asked, he would think that you were an idiot because you didn’t know that. (Darja, Slovenia)

Everyone says why you don’t raise your hand, why don’t you ask. Because you don’t want to expose yourself that you don’t know something. [...] So the teacher would ask you something and then see that you don’t know even that and then you’d think it is better to be quiet. [...] you try to expose yourself
less, especially if you are not brilliant at math. [...] Maybe sometimes, when I knew, I exposed myself. But it was just when I was 100% sure in myself that I know. (Ana, Slovenia)

Everyone was afraid. I was. I didn’t dare to ask, so the teacher would call me names because we were everything but students. (Barbara, Slovenia)

Additionally, as seen in the data excerpts above, the pre-service teachers also displayed anxiety in relation to the teachers. This often hindered them from asking questions. Darja told that she was afraid that the teacher would behave condescendingly towards her. Ana told that she was afraid to expose herself in front of the teacher because the teacher would notice her insufficient knowledge, which could lead to the teacher’s negative attitude. For many mathematically weaker pre-service teachers, her utterance ‘it is better to be quiet’ thus represents a coping strategy for handling negative experiences related to teachers, further encouraging passivity in math lessons. Additionally, her utterance ‘just when I was 100% sure in myself that I know’ points out that the mathematics classroom was an environment where mistakes were not allowed. Barbara used an extreme utterance and categorisation ‘we were everything but students’ to convince and justify why, owing to her fear of the teacher, she did not ask questions. Based on these data excerpts, it seems that pupils had to hide their ‘failure’ to avoid the rebuke or scoffing from their teachers (cf. Jackson & Leffingwell, 1999; Perry, 2004).

**External recognitions of inability**

The school context made mathematical experiences tougher, deepened negative emotions, and for the Slovenian cases, it was crucial to further recognitions of inability.

My fear started in secondary school because if you don’t know something in first grade, it is ok. You can afford that in the first grade; but if in seventh grade you don’t know how much is four multiplied by five, you just can’t afford that! This is how the society functions! [...] Mathematics in society can show how much someone is able to think logically, much more than other sciences. I want to emphasise that mathematics is not a measurement for someone being stupid or smart; this I know today, but in elementary school, I didn’t know that. Even adults don’t know that. (Éma, Slovenia)
Ema referred to society’s influence on how people perceive mathematics as a subject. Her view emphasises the power of the subject in differentiating between individuals with reference to their intellect. Thus, for Ema as a pupil, to be weak in math was unacceptable, particularly because it pointed to lower intellectual abilities, such as logical thinking. Importantly, the status of mathematics as a subject in society and its consequential manifestation through social norms in the classroom shaped Ema’s view of herself as a learner (cf. Amit & Fried, 2005; Brodie, 2011; Young, 2008). She believed that she was stupid and was anxious when exposed in front of her classmates. In all, Ema’s data excerpt displayed how society’s view of mathematics, reflected in school practices, contributed to her negative emotions and beliefs about her talent.

She was like that... when she saw that you know (understand), that you were studying, then she changed her attitude. But when she saw that you weren’t studying, then she treated you as garbage. Really! And then she even behaved like that, disdainful. She always teased you a bit, so she further confirmed what you knew already, that you didn’t study. (Ana, Slovenia)

I felt inferior because I thought it didn’t matter how much effort I put, it was never enough. If I got four, it was satisfactory, but it wasn’t excellent. [...]...because other teachers would give you nice feedback even if you got four or three and they saw your progress; but with him, it wasn’t like that. If it wasn’t five, it wasn’t worth anything. (Darja, Slovenia)

As in the above data excerpts by Ana and Darja, the Slovenian cases commonly considered their teachers as demoralising; they felt that their teachers acted in a negative way when pupils did not understand the content and did not perform according to teachers’ expectations. Ana felt that her teacher disrespectfully treated pupils who showed a weak understanding of the mathematical content (cf. Hamlin, 2004; Martin, 1984). She emphasised the latter idea by employing the extreme word ‘garbage’. Darja was discouraged by her teacher who did not appreciate anything less than the highest grades in math. Although she seemed to be successful at math assessments, she felt inferior because of the absence of teacher praise (e.g. Usher, 2009).

I was going to the same upper secondary school as my brother. His class teacher was my mathematics teacher, and the comparison was obvious. He expected similar results from me as my brother had attained. (Ines, Slovenia)
Additionally, as seen in Ines’s case, comparisons between siblings were also a part of the socio-mathematical school context. Her teacher had similar expectations of her as of her brother. Such expectations and comparisons were particularly unpleasant for her.

As opposed to teachers, mathematics tutors were a rare source of positive experience which triggered pre-service teachers’ recognition that they were able to do math.

*She never said that I should have known that already. I know that I should have known that, but there is no need to remind me of that because it is already so unpleasant that I don’t know. But she never did that! Even if she had to explain the same thing to me ten times, it was always the same tone. (Ana, Slovenia)*

*She doesn’t expect anything, so I didn’t have to know beforehand […] I don’t like the sentence “you should have known this already”. I really can’t stand it! […] We always start from the beginning with mathematics, like I had never done mathematics before. (Ema, Slovenia)*

Ema and Ana emphasised the meaning of tutors’ expectations and their positive attitude. Expectations in connection to what pupils should know and reminders of their own weaknesses were a sight of discomfort as well as embarrassment or humiliation for both of them. The description of the tutor, however, is completely opposite. The tutor is a positive teacher figure (cf. Hoskonen & Pehkonen, 2005; Krzywacki, 2009). In learning interactions with their tutors, Ana and Ema thought differently about their math ability; they felt they could finally understand math.

Moreover, experiences with classmates were a source of negative emotions and recognitions of inability.

*There were some that went to math competitions; they were better. There was rivalry in the classroom. This is always like that; you always look a bit around “aha! That one got five on the test, and I didn’t”. (Ines, Slovenia)*

*If I were in the class where everyone mastered mathematics, this would be a problem. But I was in the class where most of my classmates didn’t know math, couldn’t follow, with some rare exceptions. (Ana, Slovenia)*

Ines told about the comparative and competitive aspects of math performance, particularly in assessments. The comparative aspect was evoked because pupils believed it was important to know how well their peers were doing. However, in
Ana’s case, peers were the ones providing support. Their experiences seemed to be equally negative as Ana’s, so her negative affect was lower. In the same line, Ana told about belonging to a class where all pupils were ‘equal’ in their math performance; thus, she handled her negative experiences more easily (cf. Bandura, 1986).

I had four classmates from my hometown. In terms of mathematics, they were all successful in the first year, and the comments started right away. They had to prove themselves for others to like them, and they made weird comments like “anyway, she will fail the exam because she doesn’t know anything”. (Ines, Slovenia)

Because I was one of the best students, I think I was sometimes pushed aside in mathematics. “If you have fives in other subjects, how come you don’t understand mathematics?” (Barbara, Slovenia)

Ines pointed out that in upper secondary school, few of her classmates would constantly make negative remarks about her math performance (cf. Usher, 2009). Such remarks greatly shaped her self-confidence. Also, Barbara had additional difficulties due to her classmates’ remarks. They did not seem to understand how she, an excellent student, could have difficulty in math. In all, the role of classmates also relates to overall negative classroom practices, often reported in the research on math anxiety (see e.g. Bekdemir, 2010; Stodolsky, 1985; Trujillo & Hadfield, 1999).

The family context, including parents and siblings, played an important role in the pre-service teachers’ mathematical experiences in the following ways.

My mum helped with the Slovenian language while my dad helped with mathematics. It was always like this; if something was not clear to me, it was always “dad, how about that, why is this like that?” I think that through basic school, he was the one who had to suffer because of my tears, not understanding, anger and what not. He was basically explaining to me. [...] He would leave the room; I was throwing things around. I didn’t want to study anymore. But then he came back, and it was everything again from the beginning, “well, let me explain to you again”, and it went for the tenth time from the beginning. (Ana, Slovenia)

Mum was helping a lot, dad not so much – mostly until fourth grade; later on, not so much anymore. Here and there, I asked something, but they did not sit
next to me all the time to check that I had homework, nor did they help all the
time. They only ensured that homework was done. (Darja, Slovenia)

In the data excerpt above, Ana used the utterance ‘Mum helped with the Slovenian
language while dad helped with mathematics’, which was, in her case, a modelled
belief of women being good at human sciences and languages and men being
good at natural sciences and particularly so in math. Ana’s data excerpt can
therefore be assessed as an episode of gender stereotyping (see Frank, 1990). She
also described how interactions between her and her father generated conflict
when he tried to help her. Darja’s talk, however, showed that she received help
from her mother. She expressed that she was mainly independent when it came to
studying mathematics but that her parents helped with homework.

My mum did not have the real picture [about math performance] for a long
time because I successfully hid that, and when she found out, she was really
disappointed [...] Because when I was in basic school, my mum was saying
“this is not OK, the grades are not OK” and with this, she hindered me a lot
 [...] and then in upper secondary school, she said “Nothing Ema, it doesn’t
matter how many times you repeat”, and when she said this, this saved me.
So there is no outside pressure! (Ema, Slovenia)

Ema told about hiding her failure for a long time. Her mother played a two-fold
role in her mathematical experiences. First, during basic school, she felt pressured
to have good grades in mathematics, and later on, when her difficulties became
more and more visible, her mother was very supportive and gave her the
‘permission to fail’. In Ema’s talk, she used the word ‘saved’ to tell about the
meaning this had for her. It seems that without this, Ema would not see the
possibility for improvement in her experiences. Afterwards, she felt she could
only focus on herself and her own success/failure. In all, Ema’s talk is a good
example of how parents’ expectations can hinder successful mathematics
learning.

Sometimes, I would hear from my dad say “how come you don’t understand
that?” or “you have to learn this!” But that was it. My parents knew what
was going on, but they were like “what can we do” [...] “that’s life”. Just
once, my father told me “it doesn’t matter what the teacher is like, you will
have to know this content”. (Barbara, Slovenia)
Barbara’s parents knew about her failure, but it appears as if they felt powerless to do anything to improve her experiences. Based on her talk, especially her father saw a teacher as a professional and as an authority figure and therefore thought that Barbara should obey him/her.

*My parents did not have the time [to help], and they did completely different mathematics in school. [...] At the beginning, there was a comparison between me and my brother, like “you are not studying enough”, and then they started thinking differently. My mum was much more understanding than my dad because he did not participate in my everyday school life. He was more interested in my grades. My mum was monitoring me, and she started to understand these things sooner than my dad even though in the second year, when I had health problems, they both realised that the comparisons were not helpful as they were making things worse. Then they encouraged me because they couldn’t do more than that. (Ines, Slovenia)*

Ines’s parents were busy, and as a result of their lack of knowledge, they were unable to help. She told that her parents would sometimes compare her performance to her brother’s; however, they soon realised that such comparisons were hurtful and further hindered her success in math. Ines emphasised her mother’s supportive role and her father’s focus on her achievements in math. Both of Barbara’s and Ines’s talk were very convincing as they made great use of active voicing (Wooffitt, 1992; see also Kaasila et al., 2012), that is, direct quotes from their parents talk. In all, parental passivity—not being able to help or being powerless to do anything to improve their child’s experiences—was evident in the data, such as in Barbara’s and Ines’ cases.

Siblings were an invaluable help with math difficulties.

*He went to study at Maribor, and he was not at home that much. He usually asked “what kind of grade did you get in mathematics?” but he was no longer available, so I could not ask him week after week to explain something to me. So I missed that quite a bit. But still, I think he understood too much for me because he already had all the connections in his head between mathematics, physics and chemistry. (Ines, Slovenia)*

*My brother helped me a lot at home [...] He is nine years older. He was really good at mathematics. He took all that from me [he inherited all the mathematical genes]. (Barbara, Slovenia)*
Ines and Barbara told about their successful brothers. Ines missed her brother’s help. However, she also pointed out that she would sometimes not understand his explanation because his understanding of the content seemed too advanced. In addition, Barbara seemed to believe that there was such a thing as a ‘math gene’, which Frank (1990) discussed as one of the common math myths. Hence, in her utterance ‘He took all that from me’, it is implicit that her brother has it, and she does not.

7.2 Comparing pre-service teachers’ past-oriented mathematical identity work

In this chapter, I analysed pre-service teachers’ past-oriented identity work. The focus was on understanding who pre-service teachers as mathematics learners were and which identity narratives they constructed about their past experiences. Table 4 summarises the central ideas of the pre-service teachers’ past-oriented mathematical identity work. In the following sub-chapters, I summarise the findings by highlighting the similarities and differences between the Finnish and Slovenian cases.

Table 4. Past-oriented mathematical identity work.

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<th>Mathematical identity work</th>
<th>Finnish cases</th>
<th>Slovenian cases</th>
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<td>Central difference</td>
<td>‘Outsider’</td>
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7.2.1 ‘Outsider’ identity work

For all the Finnish and Slovenian cases in this study, not only was performance in school mathematics important, it also had an important meaning for the construction of their mathematical identities. Bandura (1997) suggests that pupils inform their mathematical ability on the basis of several factors relating to their performance in mathematics. Here, grades were closely related to the pre-service teachers’ views of themselves as mathematics learners and their ability to do math. They perceived mathematics as challenging and disliked it. For most, mathematics was the most difficult subject. Accordingly, their grades were lower in math than in other subjects. The pre-service teachers invested effort in understanding, however, this often did not bring any success (cf. Hannula et al.,
They also expressed how mathematics instruction, such as the content, was introduced too quickly and teacher-centred teaching further hindered their understanding and success in mathematics (Hoskonen & Pehkonen, 2005; Kaasila, 2006). Mari and Ema, for example, referred to themselves as slow learners (see Kaasila, 2000; Laura’s case). The pre-service teachers were unmotivated as they felt that they had failed despite their efforts. The difficulties they faced resulted in the formation of beliefs about talent (Hannula et al, 2006; see also Gutbezahl, 1995). Consequently, they developed low self-efficacy beliefs (Phelps, 2010; Zeldin & Pajares, 2000). Such beliefs are particularly erroneous and may contribute to negative emotions towards math (Austin, Wadlington, & Bitner, 2001). Moreover, math myths were identified in the data, resulting in the pre-service teachers’ false impressions about math (Frank, 1990). Particularly, grades evoked self-identification on the basis of math ability. The pre-service teachers in question identified themselves as ‘bad in math’, ‘not talented in math’, sometimes even ‘stupid’. As learners, grades provided them with proof of their mathematical failure. Heli’s utterance ‘I thought that I was very bad because I only got seven or eight’ captures this idea very well.

Grades greatly shaped the pre-service teachers’ emotional relationship with mathematics and how they viewed mathematics as a subject. The identity narratives displayed struggles to attain a desired performance, further resulting in negative emotions, such as disappointment, frustration, stress, fear and anxiety. Generally, the pre-service teachers’ relationship with mathematics ranged from dislike to hatred (Di Martino & Zan, 2010, 2011; Stodolsky, 1985). A fear of mathematics assessment was a common feature of all narratives. However, the Slovenian cases displayed a great deal of math anxiety. Math learning anxiety was triggered because these cases were worried about the consequences that their inability might bring, such as insufficient grades to pass the assessment, failing the semester or even failing the entire school year. Furthermore, experiences relating to negative classroom practices triggered math learning anxiety (see also Newstead, 1998; Stodolsky, 1985; Trujillo & Hadfield, 1999).

Several aspects pertaining to the socio-mathematical context contributed to the pre-service teachers’ ‘outsider’ identity work. First, teachers and their shortcomings were the main characters in the pre-service teachers’ identity narratives (Hoskonen & Pehkonen, 2005). They described their teachers as unfair (cf. Martin, 1984). Teachers were not sufficiently attentive to all pupils and even less towards mathematically ‘weaker’ pupils (e.g. Muller, 2001). The Finnish pre-service teachers emphasised that their school teachers favoured certain pupils
over others and also responded differently to different pupils. These cases felt they lacked their teachers’ help, encouragement and sense of caring (cf. Hamlin, 2004). Similar issues were emphasised in the Slovenian cases, however, they also reported being mistreated, even victimised by their teachers (Martin, 1984). Not only did their teachers have favourites, they also showed negative attitudes and behaviours towards pupils. Unfairness seemed to be a common aspect of the relationship with teachers. While the Finnish cases mainly perceived their teachers as incompetent, the Slovenian cases recalled with horror some past episodes with their teachers, presenting them as malicious (cf. Jackson & Leffingwell, 1999; Perry, 2004). The Slovenian cases felt that their teachers’ actions were intentionally disrespectful (Schorr & Goldin, 2008). As the data showed, this triggered a great deal of math anxiety linked to teachers’ attitudes and behaviour.

Second, teachers were not the only ones responsible; classmates and, generally, classroom practices also contributed to negative emotions and to the manner in which the pre-service teachers saw themselves and their mathematical ability as learners. Math interactions were a site of social comparison, frequent discouraging remarks and evaluative practices. Some reported about classmates laughing at their mistakes or failure and even being scorned by them (e.g. name calling; Schorr & Goldin, 2008; Usher, 2009). Some remarks by classmates made the pre-service teachers feel excluded or rejected for being generally academically successful yet less so in mathematics (Martin, 1984). These issues only convinced the pre-service teachers about their inadequacy as pupils, a finding which is in line with Usher’s (2009) discussion on the sources of students’ self-efficacy beliefs in relation to mathematics. Surprisingly, the data uncovered a small amount of unfavourable comparison with peers, although this was more common in the Finnish cases. The pre-service teachers also dealt with feelings of anxiety, discomfort and worry whenever they were exposed in front of their classmates (e.g. when solving tasks on the board or reporting results; see also Newstead, 1998). This issue seemed to be of primary importance in their identity narratives and was also related to the presence of teachers.

Third, the family context also shaped the pre-service teachers’ identities. On one hand, they reported feeling, at least to a certain extent, supported by their parents (Hannula et al., 2007a); on the other hand, some pointed to being pressured by parents’ expectations of academic success. Parents also transmitted their beliefs onto their children. Fathers were often considered ‘successful’ role models possessing math ability, interest in math and having modelled
mathematics-related skills (cf. Zeldin & Pajares, 2000). They also took upon a role of helping with learning. The pre-service teachers praised their fathers. Multiple utterances such as ‘he is good at math’ and ‘he likes math’ were found in the data. However, the data did not identify instances in which mothers were praised. Even in the cases when a mother helped with learning, she was not described as a ‘successful’, ‘powerful’ math role model. Rather, she was a parent who just had more interest in the pre-service teacher’s schooling and therefore also helped with mathematics. Tensions and conflicts in interactions between a parent who was helping and a child occurred, thus resulting in negative affect. Siblings were presented as mathematically gifted, highly motivated and as those whose help was invaluable. Unlike interactions with parents, learning interactions with siblings did not evoke conflict. However, observing ‘successful’ siblings contributed to feelings of inability and inferiority.

The social-context was therefore a source of identity formation and significantly shaped the pre-service teachers’ identity work. They understood that they lacked the ability to do math, particularly on the basis of what Bandura (1986) has labelled vicarious learning and verbal persuasion. Vicarious learning or learning by observing others (Bandura, 1986) provided them with the view of ‘struggling’ and ‘successful’ role models in the school and family contexts (cf. Usher, 2009). In this light, they refined their beliefs in their own ability (Zeldin & Pajares, 2000). Moreover, they were exposed to a considerable amount of verbal persuasion. This was seen as verbal judgments by others in the school and family contexts about their ability to do math (Britner & Pajares, 2006; Usher, 2009). In all, the pre-service teachers’ past-oriented mathematical identity work point to the fact that they did not relate to math nor identify themselves as ‘mathematically able’. Therefore, they felt alienated and distanced from math (e.g. Black et al., 2009), often as outsiders in relation to math (cf. Kaasila et al., 2012). Based on these identifications, I have labelled their past-oriented mathematical identity work the ‘outsider’.

7.2.2 ‘Rhetoric of failure’ and ‘victim’ rhetoric

As discussed above, the Finnish and Slovenian cases in this study experienced past difficulties, such as lack of success in mathematics and low grades. Their narratives were underlined by multiple references to a lack of math ability; multiple utterances referring to past performance and grades were mentioned as a
relevant indicator of their failure. I have labelled this kind of talk the *rhetoric of failure*, characteristic of their outsider identity work.

Moreover, the talk of the Finnish and Slovenian cases included many emotional utterances describing their experiences with mathematics. These pertained to the lack of ability as well as the social context of learning mathematics. The pre-service teachers’ talk addressed feelings associated with being a victim: a victim of their own ‘inability’ based on observations and comparisons with others and even being victimised by others (see also Kaasila et al., 2012). For example, in their descriptions of successful others in a socio-mathematical context, the talk of the cases reflected the idea that they were unfortunate in lacking the ability to do math, that is, victims of their own ability. However, as they talked about their teachers and classmates, they felt victimised. For example, reporting about a teacher’s favouritism towards some students was also recognised as an instance of victimisation. The cases were verbally persuaded as lacking ability. The talk describing these experiences was labelled *victim* rhetoric, another characteristic of their outsider identity work.

### 7.2.3 ‘Imperfection’ vs. ‘inadequacy’

Many similarities were identified between the Finnish and Slovenian cases in terms of their past-oriented identity as they shared understandings and interpretations of the past. However, there was an underlying difference in what they understood as failure. For instance, Bandura (1997) has argued that pupils’ perceptions of their own math abilities are not necessarily reflected in their visible achievements (e.g. grades). This means that pupils’ subjective perceptions of their mathematics performance relate to their view of mathematics, including their negative views of themselves as learners and their negative emotions (cf. Kaasila et al., 2008a). Indeed, the views of the pre-service teachers own failure during school years appeared to differ significantly between the Finnish and Slovenian cases.

During school years, the Finnish cases performed well in mathematics. Their grades were at least average, more often beyond and sometimes even nearing excellence. Only *perceived* failure was evident in their achievements, these cases understood and labelled their performance in terms of failure and identified themselves as ‘not good’ or ‘bad’ at math. Therefore, the main reason they saw themselves as lacking math ability has more to do with dissatisfaction with their own performance. Evidence of self-oriented perfectionism in the data further
illuminated this understanding of the pre-service teachers’ own performance and math ability. This identity work was therefore labelled *imperfection*.

The Slovenian cases, however, struggled tremendously with math performance, particularly in upper secondary school, to the extent that their grades bordered on acceptable. Moreover, accounts of inadequate knowledge demonstrated in the math assessments were common (Horn, 2008). I therefore contend that these cases experienced *actual* failure. Some of them (e.g. Barbara and Ines) failed mathematics in upper secondary school and had to take repeat exams in order not to repeat the school year. For the pre-service teachers, such failures seemed bereft of prospects. This led them to manage, such as learning with the help of a tutor, their failure in order to successfully progress through formal education. On the other hand, when their performance was deemed adequate, they were satisfied since they had ‘tasted actual failure’ and managed to avoid it. Their identity work was labelled *inadequacy*. 
8 Future-Oriented Mathematical Identity Work

This chapter considers the pre-service teachers’ future-oriented identity narratives in which they anticipate their future teaching. The results here are divided into two broad dialogical categories: the past-future and the present-future. First, I analyse how the pre-service teachers related their negative past experiences with their future teaching. Second, I analyse their anticipations of their future as mathematics teachers. Two substantially different ways of engaging in identity work were identified within each of these categories. Like the previous chapter, the current is structured so that it presents the Finnish cases as one group and the Slovenian cases as another.

8.1 Past-future dialogue: Using the negative past as a resource for future teaching

In this chapter, I consider the dialogue between the past and the future in the pre-service teachers’ identity narratives. The aim is to show how the pre-service teachers transformed their past negative learning experiences into inspirations for future teaching. The chapter presents two different ways of the manner in which the Finnish and Slovenian pre-service teachers bridged the past and the future, thus intimating two different ways of identity work within two cultural contexts.

8.1.1 ‘Distancing from the negative past’

I don’t think my experiences will prevent me from being a good teacher. I know I have to do better when I teach. I want to be a more exciting teacher, and I want to have more knowledge and not that teacher-based learning that I had. I would like to because I know some pupils might have difficulties like I did, so I would like to be aware of them in the class and teach individually and try to help them to have more positive feelings about mathematics. (Reija, Finland)

In the past, Reija ‘hated’ math and considered it ‘boring’; but as a future teacher, she wants to be ‘exciting’ and organise math instruction in a pupil-centred way. Based on her own experiences, she knows that there are weaker pupils in math and would like to encourage them to have more positive views of mathematics. The latter is a common phenomenon among pre-service elementary teachers who
experienced difficulties in mathematics (see e.g. Drake, 2006; Gellert, 2000). Additionally, Reija seems to have concrete views about how to improve future teaching (cf. Gellert, 2000). Her future-oriented talk shows a focus on pupil engagement, such as planning interesting and engaging lessons in order for pupils to enjoy learning math. This is in line with Hagger and Malmberg’s (2011) study on goals that pre-service teachers generally set for their teaching. In addition, Reija told that the tools used in the mathematics education course, such as manipulative models and collaborative work, have helped her to experience math differently than she did in the past. ‘The teacher of the course is very into those materials. We did things, and we searched for different kinds of information...from books and did group work, so it was good for me. I like the way we are learning; it is more student-centred learning’. Therefore, distancing from the past was promoted in her talk.

I don’t think my experiences will prevent me from becoming a good teacher because I don’t want to teach in the way my teachers taught me. I would like to do it better and see every pupil and his/her needs. Because, for example, in my group at university, there is one girl who already has a degree in engineering, and she is very good at mathematics; on the other hand, there was me who was afraid of mathematics. And I think it was easier for me to teach math because she was thinking about difficult things. It’s hard for her to go down to the children’s level, and for me, it’s easier because I want that every pupil learns. In our teaching practice, there was one boy with special needs, and mathematics was very hard for him. So when I was teaching, I always checked that he understood and knew what we were doing. (Heli, Finland)

Heli implied in her talk that she will be better able to understand her pupils’ difficulties (Di Martino & Sabena, 2011), particularly because she had negative experiences with mathematics in the past. The important aspect in her talk was taking into account individual pupils’ differences, such as tailoring teaching to individual pupils’ needs, ability levels and difficulties (Hagger & Malmberg, 2011). Additionally, Heli told that she no longer compared herself with others: ‘because ... I understand that I can’t be the best at everything, I can do my own best; I don’t need to be better than anyone else’. She appeared to have reconciled with her past, hence, the idea of leaving perfectionism behind was also present in her identity talk.

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I think it helps to have negative experiences with mathematics. I will have a better idea of the pupils who have problems because I had the same problems during my school time. So it’s easier to understand them. Because I’m not so good at math, I don’t teach difficult things, so it’s also easier for pupils. [...] I’m no longer an overly hardworking student, and I don’t have so much pressure to attain good grades... (Mari, Finland)

Mari emphasised that she sees her negative past as a positive resource for her as a future teacher because she will be better able to understand pupils’ difficulties (Di Martino & Sabena, 2011). She feels this especially because of her low math ability – ‘I’m not so good at math’. Her teaching will be less complex, and pupils will understand math easier (cf. Gellert, 2000; Phelps, 2010). In addition, Mari told that she was no longer driven by the necessity of having good grades, which is the ‘reason my experiences are more positive’. In the past, she was strongly affected by her perfectionism, however, this appears to have changed. The idea of leaving perfectionism behind in her identity talk is thus part of her distancing from the negative past.

In some way, I think that my experiences will prevent me from being a good teacher. I think that if I’m not so good at math, I can’t teach it so well. But at least I can understand pupils who have difficulties in math and that I know how to deal with those pupils, how to teach them. I would like to encourage them, all of them. (Ulla, Finland)

Ulla feels that her math ability can interfere with her teaching and prevent her from becoming a good teacher. Moreover, she emphasised that she ‘knows’ how to teach pupils, especially those with difficulties. Her confidence in teaching was manifested in her latter utterance. She drew on the past when she needed encouragement from her teachers and concluded that she wants to encourage all pupils. In addition, she told that she ‘really liked’ the mathematics education course and ‘the way of teaching’. She emphasised the meaning of narrative rehabilitation (Lutovac & Kaasila, 2009, 2011) applied in the course: ‘I really liked the course...I was really happy that we started with a discussion about our experiences in math; that was really important for me, and I didn’t expect that we would do these kinds of things’. Ulla further expressed ‘that was really relieving’ when she discovered that she was not the only one who had experienced math negatively. She also liked the teacher’s attitude: ‘even though he is very good in
math, he’s not looking at you as if you can’t do it; he’s encouraging’. These aspects helped her distance herself from the past.

My experiences will prevent me from becoming a good teacher because if I was more confident and more positive about mathematics, I would probably be better at it. But I think the negative experiences will help me understand those pupils who don’t understand. I think that’s the benefit. On the other hand, I’m thinking about pupils who are really good at mathematics and I’m not enough for them. Am I really good enough for pupils despite the fact that I don’t understand the content so well? (Pia, Finland)

Pia’s viewpoint was less optimistic. Due to her negative experiences and negative view of mathematics, she feels less confident about becoming a good math teacher. However, her future-oriented reflection (cf. Conway, 2001; Urzua & Vasquez, 2008) seems to be very unique. In her talk, she showed much awareness of her weaknesses and difficulties in math. Further, she considered high-attaining pupils and doubted her ability to teach mathematics. Additionally, referring to the narrative rehabilitation (Lutovac & Kaasila, 2011, 2012) component applied in the mathematics education course, Pia ‘understood that there are other people who don’t understand so well’. This helped her distance herself from her negative experiences. For that reason, she was able to fully reflect on her strengths and weaknesses and consider whether she could become a good-enough teacher for higher-attaining pupils.

Based on the data excerpts, some of the Finnish pre-service teachers considered that their earlier difficulties with mathematics had positive consequences for their future teaching. Others had less optimistic views and believed that their negative past might hinder them from becoming good mathematics teachers (cf. Di Martino & Zan, 2010, 2011). Particularly meaningful in the Finnish pre-service teachers’ identity talk was their discovery of a strong link between their math ability and future mathematics teaching. Their worries seemed to be bound to that aspect rather than other negative experiences they had had in the past.

Further, the Finnish cases grounded their future anticipations in their past mathematical experiences and saw their future teaching as an opportunity to compensate for the negative past. Compensating for the past was a common tendency in Di Martino and Sabena’s (2011) analysis of Italian pre-service teachers’ narratives. Additionally, they saw opportunities in their negative past; they felt better able to understand pupils’ difficulties with mathematics, which is
also common for many pre-service elementary teachers with difficulties in mathematics (Di Martino & Sabena, 2011; Kaasila, 2007a; Pietilä, 2002). The latter idea appears to be two-fold. First, they had a desire to be attentive to all pupils (Kaasila, 2007a; Pietilä, 2002). The pre-service teachers were aware of their own emotional struggles with mathematics and will thus be more empathetic towards their pupils than their teachers were towards them. Second, the cognitive aspect was also manifested in the pre-service teachers’ talk when they reflected on their pupils’ math understanding. They wanted to teach in a different way from how they were taught. The Finnish cases offered concrete examples of how to improve their future teaching and help their pupils understand math better. Their rhetoric revolved around how to teach to help pupils with their learning difficulties. Additionally, they were striving to become good teachers. The past and future were bridged, and the future was dominant in their talk. They firmly anticipated the future by distancing themselves from their negative past.

8.1.2 ‘Re-living the negative past’

I don’t think my experiences will affect me negatively, not more than with other things. I never had blackouts when I didn’t know the content. I deserved a bad grade when I didn’t know. But when I was studying, I was really afraid. One time, in upper secondary school, we had a test in mathematics and my mum said “look, if you get two or you fail…it doesn’t matter”, and when she said this to me, I didn’t have any fear, and I got the best grade. When I allow myself to fail, I usually get the highest grade. This is what I lacked during my school time. Why is it that one is not allowed to fail? Are you a bad person because of it? We cannot be successful in all areas. (Ema, Slovenia)

Ema was also optimistic that her past would not hinder her future as a teacher. She reflected on the past, recalling her math test anxiety. She again emphasised the meaning of ‘permission to fail’ for her success in math, something she felt she lacked during her school time. This seemed to be important to Ema; however she did not explicitly articulate that she would like to act in such a way with her pupils, nor did she address the future in her talk. The past remained dominant in her talk. In addition, when she reflected on her experiences during teacher education, her talk showed how she was distancing herself from how she perceived herself in the past: ‘I am not that stupid at mathematics. I can learn it, but there must also be some external cause [for her difficulties]’. However, Ema
was not able to fully distance herself from labelling or categorising herself as stupid. She still appeared to identify as being stupid, though less so. During the studies, Ema also realised ‘that the teacher does matter; the teacher is important’. In the past, she had similar difficulties in physics: ‘I didn’t like it, and I said to myself “anyway you don’t understand mathematics, so no big deal if you don’t understand physics. They are connected anyway”’. Because Ema was able to understand physics during the course, she had an ‘aha! experience’ and realised that ‘not everything depends on me’. Despite the fact that her talk sounded promising and showed that she intended to distance herself from the past, she did not articulate how the negative past could be of benefit to her future teaching. She ruminated about the past but did not draw on concrete examples of future teaching.

I know I will not be like my teacher who made my life miserable because I see how long negative feelings can last. Someone can really be bothered by this. I don’t think that my experiences will be an obstacle for me, especially the way it started this year. Really, it gave me a different perspective on everything, and I think I want to forget what happened and get the best out of it. What happened has happened. I had bad experiences with mathematics, which stuck with me for a few years, and even here at university. I felt bitter when it came to mathematics. But then the turning point happened and now it’s great! (Barbara, Slovenia)

Barbara seemed very optimistic about the future. She was well aware of the kind of teacher she did not want to become, but she seemed unable to offer a concrete view about what kind of teacher she would like to become. Her past appeared to be dominant in her future-oriented talk. Her only desire was that new, positive experiences during the mathematics education course would help her forget the past and move on. This shows that Barbara saw the course reading as a ‘salvation’. She also told about a ‘turning point’ she experienced in the mathematics education course: ‘I was really surprised about the article that the teacher gave us. The article is a bomb! I was surprised that it was possible to make such interesting lessons. It raised my motivation high for the whole year’. The fact that Barbara did not explicitly address the future in her talk shows that the ‘turning point’ might not have been very deep or effective. Nonetheless, her difficulties in the past were very emotion-laden, and the course reading did not address those issues. Moreover, her teaching experience was positive, especially when she ‘saw that pupils had an aha! experience’. But in describing it, she kept

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returning to her past, saying ‘I kept in mind all the time that there won’t be someone like me who won’t understand and who will remain quiet and feel alone. After my upper secondary school experience, I am even more careful not to do something like what was done to me...’’. Her talk shows her reflecting on all experiences through what happened to her and through her ‘bad’ teacher. I crystallised the latter with a metaphor ‘devil on the shoulder’ (Lutovac & Kaasila, 2014). She told that she tried to be different from her teacher; however she did not articulate the manner in which she tried to do that. It appears therefore that Barbara unsuccessfully tried to distance herself from the past.

I hope my experiences will not prevent me from being a good teacher. I would like to forget so that it won’t happen again. But I think that if I am going to enjoy teaching, I will have to immerse myself in it. At least for now, it is, and I think I will forget my experiences. But I will remember that you can’t have strange attitudes 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 with a reluctance towards mathematics. I no longer have it as I did before. I think I will take away many opportunities from my experiences.

(Ines, Slovenia)

Ines ‘hoped’ to become a good teacher, and for that, she has a desire to ‘forget’ negative past experiences, which she saw as a possible threat. She believed that joy towards her profession – being a teacher (cf. Hagger & Malmberg, 2011) – might help her forget the past and avoid repeating the mistakes of her teachers. She understood that her emotional relationship with pupils would be different from what she experienced with her teachers (Krzywacki, 2009; cf. Hodgen & Marks, 2009). Ines also told about her fear of conveying her aversion to math (Di Martino & Sabena, 2011), and for that reason, she would like to grow to love mathematics. She tried to draw on the benefits for the future, however, she could only see benefits in the context of the hope of avoiding disadvantages. She therefore has strong expectation that the future will be different from the past. Twice in her talk, she confidently told that she had gained benefits from her past; however, she did not elaborate. The idea of forgetting the past in her talk signalled that she had not handled her past experiences (cf. Lutovac & Kaasila, 2012, 2014) and was thus not able to adequately distance herself from the past.
It is possible that my experiences will prevent me from becoming a good teacher. I know that I will be attentive, that I will be careful with my attitude towards pupils who I see are slower because maybe they are excellent in some other subject. Let’s hope it will work out. But I really swore to myself that I would be more attentive to those who don’t know because those who know are not a problem. You just give them papers with tasks, and they will gladly solve them. But those who don’t know and will see that paper in front of them, it will be a pain for them. And with every calculation they don’t understand, it will be harder for them. This I know, and you have to look for those five times more, not in a way that you rebuke them, but with a warm approach. Even to repeat ten times if necessary, they will at least know in the end. But we all have a tight curriculum, and it is the fault of those who construct the curriculum because they don’t think of pupils who are actually not able to grasp quickly. Because then, the teacher is the one who doesn’t reach the objectives, and again it is your fault. (Ana, Slovenia)

Ana thought that her experience might hinder her from becoming a good teacher. She talked about developing emotional relationships with pupils and being attentive to ‘weaker’ pupils (Kaasila, 2000; Pietilä, 2002). She labelled the latter idea as a ‘warm approach’, which is something she lacked from her own teachers. Additionally, she appeared to draw on traditional ways of teaching in the utterance ‘even to repeat ten times if necessary’. She also used an elementary teacher rhetoric when she told about the teaching profession being guided and bound by the curriculum and teachers being responsible for any deviation from it. Ana’s talk appeared to be inspired by the talk of the elementary teachers by whom she was surrounded because, as a pre-service teacher, she could not have experienced the issues she was addressing. In addition, she experienced mathematics courses in a ‘really negative’ way. She considered that elementary teachers were more apt than university lecturers: ‘She showed us everything, even the things that are not so closely connected to mathematics didactics. These things are important. These teachers here [teacher educators] don’t teach us that. They should warn us about mistakes that are done in practice and how to teach something’. Ana did anticipate the future. However, despite the fact that she did offer a view on what kind of benefits her past experiences might bring for her future teaching, she continued to blame others (e.g. teacher educators) for her challenges. She had not adequately addressed her experience and fully reflected on her past about the reasons for the negative experiences. This unresolved issue
appeared to hinder her from moving on as she continued to search for a scapegoat.

You learn from your experiences so that you don’t make the same mistakes as your teachers. I don’t think I will have major problems because I am fair to all pupils. Of course it happens that you like some pupil better than another, but you should try to like all of them. You should not like some and hate others. But I think that when you have your own class, you like all pupils because you get to know them. (Darja, Slovenia)

Darja’s talk seemed optimistic. Her experiences should benefit her as a future mathematics teacher as she would like to avoid the mistakes that her teacher made. In her talk, she focused mostly on teachers’ affective aspect (Krzywacki, 2009), such as the emotional relationship with pupils (cf. Hodgen & Marks, 2009). She would therefore like to be fair and like all pupils. However, in her reflection, Darja did not get to the future with a concrete example of how to attain fairness. She seemed to only think of how to avoid the things she remembered from the past. She differed from other cases, in that, she displayed a milder form of reliving the past. Notwithstanding, upon paying attention to her rhetoric, I see that the past was in the background of the thoughts she expressed. She also had the following appraisal of her experiences during mathematics education courses: ‘Some things make sense, but others do not make any sense at all. It is a waste of time and resources. Mathematics education lectures are OK. We need to get certain knowledge, so this is not wrong. And I understand that in mathematics education, not everything can be explained with concrete examples. They teach us more theoretical things. But we have exercises of which you can only wonder “What for?” What is the point of transcribing things from the curriculum? I can do this at home by myself if I am interested in that’. It seems that Darja shifted from dealing with the past to the present challenges, which gives her little to reflect further into the future.

The Slovenian cases seemed to be optimistic about their future teaching because of the benefits they felt they had gained from their negative past. They see the future as holding the possibility to compensate for the negative past. As in the study of Di Martino and Sabena (2011), the Slovenian cases also wanted to avoid the mistakes made by their teachers. Some, such as Ines, expressed uncertainty and worry that the past might hinder their future teaching. Their memories of school-time mathematics were closely related to their ‘bad’ teachers (cf. Hoskonen & Pehkonen, 2005; Jackson & Leffingwell, 1999; Perry, 2004; see
Chapter 7) who were mostly labelled as such due to their negative attitudes and behaviour towards pupils. The central aspect in these pre-service teachers’ talk was therefore to guard against becoming insensitive teachers. Furthermore, some like Barbara and Ines expressed the same idea of ‘forgetting’ the negative past in hope of becoming a good teacher. This seemed to imply that their past experiences were still very alive and had not been handled in such a way as to adequately distance themselves from the past (Lutovac & Kaasila, 2011, 2012).

In line with much of the research literature, the Slovenian pre-service teachers talked about building caring and emotional relationships with pupils (e.g. Gellert, 2000; Hagger & Malmberg, 2011; Hargreaves, 2001; Hodgen & Marks, 2009). Ana, for example, used the metaphor ‘warm approach’ to emphasise such a relationship, which, to some extent, resembles Gellert’s (2000) metaphor of a mother protecting her fragile child. Their rhetoric bore the characteristic of being careful with your attitude towards pupils. In their talk, they sought to bridge the past and the future; however, their attention was often confined to the past. The past overshadowed anticipations of the future as they relived it through the relationships they had with their ‘bad’ teachers.

8.2 Present-future dialogue: Fit between math ability and future mathematics teaching

This chapter brings forth the dialog between the present and the future in the pre-service teachers’ identity narratives. They anticipated their future teaching on the basis of their current experiences in teacher education. The chapter is divided into two sub-chapters that consider two substantially different ways of engaging in identity work.

8.2.1 ‘Decisive’ identity work

I’m still quite afraid, but I think now that I have the experience of teaching math and it’s positive, I think I also have more confidence in myself in relation to math. So I think I will do well later on. Of course I have to study very hard those things I don’t know. I just don’t want my students to feel like they hate math and that the teacher is boring. Again, I put much pressure on myself to do well. I know I have to try to study harder, and I will do well because I want to be a good teacher in everything, in math too. My students deserve me to be the best I can be. (Reija, Finland)
In the past, Reija had a tendency to view (mathematics) performance as highly important and had a difficult time accepting failure (cf. Besser et al., 2004; Lutovac & Kaasila, 2010; see Chapter 7). Now, her goal of wanting to become a good mathematics teacher despite the challenges also reflects her perfectionism. She balances between what she wants and what she would like to avoid. She seems to understand her weakness – low mathematics ability in relation to the fact that she will have to eventually teach mathematics (cf. Phelps, 2010). It appears that the experience of teaching math has helped her gain self-confidence. Moreover, Reija told that despite the fact that her emotional relationship with the subject did not change: ‘I still kind of don’t like mathematics that much’, so she ‘decided to have one more mathematics course so that I could learn more because I have to teach it to pupils’. Therefore, she took on the initiative to develop herself to ensure successful mathematics teaching in the future. She found a resolution in ‘studying hard’. Reija’s talk was decisive and a good example of self-development rhetoric (see also Kaasila et al., 2012; Lutovac & Kaasila, 2010).

I think it’s not easy to teach because they can ask amazing things that I cannot understand; for example, in the fifth and sixth grades, there are some very difficult things to teach. But I think I can manage it. But I have to prepare myself for the lessons. The main point is that I want to teach that kind of mathematics that everyone understands. And I don’t want it to be very abstract because I think it’s more important to understand the mathematics that is related to everyday life. (Heli, Finland)

Heli emphasised that she wants to teach reality-oriented mathematics (Gellert, 2000), her reference point being pupils’ understanding through everyday life examples. In her talk, she balanced between how/what she wanted and did not want to teach. She also adopted a self-development rhetoric. Throughout her narrative, Heli told about how she was approaching mathematics in order to learn more and emphasised the importance of preparation. Furthermore, some concrete examples on how to improve future teaching were manifested in her talk (cf. Gellert, 2000), which I see as a central aspect of a self-development rhetoric. She further described the mathematics education course she had taken as ‘very good because we do things in groups, and it gives me some ideas about how to teach children, not only the paper and the book like in the past’. It seemed that before the mathematics education course and her application of these principles in the teaching practice, Heli was ‘terrified’. She thought ‘I’m so bad at math, so I can’t
teach it’. She identified with what she was rather than with what she was not by using a positive sentence to describe her low math ability (cf. Lieblich et al., 1998). The close link between the course and the teaching practice changed her view of teaching mathematics: ‘Now I think that it’s a very nice subject to teach. Maybe I don’t yet understand it, but I like it more’. The desire to understand math better led Heli to ‘enrol in more mathematics courses than earlier’.

I think I still have to work a lot for me to be able to teach math, but it’s not such a big problem. I have to concentrate on the area that I’m going to teach so that if pupils have some questions, I will know the answers. I have positive feelings. I’m not afraid. [...] I have to work a lot, and I have to think very much about some math content. And I have to be very clear in what I’m trying to say when I’m teaching math. It has to be clear to me how things are going to go, and I have to concentrate on teaching and not so much on me. [...] If I teach the upper classes, fifth and sixth, I must prepare myself a lot.

(Mari, Finland)

Mari expressed positive emotions about future teaching. She saw it as important to learn more about the content being taught and, therefore, to improve her math ability. She also saw the mathematics contents in the upper primary classes as more challenging and therefore felt the need to prepare herself even more for teaching these contents. Mari drew on the self-developer rhetoric (see also Kaasila et al., 2012), and in anticipation of her future mathematics teaching, she took into account her interactions with pupils (Oliveira & Hannula, 2008). She also told how becoming a mathematics tutor in the mathematics education course enhanced her mathematical experiences: ‘We had to choose two math tutors in our group, and there were just a few students with an advanced level in upper secondary school. So I was chosen. And I was like... “no, not me because I’m not as good as you think”’. The close link between the course and the teaching practice, and particularly planning the lessons in a group, helped her ‘a lot to start thinking about the lessons.... And we did the plan for math lessons together, and it was easy to start to teach when you have already thought about it’. She seemed to have gained more confidence in her abilities too: ‘I understood all the things very well, and I now have better experiences’.

I feel that I can teach math to younger children, but in a way, I couldn’t teach the upper grades. I’m afraid that I won’t know all the contents. I feel really challenged. [...] And for me, it was interesting to notice that although I was
really successful at teaching mathematics, the feeling of inferiority connected to my ability did not disappear. [...] But as a teacher, you want to give really positive experiences, encouragement...that you can do this. Even though it’s difficult for you, you can try. I would like to make learning fun and exciting. (Ulla, Finland)

Ulla felt quite confident to teach the lower grades of basic school. However, due to her ability, she felt mathematically challenged to teach the upper classes. Her future-oriented talk was decisive as she knew what she wanted for her future. She gave examples of how she would like to teach mathematics (Gellert, 2000): she would like to encourage pupils to persevere in the face of difficulties. Her case is interesting because throughout her narrative, including the past-future dialogue, Ulla’s talk strongly focused on how she would like her future to be. She almost did not articulate any fears or avoidance. Besides the course, Ulla also told how teaching practice helped her realise that ‘math was one of the most interesting subjects to teach’. Teaching helped her became aware of the ways in which she could teach in the future in order to enhance pupils’ experiences (Lutovac & Kaasila, 2011): ‘In a way, how many different things can you do when you teach math to children? I really saw that you can make math fun’. It seems that these realisations helped Ulla focus fully on the likely possibilities rather than the disabilities she could face in future math teaching.

Well, I am still insecure. I think if I had to teach mathematics in the sixth grade now... if I knew what to do, then it would be OK, but if I don’t and I have to go and try to teach, then it would be terrible. I think I have to do a lot of work for the preparation before the class; I would like to understand. [...] I’m not so deep in mathematics, and because I think mathematics is an important subject, the teacher should be very good at it. That’s why I feel bad for good pupils because they would need something more. [...] I would like to be like the girl from my class. I would like to have more skills for the students. But I know that I’m not going to be like that, not in the same way. But I have to do lots of work to understand mathematics and to give the knowledge to the students. It will be more difficult to teach math than other subjects. (Pia, Finland)

Pia was able to see the relationship between subject-matter knowledge and the teacher’s efficacy to teach it (Phelps, 2010), particularly on the basis of her belief about the value of mathematics (cf. Gellert, 2000). She felt that her math ability
should be better in order to be able to teach math well. She saw one of her fellow pre-service teachers as a role model and had the desire to become such a teacher in the future. She continued with a disclaimer ‘But I know that I’m not going to be like that...’ to present her doubts about this. The latter shows Pia’s pessimism towards reaching her ‘ideal’ (Kaasila et al., 2012; cf. Markus & Nurius, 1986). However, regardless of her pessimistic view, she still succeeded in finding a resolution; she felt that she had to and wanted to understand math well so as to teach it well. She also recognised that she had to ‘do a lot of work’. In relation to the mathematics education course, Pia told that it was ‘something really like new doors opening, like understanding that there really are different ways of doing mathematics’. This is consistent with the findings of Palmer’s (2009) study on an alternative math course which triggered students’ positive inclinations towards math. Pia interpreted the past in the 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’. This encouraged her to think that she ‘could go deeper in mathematics’ to ensure her future success as a teacher (Phelps, 2010). In addition, Pia told that mathematics was ‘the most difficult subject to teach in the practice’, but ‘I also got positive things’. She told how she helped one of her students: ‘There was one girl who didn’t understand how to do round ups, and I tried to help her. In the tests at the end of the practice, she knew how to do it, so I was really proud that I could teach that to her’. This experience helped Pia gain self-confidence, but she understood that her experience was positive because she ‘did quite a lot of work before’. This knowledge promoted her decisiveness. Therefore, learning seemed to be a resolution for the future.

In the Finnish pre-service teachers’ future-oriented identity narratives, the awareness of low mathematics ability and its potential hindering role in teaching seemed to elicit negative emotions. However, the pre-service teachers found a resolution in learning to become mathematics teachers, which is why their identity work was labelled decisive. Moreover, they seemed to think that the improvement of their mathematics ability would also improve their mathematics teaching. Arguably, the salient part of their resolution was the goal set (Phelps, 2010), which is closely related to imagining their future interaction with pupils (cf. Oliveira & Hannula, 2008). This means that the Finnish cases felt they needed to understand mathematical content in order to be able to teach it to their pupils. Furthermore, based on the data, there was a clear connection between the Finnish pre-service teachers’ beliefs about their mathematics ability and mathematics teaching efficacy beliefs (cf. Phelps, 2010).
8.2.2 ‘Irresolute’ identity work

I am sometimes afraid of mathematics. How will I teach it at all if I don’t understand? How will I be able to explain so someone else would understand? This is what I am the most afraid of now about the future. Just how will I explain to them if I don’t understand? If I don’t understand something because I didn’t learn it when I should have, I am afraid I will not be able to pass the necessary knowledge on to pupils. (Barbara, Slovenia)

Barbara posed many rhetorical questions in her talk. She focused on fears for the future but did not rise beyond them to reach conclusions. She did not anticipate addressing her weaknesses and seemed to remain indecisive. However, she told about her enthusiasm towards the mathematics education course: ‘You can really see they [the teacher educators] try to make us think on our own, like “how would you teach this to pupils”. That is really great to think about!’ She also told that she was gaining understanding and motivation for math because of the course: ‘I am still not completely there. I don’t understand everything. But I am getting there slowly. At least I think it is interesting, and I am not bored. I am more motivated’. However, despite this, she remained insecure about how to explain the content to pupils. Once again, it seemed that there was no real future vision in her talk. The fact that Barbara did not distance herself from her negative past made it more difficult to have a clear vision of her positive future self.

Maybe I am afraid. Maybe I just don’t feel indifferent about it. And I want to teach in higher classes, like fourth or fifth. I am not yet quite sure of what is waiting for me there [future practice]. Teachers here [teacher educators] think that we already know everything. I really don’t know what to expect. I think I still have time for that. I am more afraid that I will not know how to explain something so that pupils will understand me. If I were to teach the higher classes, I wouldn’t have to break myself into pieces so pupils could understand. They are already writing and reading fluently. And also, the fact that you have these pupils one year is good because if you get a difficult class at the elementary stage and you have them for three years, it can be hard. In the higher classes, you get them when they are already educated while in the lower classes, you have to educate them. (Ema, Slovenia)

Ema talked about her fear and uncertainty towards future teaching (cf. Di Martino & Sabena, 2011) and may have been responding to the expectations that are often present in teacher education (Kaasila et al., 2012). She expressed that she lacked
the knowledge about her future work as a teacher; in particular, she felt that she lacked a good overview of the curriculum (cf. Hagger & Malmberg, 2011). Ema expressed negative emotions with respect to her teaching competence (Phelps, 2010) and felt insecure about her ability to teach in a comprehensible way. Consequently, her desire was to teach upper primary classes, which is the contrary to the common desire of pre-service elementary teachers to teach the lower classes (Wilson, 2009). She used a metaphor ‘to break myself into pieces’ in order to explicate the complexity of teaching in lower classes and saw that such teaching would not necessarily have to be applied in the fourth grade. Ema provided further justifications as to why it would be easier for her to teach in higher classes and used the elementary teacher rhetoric manifested through ideas, such as ‘teaching one class only one year’ and ‘pupils being already educated by previous teachers’. In addition, she told that teaching mathematics ‘was a really nice experience. Anyway it is not at all difficult what we are teaching in elementary grades, at least in my opinion. It is not mathematics that is complicated. I would say that if I was studying mathematics’. Ema concluded that she ‘definitely learned new things’. However, despite this, she did not anticipate her future in a concrete way, neither did she try to find a resolution to the problem she posed, that is, ‘how to explain the content to pupils in order for them to understand’. Rather, as seen above, her talk shows that she would try to avoid teaching those classes for which she was being educated to teach.

_Emma said:_

_Horrible! If I have to teach lower grades, OK, but if higher, I’d actually be afraid. I’d be really afraid because I know that I have major deficiencies in mathematics in terms of how to explain to someone as concretely as possible. I am really afraid of that and maybe also that I will not teach math so well because I haven’t mastered it. I don’t picture myself right now as a teacher, maybe even for a further five years. I am lost! Because you know that you’re not ready, that they will put you into some environment where you are actually lost, and you know that you have a responsibility towards all those little ones who are sitting in front of the blackboard. (Ana, Slovenia)_

Ana expressed many fears by using extreme utterances, such as ‘major deficiency’, but did not say anything about her future expectations. Further, she appeared ill-prepared to become a teacher. She discussed her insecurity; she generalised her feelings with the use of the second person singular pronoun ‘you’, thus implying that other pre-service teachers might feel similarly uncertain. She appeared to have been left indecisive by the mathematics education course as she
raised doubts about her competence in teaching mathematics. In addition, Ana told that she experienced mathematics courses in a ‘really negative’ way. She considered elementary teachers as more apt than university lecturers: ‘She showed us everything, also the things that are not so closely connected to mathematics didactics. These things are important. These teachers here [teacher educators] don’t teach us that. They should warn us about mistakes that are made in practice and how to teach something’. Ana still seemed to blame others (e.g. teachers) for her challenges rather than seeking to resolve them and move on.

We have so little practice that I am a bit afraid. If you put me in the classroom now, I don’t know how I would manage. I have a feeling that I don’t have the ideas. But on the other hand, you have other teachers next to you who you can ask for help, and you have this textbook for teachers. I would somehow manage. At the end of the fourth year, they already expect something from you, but I think I’ll be fine. I would like to teach more in the first three classes because I think it suits me better, and I think there are a lot of things on the concrete level. You just have to have ideas and different ways of explaining things. This is not mathematics relating to drills and equations. So I am not that afraid. On one side, I cannot wait to go into the classroom so I can actually see what it means to be a teacher. I hope it will be good. (Ines, Slovenia)

Ines’s future-oriented talk appeared to be quite incoherent, as evident in the following utterances: ‘I don’t know how I would manage...’, ‘But on the other hand...I would somehow manage...’, ‘how will I manage...’ and ‘but I think I’ll be fine’. Her views appear to be mutually exclusive shifts between negative and more optimistic outlooks towards the future. For example, she first says she lacks ideas on how to teach math; later, she says she could teach math in lower elementary classes. This incoherence, in my view, speaks to Ines’s uncertainty regarding the future (cf. Urzua & Vasquez, 2008). There might be unresolved issues that prevent her from having a clear vision of the future (Lutovac & Kaasila, 2013). Additionally, her talk does not include concrete examples of the kind of mathematics teacher she would like to become. She seems to anticipate teaching in a traditional way (e.g. teachers’ guidebook-driven instruction) as a future-oriented coping strategy and generalises her views by shifting her use of the pronoun ‘I’ to ‘you’.

When Ines reflected on her ‘positive’ teaching experience, her talk displayed confidence and a feeling of competence for teaching mathematics: ‘I have a
feeling for children, and when I come to the classroom, I no longer think of how to say something; I just think of what to say. I don’t have the fear of how to say something, how to react; for me, it is spontaneous’. The teaching experience provided her with ‘the feeling that I am OK!’ This is again inconsistent with the views she presented above. In addition, during the mathematics education course, Ines found a new perspective on mathematics: ‘you no longer think that mathematics is some drill, equations, but you start thinking about 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 differently’. Ines appears to have started seeing mathematics through the lens of teaching. She declared ‘I think I got a positive feeling about mathematics’; however, the past memories continued to invade her thoughts: ‘Even though, when I think of mathematics, I still remember. It is still in me, and I just don’t know how to erase it’. Ines’s identity talk again implies that she wanted to forget the memories; however, she did not know how to achieve this. She failed to distance herself from the negative past (Lutovac & Kaasila, 2013), which is now manifested in her incoherent talk and prevents her from being more decisive.

I am not afraid of teaching. But I think that the lack of experience might hinder my future teaching. We lack teaching practice. It is much better now for new generations who started their practice in the first year. I am aware that we have to learn mathematics didactics... I will probably need it one day, but I will not work like that all my life. I can manage through this course as long as I’m not going to teach mathematics didactics. On the other hand, I really enjoy when I go to the class to teach. That is great! So, about all these problems during my studies, I just tell myself that I have to survive until the end of university, and then I will not have to deal with this anymore. (Darja, Slovenia)

As in the past-future dialogue, Darja almost did not focus on the future at all. She was critical of the lack of teaching practice during her studies and the course and was stuck in articulating these challenges. Despite the fact the she had the attitude of not being burdened by these issues, she could not rise above them. She did not go further to anticipate her future teaching and what she could do. It seems that the negativity that Darja identified in her current experiences prevented her from being decisive about her future teaching. She continued to negatively evaluate her current experiences: ‘We had teaching experiences in the first semester, and we learned how to write a lesson plan in the second semester. Above all, lesson plans
are not unified across the different subjects. This kind of chaos around the lesson plans bothered me because I think that the lesson plan is not that important. It is more important how you work with kids and what you teach them’. Darja was critical of lesson planning and seemed to believe that what she was learning was not useful for her future as a teacher: ‘Most likely, we will never in future write such lesson plans as we had to do now’. However, besides the teaching practice, Darja did not offer any view on what would be useful for her as a future teacher. As mentioned earlier, Darja differed from other Slovenian cases in the fact that she did not reflect on her mathematics ability or ability to teach. Arguably, therefore, Darja’s reflection on the future was not sufficiently deep.

Based on the data, the Slovenian cases also perceived their mathematics ability to be low. They seemed to believe that their low mathematics ability would hinder their teaching and wondered how they would ‘manage’ in the future. In addition, many of the Slovenian pre-service teachers doubted their mathematics teaching efficacy. Tension between their mathematics ability and the fact that they will have to teach mathematics in the future elicited very strong negative emotions. However, they neither reached conclusions, nor did they make decisions. In their future-oriented identity talk, they remained helpless and full of anxiety. Learning for the purpose of becoming a mathematics teacher was not promoted, and for that reason, their identity work was labelled irresolute. Furthermore, some Slovenian pre-service teachers (e.g. Ines) were able to cope with irresolution by anticipating their future teaching in a traditional way (e.g. textbook/teachers’ guidebook-driven instruction).

8.3 Comparing pre-service teachers’ future-oriented mathematical identity work

In this chapter, I analysed the future-oriented identity narratives of the Finnish and Slovenian cases. The focus was on understanding their future anticipations by linking them to past and present experiences (cf. Mead, 1934). I analysed the dialogue between the past and the future as well as that between the present and the future in the pre-service teachers’ identity narratives. The data was divided into these two categories, however, it is important to emphasise that the borders between the past-present and present-future dialogues are flexible. The data in both categories also complement each other. Finally, the analysis revealed the future-oriented mathematical identity work that the pre-service teachers engaged
in. In what follows, I summarise the findings by highlighting the similarities and differences between the Finnish and Slovenian cases.

The first important aspect that emerged from the analysis is the future goals in the pre-service teachers’ identity work. Phelps (2010) suggests that career goals play an important role in pre-service teachers’ motivation to learn mathematics. Here, I considered their future goals as manifested through their possible selves (cf. Hamman et al., 2010; Markus & Nurius, 1986). The pre-service teachers in question were encouraged to interpret their previous and current experiences in light of anticipating their future (Conway, 2001; Urzua & Vasquez, 2008). They imagined the kind of mathematics teachers they wanted to become and thus projected possible selves as mathematics teachers (Markus & Nurius, 1986; Markus & Ruvolo, 1989; see also Sfard & Frusak, 2005). These possible selves included versatile ideas about what pre-service teachers might become, what they would like to become and what they were afraid of becoming (cf. Markus and Nurius, 1986). Based on the data, they had some knowledge of what they hoped, expected and feared about the future (cf. Markus & Ruvolo, 1989). Their possible selves were manifested in their past-future and present-future dialogues. Therefore, the pre-service teachers articulated their possible selves; however, the nature of these selves differed.

Following Markus and Nurius (1986), many of their possible selves were the result of previous social comparisons in which their own thoughts, emotions, characteristics and actions were contrasted with those of significant others (e.g. teachers, classmates, parents, siblings etc.). Indeed, the data showed that teachers were often considered significant others or role models influencing possible selves. The cases anticipated their future as math teachers by providing contrasts with their past or present teachers. For example, many refused to become like their past teachers. Moreover, some found other role models, such as peer colleagues, which seemed to represent their possible future ideal selves (Lutovac & Kaasila, 2011, 2014; cf. Arnon & Reichel, 2007). What follows is a discussion on two distinct types of future-oriented mathematical identity work in each temporal category.

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6 In the following text, I use the term positive possible selves to incorporate expected and hoped-for possible selves and the term negative possible selves when referring to feared possible selves.
8.3.1 ‘Distancing from the negative past’ vs. ‘reliving the negative past’

The central idea behind the past-future dialogue were pre-service teachers’ reflections on how to turn the negative past into inspirations for future teaching. Their identity narratives portrayed versatile views about how the negative past might shape their future as mathematics teachers. For some, past difficulties did not represent future obstacles; even more, negative past experiences were seen as opportunities. Some hoped that the negative spin would stop; however, others saw their past as hindering their future teaching. Based on the results, the Slovenian and Finnish cases referred to the past as a resource for their future teaching. They derived their possible selves precisely from their negative past. Moreover, they saw in the future the possibility to compensate for their negative past (Di Martino & Sabena, 2011). They would like to avoid becoming like their teachers from their school years. Their talk thus focused on what they needed most and did not get from their teachers, thus paving a way for their future teaching. Their talk reflected the possible selves that they would like to avoid in the future as well as those they had hoped for in the past but which never materialised.

Although the identity talk of the two groups appeared to be similar, a careful reading of the data revealed important differences in how the Finnish and Slovenian pre-service teachers used the past as a resource for their future teaching. Moreover, there were also differences in how they bridged the past and the future and thus the kinds of possible selves they were projecting. As a result, two different types of identity work were identified between the two groups: ‘distancing from the negative past’ and ‘reliving the negative past’ (see Table 5).
Table 5. Pre-service teachers’ identity work in the past-future dialogue.

<table>
<thead>
<tr>
<th>Mathematical identity work</th>
<th>Finnish cases</th>
<th>Slovenian cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>The past as a resource for future teaching</td>
<td>‘understanding pupils’ difficulties’</td>
<td>‘being careful about attitudes towards pupils’</td>
</tr>
<tr>
<td></td>
<td>‘The cases know how to teach pupils with difficulties: they commit to handle teaching differently’</td>
<td>The cases know what kind of attitude and behaviour they should have: they commit to act differently</td>
</tr>
<tr>
<td>Possible selves</td>
<td>The cases express various possible selves: expected, hoped-for, feared, avoidant</td>
<td>The cases mainly express avoidant possible selves: they avoid becoming like their past teachers</td>
</tr>
<tr>
<td>Rhetoric</td>
<td>The future is more dominant in their talk: the cases focus on anticipating the future</td>
<td>The future is less dominant in their talk: the cases focus on recalling the negative past</td>
</tr>
</tbody>
</table>

Gellert (2000) suggests that pre-service teachers who remember mathematics classes as frightening and whose emotional relationships with mathematics can be labelled as mathematics anxiety may try to avoid reproducing such emotions in their teaching. Indeed, this idea has been a central feature of the data. The Finnish cases expressed that they wanted their pupils to have more positive experiences with mathematics as they themselves had; some talked explicitly about reducing fear towards math and establishing positive feelings. However, the Finnish pre-service teachers’ identity talk was not only emotional but also cognitive in character. As they told of the past, their teachers showed insensitivity towards pupils’ difficulties and failed to teach well (cf. Di Martino & Sabena, 2011; Hoskonen & Pehkonen, 2005). For this reason, the central aspect of their talk seemed to be to approach mathematics teaching differently than it had been by their school-time teachers. They made a commitment to handle their teaching differently. Of primary importance in their talk was how to help pupils with understanding and learning mathematics while also being an affective teacher. Based on their own experiences as pupils, they felt better able to understand the struggles of particularly low-attaining pupils (Di Martino & Sabena, 2011; Kaasila, 2007a). Furthermore, despite their own difficulties with math, they felt sufficiently competent to teach and help pupils. In all, these cases used their negative experiences to build positive possible selves. Their rhetoric was future-oriented: the future, rather than the past, was dominant. They seemed to
understand the meaning of their past and were therefore distancing themselves from it; they anticipated the future without impediments from the past. Their emotionally challenging past experiences seemed to be handled, thereby allowing them to move on. For these reasons, their identity work was labelled *distancing from the negative past*, which was also one reason they were able to also reflect on their cognitive qualities as math teachers.

The Slovenian cases recounted their school-time mathematics mainly by recalling their teachers who showed negative affective qualities (Krzywacki, 2009), such as negative attitudes and behaviours towards pupils. By using the past as a resource, they thus built their anticipations upon emotion-laden past experiences and gave preference to developing affective qualities as future mathematics teachers (cf. Hagger & Malmberg, 2011; Krzywacki, 2009). Regardless of how optimistic or pessimistic they were about their future teaching, in their future-oriented identity talk (cf. Urzua & Vasquez, 2008), they mainly elaborated on ‘being careful about attitudes towards pupils’. Therefore, as future teachers, they made a commitment to *act* differently. Additionally, they doubted their ability to teach mathematics but felt able to care for pupils and develop an emotional relationship with them. Conversely, teachers’ cognitive qualities, which were manifested in the Finnish pre-service teachers talk, seemed to be overlooked in the Slovenian cases’ identity narratives. The Slovenian cases did not elaborate on how to teach mathematics or how to help students with learning mathematics. They derived mainly *negative* possible selves from the past, such as feared and avoidant selves. The past remained dominant in their talk, often to the point of recalling their past experiences. Importantly therefore, past experiences were still very much alive in them and had not been handled in such way that would enable them to distance themselves from the negative past (cf. Lutovac & Kaasila, 2011, 2012). Their identity work was labelled *reliving the negative past*. Moreover, the fact that their past was not handled, it continued to invade their thoughts and hindered them from fully reflecting on the future.

### 8.3.2 ‘Decisive’ vs. ‘irresolute’ mathematical identity work

In the *present-future dialogue*, the pre-service teachers bridged their present mathematical experiences during teacher education and their anticipated future. The emotions that the Finnish and Slovenian cases held towards future teaching were positive as well as negative (cf. Di Martino & Sabena, 2011; Drake et al., 2001); however, their negative emotions arose from their awareness of their low
mathematics ability and its potential hindrance for their future teaching. Notwithstanding, the two groups of pre-service teachers handled this tension differently and, thus, two different types of identity work were identified (see the Table 6).

Table 6. Pre-service teachers’ identity work in the present-future dialogue.

<table>
<thead>
<tr>
<th>Finnish cases</th>
<th>Slovenian cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical identity work</td>
<td></td>
</tr>
<tr>
<td>Fit between math ability and future teaching</td>
<td>Tension and negative emotions emerge</td>
</tr>
<tr>
<td>Possible selves</td>
<td>Imbalance between positive and negative possible selves: the negative dominates</td>
</tr>
<tr>
<td>Resolution</td>
<td>Resolution is absent: submitting to fears and insecurities</td>
</tr>
<tr>
<td>Agency</td>
<td>Lack of agency; uncertainty, anxiety, helplessness and coping</td>
</tr>
<tr>
<td>Rhetoric</td>
<td>Teacher educators are significant narrators</td>
</tr>
<tr>
<td></td>
<td>Elementary teachers are significant narrators</td>
</tr>
<tr>
<td></td>
<td>Quite coherent talk</td>
</tr>
<tr>
<td></td>
<td>Less coherent talk</td>
</tr>
</tbody>
</table>

The Finnish cases anticipated the future in a clear way (e.g. Reija and Heli). Their talk was more goal-directed, and they expected their possible selves to materialise. The balance between positive (expected and hoped-for selves) and negative (feared selves) possible selves was created (Lutovac & Kaasila, 2012, 2014); they balanced between what they would like to be and vice versa. This reflects well the idea expressed by Markus and Nurius (1986) that people imagine the selves that they would like to achieve as well as those they would prefer to avoid. Due to the balancing between positive and negative possible selves, their identity talk expressed motivation (cf. Markus & Ruvolo, 1989). Identifying with becoming ‘a good teacher in everything, in math too’ as a possible self is particularly motivating, and pre-service teachers are more likely to work hard and do what it takes to reach that self (cf. Markus & Nurius, 1986). Furthermore, they
made a resolution to learn to become mathematics teachers, which was central to their identity work. They engaged in *decisive* identity work whereby one’s progress, improvement and development through learning were seen as assuring good future teaching (Lutovac & Kaasila, 2012, 2014). Accordingly, the Finnish cases felt motivated to improve their math ability as well as their ability for mathematics teaching by taking into account their desired future (e.g. being a good math teacher). At the same time, they seemed to work harder in the present in order to achieve these future selves (cf. Mead, 1934) by, for example, choosing more mathematics courses (e.g., Heli, Reija). The latter acutely exemplifies the interaction between the present and the future. Additionally, in their talk, mastery goals were promoted, and they wanted to learn for the purpose of understanding and mastery rather than grades, praise or looking good in front of others (cf. Phelps, 2010).

On the contrary, the identity talk of the Slovenian cases seemed to showcase the imbalance between *positive* (e.g. expected or hoped-for selves) and *negative* possible selves (e.g. feared selves) and thus anxious and uncertain anticipations of their future as mathematics teachers (Lutovac & Kaasila, 2012, 2014). This was manifested through the frequent use of the utterance ‘I am afraid’ as well as ‘I don’t know’. As suggested by Urzuza and Vasquez (2008), too many expressions of uncertainty may signal that the pre-service teacher is struggling or incompetent. This can potentially be problematic since pre-service teachers would therefore be less goal-oriented. Indeed, the Slovenian data showed a lack of clear goals. This is not to say that the Slovenian pre-service teachers did not have goals for the future; however, the precise goals were not manifested in their future-oriented talk. According to Oyserman and Markus (1990), less balance between *positive* and *negative* selves suggests a sense of helplessness, which was indeed noted in the Slovenian data. They seemed to be left unmotivated. Moreover, these pre-service teachers did not draw conclusions, nor did they make decisions. Their future-oriented identity talk remained replete with fear and indecision. They seemed to lack agency to learn for their future profession. Therefore, their identity work was labelled *irresolute* (Lutovac & Kaasila, 2012, 2014). Markus and Nurius (1986) have argued that possible selves can be viewed as cognitive bridges between the present and the future by specifying how pre-service teachers may change from how they are now to what they will become. Accordingly, the Finnish data enabled an insight into how these pre-service teachers might change and what they might become in the future, but the same was rendered difficult in terms of the Slovenian data. Due to the lack of *positive* possible selves (e.g. expected or
hoped-for selves) in the Slovenian cases, it was hardly possible to discuss anything about their future development.

The resolution was essential for understanding the differences between the two types of identity work as the pre-service teachers responded to tensions and future-related fears differently. The decisive cases chose to rise above their fears and insecurities whereas the irresolute cases seemed submitted to their fears. For example, the decisive case, Pia, whose views were to a certain extent pessimistic, was still willing to invest extra effort to secure future benefit. The irresolute case, Ines, whose talk may resemble Pia’s, did not demonstrate similar agency. In all, one interesting finding here is that the perception of math ability, which was central to the pre-service teachers’ past-oriented mathematical identity work continued to play an important role in their future-oriented identity work. In line with the theory of possible selves, Markus and Nurius (1986) argue that the past that remains within oneself as a possible self (e.g. someone who lacks math ability) is representative of one’s ongoing concerns and the actions that give rise to these concerns (see Hamman et al., 2010). This clearly shows that pre-service teachers’ mathematical identities are significantly shaped by their perceptions of ability.

8.3.3 Pre-service teachers’ rhetoric

The pre-service teachers’ rhetoric was of particular interest to this study. Their rhetoric displayed who or what had most shaped their identity work. Based on the data, their future-oriented rhetoric differed. In the Slovenian data, the meaning attached to elementary teachers who taught the pre-service teachers during teacher education (e.g., in the courses and in the teaching practice) was crucial. Accordingly, they noted that practice is what elementary teachers do and talk about (cf. Dolk & Hertog, 2008). Applying Sfard and Prusak (2005), it seemed that the Slovenian cases in this study saw elementary teachers as significant narrators. Further, important sources of the pre-service teachers’ identities were stories about others. Thus, if a storyteller was sufficiently significant for a pre-service teacher, her/his stories would feature in the pre-service teacher’s identity (Sfard & Prusak, 2005). Arguably, therefore, elementary teachers had to have been significant narrators and objects of identification as their rhetoric was manifested in the pre-service teachers’ identity narratives. The Finnish cases referred more to teacher educators and the knowledge they gained as relevant for their future practice. They focused their narratives on the importance of their own
histories as pupils and the meaning of life-long learning for them as future teachers (Kaasila et al., 2014). It seemed that for the Finnish cases, their teacher educators were significant narrators (Sfard & Prusak, 2005).

A further rhetorical difference which was particularly meaningful in identifying the differences between the Finnish and Slovenian pre-service teachers’ identity work was the (in)coherence of the identity talk (cf. Kaasila et al., 2012). Incoherence was present to a greater extent in the talk of the Slovenian cases. In their future-oriented talk, they regularly shifted between optimistic and pessimistic views. Additionally, they often presented very opposing views in the same breath. One reason for the incoherence in their talk was related to responding to the expectations of teacher education (Kaasila et al., 2012) and the wider social context which made them shift between what is and what ought to be (cf. Ricoeur, 1991). Incoherent talk was also a strong basis for clarifying the difference between decisive and irresolute identity work as shifting views signalled greater uncertainty about the future and indecisiveness in approaching it. The future was only an anticipation of a different past with no other expectations, wishes or hopes. This also intimated an understanding that there might have been unresolved issues and illuminated the differences in the pre-service teachers’ identity work. Finally, the identity talk among the Finnish cases was generally more certain and assertive and thus less, if at all, incoherent. Opposing views were not identified in their talk. They seemed to be at least partially at peace with their past, and anticipations of the future were an opportunity to see themselves as future teachers, not only differently from their teachers, but also to explore other possible selves. Even when bridging the past and the future, they were able to move from the negative past and see the future clearer without emotional barriers, which were indeed obvious in the talk of the Slovenian cases.
9 Summary of the Findings: Towards Conceptualising Mathematical Identity Work

I discussed the gap in addressing identity work in mathematics education research in the section on the theoretical framework of the study. Some publications in this domain do mention the term identity work; however, they do not explicate what it means. On the other hand, to my knowledge, the phrasing ‘mathematical identity work’ has not been used before. This chapter therefore summarises the main findings of the study by answering the research questions. It connects the findings with the theoretical framework and derives a conceptualisation of mathematical identity work.

The temporality of experience (see Ricoeur, 1984–88) has been shown to be not only useful but also necessary in addressing an understanding of pre-service teachers’ identity work through the narrative identity (Ricoeur, 1992) framework. Therefore, not only do past and present experiences matter, future anticipations are also pivotal. The dialogue between the temporalities in the pre-service teachers’ identity narratives displayed the linkages between the past, present and future. Table 7 is a combination of Tables 4, 5 and 6. It synthesises the pre-service teachers’ identity work and its temporalities.

Table 7. Pre-service teachers’ mathematical identity work.

<table>
<thead>
<tr>
<th>Past-oriented mathematical identity work</th>
<th>Finnish cases</th>
<th>Slovenian cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differing understandings of failure</td>
<td>Imperfection</td>
<td>Inadequacy</td>
</tr>
<tr>
<td>Rhetoric</td>
<td>Rhetoric of failure and victim rhetoric</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>Future-oriented mathematical identity work</th>
<th>Finnish cases</th>
<th>Slovenian cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past-future dialogue</td>
<td>Distancing from the negative past</td>
<td>Reliving the negative past</td>
</tr>
<tr>
<td>Present-future dialogue</td>
<td>Decisive</td>
<td>Irresolute</td>
</tr>
<tr>
<td>Possible selves (future goals)</td>
<td>Expected, hoped-for and feared possible selves</td>
<td>Dominance of feared possible selves</td>
</tr>
<tr>
<td></td>
<td>The cases know what kind of teachers they want to become and what kind of teachers they would like to avoid becoming</td>
<td>The cases know what kind of teachers they want to avoid</td>
</tr>
<tr>
<td></td>
<td>Teacher educators are significant narrators</td>
<td>Elementary teachers are significant narrators</td>
</tr>
</tbody>
</table>
However, it is important to note that the temporality of experience should not be understood as linear (cf. Conway, 2001). Rather, we live in the present, and our ‘interpretations of the past and the future are shaped by the present’ (Flaherty & Fine, 2001, p. 147). The past and future are thus modes of the present (Mead, 1934, 1936). This means that the past is part of the pre-service teachers’ present experience, and the future (hopes, expectations, anxieties etc.) is also a part of their present experience. Therefore, it is important to keep in mind that pre-service teachers construct their narratives from the present standpoint (Schütze, 1984). I have therefore analysed the pre-service teachers’ identity narratives by dividing them into the following dialogues between the temporalities: past-present, past-future and present-future. Accordingly, I have considered the results as past-oriented and future-oriented and labelled the pre-service teachers’ identity work as past-oriented and future-oriented mathematical identity work. Furthermore, the results of the study show what kind of identity work the pre-service teachers engaged in and which aspects of mathematics education contexts were essential in facilitating their identity work. In what follows, I synthesise the findings in light of the research questions addressed.

9.1 Past-oriented mathematical identity work

The first research question of the study concerned pre-service teachers’ identity work based on their school-time experiences with mathematics—based on pre-service teachers’ memories of their negative experiences of learning mathematics, in what kind of mathematical identity work do they engage? Based on the results, this type of mathematical identity work was labelled past-oriented as well as ‘outsider’ mathematical identity work.

The central idea of ‘outsider’ mathematical identity work is that based on perceptions of ability and failure as well as relationships and interactions, the pre-service teachers did not identify themselves as ‘mathematically able’, felt alienated and distanced from math (Black et al., 2009, see also Kaasila et al., 2012) and consequently identified themselves as outsiders in relation to mathematics. Striking similarities in the pre-service teachers’ narrations of their mathematical backgrounds were found. They used a rhetoric of failure; with such rhetoric, they were not able to guide themselves through the difficulties (cf. Usher, 2009). Despite the similarities in the rhetoric of failure, understandings of their own failure were different between the two groups. The Finnish cases labelled their performance in terms of failure, but in fact, it could have been
considered as imperfection as their reported grades were quite high. However, when the Slovenian cases labelled their performance in terms of failure, they were referring to inadequacy in reaction to passing examinations. Therefore, we can talk about ‘imperfection’ or perceived failure on one hand and ‘inadequacy’ or actual failure on the other. Assessments and, consequently, perceptions of ability therefore defined who the pre-service teachers were mathematically (see Black et al., 2009).

Furthermore, identifications based on ability were recognised and reinforced in a socio-mathematical context. Perceptions of others – manifested through comparisons with others, vicarious learning by observing successful math role models as well as verbal persuasion (Britner & Pajares, 2006; Zeldin & Pajares, 2000) – played a role in the pre-service teachers’ mathematical identity. Perhaps what stood out in their narratives was that teachers explicitly communicated the belief that success reflects mathematical ability and that failure reflects the lack of it (cf. Molden & Dweck, 2006). The cases in this study were susceptible to these verbal persuasions (cf. Britner & Pajares, 2006; Usher, 2009), which led to many emotion-laden experiences. One of the most influential relationships in the pre-service teachers’ past-oriented identity work was the pupil-teacher relationship (cf. Black et al., 2009; Uitto, 2011). Moreover, the wider socio-mathematical context, such as interactions with classmates and family members, had an important meaning for their mathematical identities. Talk about their math experiences, particularly in relation to the socio-mathematical context, was labelled victim rhetoric.

Finally, in constructing their own identities, the pre-service teachers also constructed the identities of others (cf. Cobb, 2004). The cases thus narrated and constructed unfavourable identities of their teachers. However, whether these narrations reflected what actually happened or whether teachers’ actions were misinterpreted is of minor importance as it has been recognised that students’ interpretations form the basis for the interactions and relationships that develop in the classroom (Muller, 2001). In all, interactions with teachers (including teachers’ attitudes and actions) contributed significantly to the fact that the pre-service teachers’ perceptions of their math ability seemed to be a salient aspect of their mathematical identities (cf. Hodgen & Marks, 2009). Moreover, their mathematical identities as learners were meaningful for the construction of their future identities as teachers of mathematics (cf. Wilson, 2009).
9.2 Future-oriented mathematical identity work

The second research question of the study concerned pre-service teachers’ future anticipations—based on pre-service teachers’ future anticipations of teaching mathematics, in what kind of mathematical identity work do they engage? Here, their identity work was labelled future-oriented; however, based on the past-future and present-future dialogues in their identity narratives, the following sub-types of identity work were identified: ‘distancing from the past’ vs. ‘reliving the past’ and ‘decisive’ vs. ‘irresolute’. These types of identity work were understood as opposites. However, future-oriented identity work based on past-future dialogue should be seen as a precondition for future-oriented identity work based on present-future dialogue. This means that ‘distancing from the past’ led to ‘decisive’ identity work and ‘reliving the past’ led to ‘irresolute’ identity work.

In the future-oriented aspects of the pre-service teachers’ identity narratives (Urzua & Vasquez, 2008), they imagined their possible selves as mathematics teachers (Markus & Nurius, 1986; Markus & Ruvolo, 1989). Most of their negative (e.g. feared) possible selves were closely related to their negative pasts as pupils. When emotion-laden memories persisted in their thoughts (e.g. when reliving the past), their feared selves became dominant, and they lacked strategies to escape those selves (Markus, 2006). This prevented and even disabled them from coping with the future. Therefore, the lack of will to move forward can be seen as related to the existence of well-elaborated negative possible selves, which was evident in the Slovenian cases (cf. Markus & Ruvolo, 1989). However, when the pre-service teachers’ school-time experiences were addressed (as in the Finnish cases), they gained insight into their mathematical past, present and future (Hänninen & Valkonen, 1998; Lutovac & Kaasila, 2011). The Finnish cases were thus able to distance themselves from the past. Arguably, elaborated possible selves motivated them and focused their activities in a goal-directed manner (Lutovac & Kaasila, 2014).

Building on Markus and Nurius (1986), the phenomenon of agency or will could be interpreted in terms of pre-service teachers’ ability to develop and maintain distinct possible selves. The authors explain that the lack of ‘agentic qualities may be related to the existence of well-elaborated negative possible selves that give vivid cognitive form’ to individual’s fears and insecurities but that do not contain strategies or self-scripts for how to escape them’ (Markus & Nurius, 1986, p. 962). This was indeed well-founded in the Slovenian cases and supports the idea of irresolute identity work. In addition, the decisive cases’
rhetoric no longer reflected feelings of victimisation. Rather, they used self-development rhetoric: future-oriented talk with an optimistic connotation describing one as an active actor with clear goals (Kaasila et al., 2012). It is a language about how to improve oneself as a teacher. Kaasila et al. (2012) note similar changes and suggest that mathematics education courses that include students’ autobiographical context promote self-development rhetoric. I see self-development rhetoric as a central aspect of decisive identity work. This rhetoric was not identified in the irresolute cases. On the contrary, the irresolute cases’ talk continued to reflect feelings of victimisation.

It has been argued that identities are multiple (cf. Beauchamp & Thomas, 2009; Markus & Nurius, 1986; Mead, 1934). Temporality in the pre-service teachers’ identity narratives displayed multiple mathematical identities, closely dependent on the roles that the pre-service teachers played in their mathematical experiences. In the past-oriented mathematical identity work, they constructed their identities as students while in the future-oriented mathematical identity work, they also constructed their identities as teachers (cf. Oliveira & Hannula, 2008). This clearly shows that there can be multiple answers to the question of who one is. We can therefore also talk about the duality of identity work: past-oriented identity work constructed an identity of a student of mathematics and future-oriented identity work constructed the possible identity of a teacher of mathematics. Moreover, the possible selves that the cases projected made it clear that their past identities as students remained important for the teacher identities they were constructing.

The findings show that in their past-oriented identity work, the pre-service teachers strongly identified with lacking math ability. The cases had undergone shifts in several aspects of their identities during teacher education, particularly in how they saw mathematics as a subject, its learning and teaching (see also Pezzia & Di Martino, 2012) as well as whether they believed they could learn and teach mathematics. Unfortunately, however, their identifications with math ability did not shift. Despite the fact that the Finnish cases had been provided with the perspective that they could become good mathematics teachers, notwithstanding the challenges and despite gaining new perspectives on their past, present and future, they could not entirely resist the definitions of themselves deriving from their school time. As in the Slovenian cases, identifying oneself according to ability (e.g. ‘I am not good at math’) remained the key aspect in the emerging teacher identities of the Finnish cases. This is in line with the argument that pre-service teachers construct their teacher identities in accordance with how they
perceive their abilities (Wilson, 2009). In this sense, the beliefs that all cases had about their own inability were crucial for their approaches to teaching mathematics, for example, their willingness to teach upper classes in basic education. I elaborate these views further with the standpoint that the pre-service teachers’ identities as students became an important part of their teacher identities. Moreover, perceived math ability represented the so-called ‘core’ of their emerging teacher identity.

9.3 The mathematics context and pre-service teachers’ mathematical identity work

The third research question of this study addressed the manner in which pre-service teachers’ identity work reflected the educational contexts in question—how is pre-service teachers’ mathematical identity work reflective of the mathematics and teacher education contexts they belong to? The findings show that the differences identified in the pre-service teachers’ identity work stemmed from the different educational practices in the two contexts.

Within the first research question, I discussed the meaning of relationships and interactions in the mathematics context for pre-service teachers’ past-oriented identity work. I would like to add here that the rhetoric cases used in this study gave a deeper understanding about the meaning of context for their identity work. We know that the pre-service teachers’ talk was very tightly connected to justifications of their own views and actions (cf. MacLure, 1993) as well as those of others. Vivid and detailed descriptions articulated by the cases served to convince the audience of the significance of their experiences. In this sense, the audience can take the role of pre-service teachers more easily and sympathise with their struggles. In the same vein, the cases here often used active voicing – direct quotes of teachers’ talk (cf. Kaasila et al., 2012; Wooffitt, 1992). This is another way of convincing the audience that the experiences really happened. From the rhetorical perspective, the Slovenian pre-service teachers produced more detailed narratives and also categorised themselves as victims to a much greater extent. They frequently used extreme utterances which seemed to be an effective rhetorical device to convince the audience of the ‘tragic’ nature of their experiences (see Kaasila et al., 2012). However, because we know that pre-service teachers tell their narratives from the present perspective, describing school teachers as professionally and morally incompetent was a way of ‘blaming’ the socio-mathematical context for their negative experiences and the
consequential struggles they experienced. This was one way of trying to distance themselves from the idea that they naturally lacked math ability (cf. Fraser et al., 1997). Similarly, the fact that some Slovenian cases ‘wished to forget the past’ which was closely linked to their teachers’ actions tells us that relationships and interactions or the socio-mathematical context, rather than mathematics itself, significantly shaped pre-service teachers’ ‘outsider’ identity work.

Further, particularly the observation of the different types of future-oriented mathematical identity work suggested that the reasons for these differences were different emphases and pedagogical practices in mathematics education courses within the teacher education programmes. Based on the pre-service teachers’ talk, mathematics education courses were seen as facilitators in the broadest sense. Specific meaningful facilitators were not always explicitly mentioned, however, some cases did consider them. Based on knowledge of both contexts and my insider role, I was able to identify those facilitators.

The Finnish cases in this study undertook the mathematics education course that explicitly addressed pre-service teachers’ beliefs and prior experiences as part of their identity development. This course enhanced the pre-service teachers’ views of mathematics through narrative tools that addressed school-time memories: narrative rehabilitation and bibliotherapy as well as reflective writing (Lutovac & Kaasila, 2011, 2013, 2014; Kaasila et al., 2008a). Therefore, affective changes were highly promoted in the course. In addition, the course facilitated shifts in the pre-service teachers’ identities by applying explorations of the content with manipulative models and peer tutoring (Kaasila et al., 2008a). The Slovenian cases, on the other hand, undertook mathematics education courses with an emphasis on attaining knowledge, skills and attitudes to teach mathematics (cf. Korthagen, 2004). The central tool used in the course was a portfolio which included various tasks designed to promote pre-service teachers’ mathematical content and pedagogical knowledge. Like for the Finnish cases, the course involved course reading; however, it was aimed at widening their knowledge rather than facilitating affective change. The coursework did not include a focus on pre-service teacher’s autobiographical contexts and identities (Lutovac & Kaasila, 2013, 2014). Moreover, these findings suggest which tools might be especially important in facilitating positive change among pre-service teachers who earlier experienced mathematics negatively.

Importantly, therefore, narrative tools played a key role in the differences between the two contexts and, thus, pre-service teachers’ identity work. In my earlier articles (Lutovac & Kaasila, 2009, 2011) in which I considered one of the
Finnish cases (Ulla), the potential of narratives as educational tools for enhancing the view of mathematics and promoting identity work was examined. These tools are designed to promote the process of reinterpreting past experiences, which has been shown to lead to the development of a more positive identity (Wilson, 2009; Wilson & Thornton, 2008). Through narrative rehabilitation, the Finnish cases had opportunities to tell stories about their memories as students and share their experiences with others in small groups (Pietilä, 2002; Valkonen, 1997). The aim of narrative rehabilitation is to support pre-service teachers to create meaningful narratives and help them realise these narratives. Hearing other people’s stories is considered to lend support to one’s identity (Hänninen & Valkonen, 1998). Students subconsciously interpret their mathematical autobiographies from the viewpoint of a tragic story, particularly when they mainly remember failures from their pasts and when they see a threat in their future. When students realise that the interpretation can be changed, this can lead them to search for different aspects in their mathematical past and future, and their self-confidence in relation to learning and teaching mathematics might improve (Kaasila, 2000; Lutovac & Kaasila, 2011; cf. Valkonen, 1997). Narrative rehabilitation may support pre-service teachers in regaining authorship of their mathematical autobiography (Lutovac & Kaasila, 2009, 2011). Similarly, Hauk (2005) has shown that many college students report feeling greater self-control with respect to mathematics when they allowed themselves to write about their emotions.

Besides narrative rehabilitation, bibliotherapy has an important meaning in handling emotion-laden school-time experiences. In bibliotherapy, reading (e.g. mathematical biographies) is used to produce affective change and promote pre-service teachers’ growth (Lenkowsky, 1987; Kaasila, 2006; see also Wilson & Thornton, 2008). Bibliotherapy includes three main components: identification, catharsis and insight (Lenkowsky, 1987). Through Ulla’s case (Lutovac & Kaasila, 2011), I have also elaborated on the phases of this therapeutic process. Ulla was able to identify with the characters in the text, and the more she had in common with the characters, the closer the identification process was (Hebert & Furner, 1997). Identification with characters or situations in a narrative enabled Ulla to see her challenges from a new perspective and gain tension release (Lutovac & Kaasila, 2011; Lenkowsky, 1987). This is called catharsis and involves an emotional feeling that one is not alone in facing one’s problems (Hebert & Furner, 1997). Finally, Ulla gained an insight into her own motivations, which allowed for positive change in her views and behaviour (Lutovac &
Kaasila, 2011; Lenkowsky, 1987). For example, her reflection on the bibliotherapy was as follows:

This influenced me also when I first time had to teach mathematics. [...] The article was for me therapeutic reading. I had an insight that I am not alone with my attitudes and problems. I was also consoled, because this topic has actually been studied, and also because [in the mathematics education course] it is not demanded from us to have positive attitude toward mathematics and that I should be perfect. (Lutovac & Kaasila, 2011, pp. 232–233)

Ulla chose to read an article ‘Math Is Not for Me’ (Huhtala & Laine, 2004), which focused on students’ difficulties in mathematics and on the ways of handling them. Reading the article helped her distance herself from her past and focus on building a better future for herself in relation to math teaching. She experienced the therapeutic power of tools. For pre-service teachers, such as the cases in this study whose experiences were strongly emotional (e.g. math anxiety), handling school-time memories with therapeutic tools is important (cf. Hannula et al., 2007b). I believe that the latter would have made a difference for the Slovenian cases. Narrative tools are generally similar in their processes, but they do have some differences. Due to the processes of reflecting and sharing experiences, these tools have important meanings for identity work. As discussed elsewhere (Lutovac & Kaasila, 2011) in the context of identity work, the process of sharing experiences is as important as the process of reflecting. Narrative rehabilitation is, in this sense, a complete tool containing both processes; however, bibliotherapy is more an individual process of reflection. To allow for sharing, the follow-up technique of ‘reflective writing’ through written narrative can be applied (Hauk, 2005; Hebert & Furner, 1997). In all, these tools complement each other in promoting pre-service teachers’ mathematical identity work (Lutovac & Kaasila, 2011).

I therefore elaborate on prior research, especially from the lens that narrative tools address pre-service teachers’ autobiographical context and facilitate their ‘distancing from the negative past’. This identity work enables pre-service teachers to resist negative possible selves (Lutovac & Kaasila, 2012) and orients them towards future challenges. Laszlo (2008) asserts that the resolution of traumatic events may lead to a state of identity in which the individual knows facts and also knows what to do with these facts. This has to do with the restoration of agency, as displayed in the decisive cases in this study. For the
Finnish cases, the restoration of agency was possible in the sense that they were encouraged through the use of narrative tools in the course to rise above the biographical constraints and search to change or improve the things they felt they needed in order to become better at teaching mathematics. However, for the Slovenian cases, it seemed that biographical as well as contextual constraints (lack of dealing with the biographical context and other demands in the courses) were insuperable and limited their agency. Therefore, ‘distancing from the negative past’ might propel pre-service teachers to engage in ‘decisive’ identity work. On the other hand, when such tools are not used and the opportunities to deal with recollections are not available, pre-service teachers may be rendered ‘indecisive’, thus engaging in ‘irresolute’ identity work.

9.4 Conceptualising identity work in mathematics education research

The fourth research question of this study addressed the elaboration of mathematical identity work as a concept—how could identity work in mathematics education research be conceptualised?

In line with the narrative framework, I contend that to become someone ‘mathematically’ is to construct a narrative of the past (Ricoeur, 1992), an evaluation of the present and the formation of plans for, or in anticipation of, the future (cf. Hamman et al., 2010; Markus & Nurius, 1986). The pre-service teachers’ narrations displayed various dialogues between the temporal aspects of their identities. The dialogue between the past and the present enabled us to understand how they saw their mathematical past in comparison with their current viewpoint. However, especially important and helpful in conceptualising mathematical identity work was how the pre-service teachers verbalised their reflective future-oriented thoughts (cf. Urzua & Vasquez, 2008). The dialogue between the past and the future revealed the bridge between the pre-service teachers’ pasts and their possible futures, in particular, how a negative mathematical past may or may not hinder their future work as teachers (see Di Martino & Sabena, 2011). The dialogue between the present and the future revealed that who pre-service teachers are may shape who they will become as teachers of mathematics and vice versa and that how they wish to become might shape who they are now. In line with the research literature, the findings therefore showed that the past and the future matter because they influence pre-service
As such, whenever the pre-service teachers were involved in a process of reflection, discussion, sharing and telling stories about their relationship with mathematics, its learning and teaching, they engaged in mathematical identity work. When they engaged in mathematical identity work, they utilised their previous mathematical experiences, their current definitions of experiences related to mathematics as well as how these experiences might shape future ones. Moreover, in this meaning-making process, they did not only make sense of their experiences but also of what they were told about themselves (cf. Fraser et al., 1997). Based on the data, it is evident that the pre-service teachers’ mathematical identities carry an individual as well as a social emphasis and are therefore also socially constructed (Black et al., 2009). The role of relationships, particularly with teachers, peers and family members was crucial in the pre-service teachers’ identity work. Accordingly, they developed their sense of identity relative to others—based on how they were seen by others and how they thought they were seen by others (cf. Martin, 1984). The reflection and interaction with others in this process helped them recognise the gap between their present and the ideal mathematical identity.

Accordingly, I (see Lutovac & Kaasila, 2011) firstly conceptualised mathematical identity work as emerging in and through narratives as a process of interaction between the individual and the social mathematical context (cf. Hinchman & Hinchman 2001; Mead, 1934). It is a process of deep reflection and self-evaluation whereby past, present and future mathematical identities enter into a dialogue that leads to one’s awareness of the tension between the real (present) and the ideal state of mathematical identity (Arnon & Reichele, 2007; Kaasila & Lauriala, 2010). The presence of tension or a gap is a condition for evoking teacher change and the developmental process.

The possible selves theory (Markus & Nurius, 1986) was especially useful for understanding future-oriented mathematical identity work and in demonstrating the place of one’s agency in identity work. In this sense, they were a useful addition to the concept of narrative identity as they enabled the bridging between the temporal aspects (past, present, future), described how future-oriented thoughts provide identity-relevant information and motivation to pursue goals (Hamman et al., 2010) and thus helped in understanding how pre-service teachers may develop as future teachers of mathematics (cf. Dunkel & Anthis, 2001; Markus, 2006). Therefore, as Markus and Nurius (1986, p. 960) note, ‘some
possible selves stand as symbols of hope, whereas others are reminders of bleak, sad, or tragic futures that are to be avoided’. Yet all the pre-service teachers’ anticipations provided some direction for action; through the construction of possible selves, pre-service teachers were active in their own development (cf. Markus & Nurius, 1986).

Given that the pre-service teachers in question had or still have negative views of mathematics, it was obvious that they saw their futures through expectations, possibilities and ideals as well as through fears. The use of possible selves also allowed for capturing the relationship between identity and emotions in terms of hoped-for and feared possible selves (cf. Hamman et al., 2010), which was especially important because the cases here had very emotion-laden experiences. Finally, the concept of possible selves helped in establishing links between the identity work and the contexts since it has been argued that possible selves derive from what is perceived as valued within an individual’s social and cultural context (Hamman et al., 2010; Markus & Nurius, 1986).

Accordingly, the conceptualisation of mathematical identity work was further elaborated by taking into account the knowledge of possible selves (see Lutovac & Kaasila, 2012, 2014). Arguably, therefore, pre-service teachers’ mathematical identity work can be seen as a process of acquiring and then achieving or resisting certain possible selves (cf. Markus, 2006). It is either closing the gap between the present mathematical selves and the positive possible selves (e.g. expected, hoped-for, ideal selves) or increasing the gap between the present mathematical selves and the negative possible selves (e.g. feared selves). I note that the role of agency is important in the resolution of this dialectic. I understand agency as the pre-service teachers’ will and ability to develop distinct mathematics-related possible selves (cf. Markus & Nurius, 1986). The role of agency becomes evident in the extent to which pre-service teachers’ possible selves are associated with strategies to achieve or avoid (cf. Hamman et al., 2010). Additionally, pre-service teachers have been identified as active agents in their mathematical identity work when acting towards the future by creating continuously new possible selves (Sfard & Prusak, 2005). Therefore, the focus on identity (or lack thereof) in mathematics education courses is important. Following Beauchamp and Thomas (2009), a pre-service teacher’s awareness of his/her identity may result in a sense of agency.
10 Trustworthiness and Critical Considerations of the Study

Evaluating narrative research based on reliability, validity and replicability, contradicts its nature (Lieblich et al., 1998). Instead, narrative research should be judged on the ‘standard of whether the work communicates or “says” something to us’ when trying to conceptualise our experience (Gillham, 2000, p. 11). According to Polkinghorne (2007, p. 474), the validity in qualitative research ‘concerns the believability of a statement or knowledge claim’. Therefore, a conclusion is valid when there is enough evidence to believe in it. In this sense, explanation has to fit with the data. Hammersly (1992) asserts that it is important to ask whether a research contributes to the field. Rather than validity or other terms used to discuss the quality of the research, I use the term trustworthiness as it has been extensively employed in relation to the narrative approach (Mishler, 1986).

10.1 Trustworthiness in narrative research

The narrative approach starts from an interpretive viewpoint and asserts that narrative data can be analysed in diverse ways (Lieblich et al., 1998). It highlights that value-freedom is not possible. This is because what counts as truth depends on social influences (Orlikowski & Baroudi, 1991). Therefore, the narrative approach advocates pluralism and subjectivity (Lieblich et al., 1998). Lieblich et al. (1998, p. 171) note that ‘reaching alternative narrative accounts is a manifestation of the wealth of such data and the range of sensitivities of different readers’. An analysis of narrative data thus depends much on the insights and creativity of the researcher (cf. Patton, 1999). Additionally, because narrative research does not require replicability of findings, readers need to rely on the researchers’ integrity (Lieblich et al., 1998). However, narrative research should still be systematic and coherent, and a researcher has to explain his/her choice of methods, report in detail on data collection and analysis to allow readers to evaluate the quality of the research (Lieblich et al., 1998; Polkinghorne, 2007). In what follows, I will tackle these issues, including my role as a researcher in the research process, such as personal and professional information that may have affected the data collection, analysis and interpretation either negatively or positively (cf. Patton, 1999).
10.2 Evaluation of the chosen methodology and perspective

As a researcher involved in the interpretive process, I attempted to understand pre-service teachers’ identity work by accessing the meanings they created on the basis of their own experiences. An understanding of the process of identity work involved getting inside the world of the pre-service teachers’ who were engaging in it. Through this process, I saw qualitative research, particularly its ‘naturalistic’ nature, ‘inductive analysis’, ‘purposeful sampling’ and ‘holistic thinking’ (Patton, 1999, p. 1190), as of great value in exploring such phenomena. Further, because we can all think in narratives (Bruner, 1986), the method seemed appropriate for the purpose of the study and the questions posed. In choosing the narrative approach, I took the position that narratives are not complete and accurate representations of life, neither are they fiction (Bruner, 1986; Ricoeur, 1991). I agree with Lieblich et al. (1998, p. 8) that ‘stories are usually constructed around a core of facts or life events, yet allow a wide periphery for the freedom of individuality and creativity in selection, addition to, emphasis on, and interpretation of these “remembered facts”’. Bruner (1986) also notes that the meaning of narratives is more important than the truth. Arguably, therefore, and building on Riessman (1993), the narrative truth is evident in the established relationship between the past, present and future.

I argue that the pre-service teachers’ narratives were not direct copies of their experiences; rather, they offered them a way to reconstruct their mathematical lives (cf. Ricoeur, 1988; Verhesschen, 2003). In this sense, the narrative provided the pre-service teachers’ experiences with meaning. Accordingly, my role as a narrative researcher was to acknowledge what was meaningful for the cases in the study; however, this does not have to be meaningful to the world (cf. Dolk & Hertog, 2008). For that purpose, my aim was to avoid generalisations. I took into account that in their narrative, the pre-service teachers reflected on their past events from the perspective of their present situation. Pre-service teachers knew how their narrative would end, and their narration was adapted accordingly (see Schütze, 1984). Additionally, I acknowledged that imagination plays a role in pre-service teachers’ storytelling (cf. Riessman, 1993).

Research on teachers’ professional identity has been criticised for an underlying cognitive perspective, that is, that research results are based on written or verbal data collected from teachers (see Beijaard et al., 2004). Consequently, I have also approached the pre-service teachers’ identity work from a more social perspective. I applied the narrative approach and constructed the pre-service
teachers’ mathematical biographies. Narrative research thus connected the pre-service teachers and their social contexts. Further, I acknowledged that the story through which the pre-service teachers constructed their mathematical identity showed that their lives are always linked to others, and as the data illustrated, this is not always in the way they would prefer (cf. Ricoeur, 1992). Others were therefore constituents in the pre-service teachers’ identities and vice versa. Moreover, this study showed how pre-service teachers’ stories were intertwined. Thus, the social perspective is implied in this approach. In line with Beijaard et al. (2004), understanding pre-service teachers’ narratives is only possible when information about their contexts is available. For this purpose, I provided sufficient information, especially about their educational contexts (see Chapter 4).

10.3 Evaluation of the collected data

On sample size and generalisations

As in most narrative studies, this study considered only a few cases (Lieblich et al., 1998), all of whom had a negative view of mathematics. Therefore, I am aware of the limitations of my cases in terms of elucidating pre-service teachers’ identity work. I encountered several challenges that prevented me from obtaining additional cases. First, due to the narrative nature of the study, research participants generally need to feel they have sufficient narrative competence. The latter might have had hindered participation by Slovenian cases in the study. In line with the strong tradition of quantitative studies (Marentič-Požarnik & Šteh, 2013), they might have felt intimidated about engaging in in-depth interviews and revealing aspects of their lives. Second, the reasons for developing a negative view of mathematics may be found in previous, sometimes very traumatic experiences. This might have further hindered the willingness to talk about those experiences and, therefore, participation in the study in both educational contexts. Third, the fact that the interviews with the Finnish cases were conducted in English might have also hindered their participation. I further discuss the language issues below. However, due to possible reasons for low participation in the study, such as perceived narrative competence, communicating in a foreign language and revealing personal experiences, the actual pre-service participants contributed to the quality of the data and thus the trustworthiness of the study.
According to Patton (1990, p. 184), there are no rules relating to sample size in qualitative inquiry and that ‘sample size depends on what you want to know, the purpose of the inquiry, what’s at stake, what will be useful, what will have credibility, and what can be done with available time and resources’. The small sample size of this study is a shortcoming; however, identity is a complex topic. Therefore, in order to approach it in an appropriate way, some understanding of pre-service teachers’ perspective is needed. In this sense, the data collected does shed light on important issues revolving around many challenges that pre-service elementary teachers experience in relation to mathematics. The narrative method helped to illuminate the ‘mathematical world’ of pre-service teachers from two different cultural contexts. Additionally, it gave unity to various issues in their mathematical experiences. I applied Patton’s (1990, p. 181) recommendation for data collection and selected ‘information-rich’ cases: ‘These are cases from which one can learn a great deal about matters of importance. They are cases worthy of in-depth study’. Therefore, based on the quality of the information collected, I determined that the number of cases considered was sufficient (cf. Sandelowski, 1995) as the relevant cross-contextual notions were obtained in a practical and theoretical sense as well as because the purpose of the study was not to generalise in terms of representativeness (Patton, 1990).

I am aware that the results might pertain exclusively to the teacher education contexts in question. Thus, I did not attempt to generalise my findings to all pre-service teachers in particular settings or more widely, neither to all pre-service teachers with a negative view of mathematics. Although the narrative is often considered in individual terms (Murray, 2003), we can also understand the pre-service teachers in this study as a particular group telling narratives about their past and their aspirations in relation to mathematics. Therefore, taking pre-service teachers’ narratives as a collective illustrates well the mathematical identity work in which those with a negative view of mathematics may be engaged during teacher education. Nevertheless, without attempting to generalise, teacher educators can find similar cases in their courses.

On language issues

I also wish to acknowledge here the methodological challenges related to language issues, such as the limitations to conducting interviews with participants in different languages. First, I address the limitations relating to the language barrier between me, the researcher, and the Finnish participants in the study. The
interviews with the Finnish students were conducted in English, which is a foreign language for them as well as for me. This poses the question of how well the pre-service teachers were able to express themselves in a language that is not their mother tongue as well as how well I was able to understand and capture the meanings communicated. The Finnish cases in the study had no difficulty expressing themselves in English. I would evaluate their English proficiency as fluent. As with all non-native English speakers, the Finnish pre-service teachers also had certain linguistic problems, including making grammatical and syntactical mistakes. However, none of these problems affected the findings of the study as the students were able to use proper vocabulary. Occasionally, there were problems regarding the use of particular English words for the mathematical contents (e.g. when describing the lessons they were teaching), however, I found it surprising that they were quite knowledgeable about specific vocabulary pertaining to the domain of affect (for example, words such as anxiety, beliefs, attitude etc.). Despite the fact that there might have been differences in the use of emotional expressions in the native language versus another language, the Finnish students expressed their emotions in a straightforward manner. The expressions were familiar to me. Moreover, they were often very similar to those expressed by the Slovenian pre-service teachers. In addition, due to the fact that they knew the requirements for participation in the interview, they appeared to speak openly about their emotions. I would also evaluate my own command of spoken English as fluent. Particularly in the case when the research persons, myself as the researcher included, were non-native English speakers, I found speaking and understanding the spoken word easier than in a case whereby one of the two parties was a native English speaker. It seems to me that this also affected the more relaxed and safe atmosphere during the interview. As a researcher, I expected that the setting of conducting the interview in a foreign language might have evoked worry or anxiety in participants, but the Finnish students seemed at ease when narrating.

During the interviews, I tried to reassure that I fully understood what students meant when using particular words, and in case of doubt, I would ask for clarification, such as ‘what do you mean when you say...?’ Considering that I have been living in Finland for several years, I have also learned to understand ‘the Finnish way of speaking English’, that is, the meanings they give to certain words they use in English. The latter was of great help while analysing the data. I also acknowledge here that cultural scripts might have been at play in the pre-service teachers’ narratives, which might not have been visible to me as an outsider to the
Finnish context. On the contrary, as an insider to the Slovenian context, I was able to intuitively recognise and understand some of the cultural scripts present in the talk of the Slovenian cases. As Goddard and Wierzbicka (2004, p. 153) discuss, ‘cultural scripts intend to capture background norms, templates, guidelines or models for ways of thinking, acting, feeling, and speaking, in a particular cultural context’. By applying the notion of cultural scripts, it would have been possible to specifically focus on the analysis of these scripts in relation to the content of the narratives. However, particularly in relation to the form (e.g. coherence of the talk), such scripts would have better explained speech practices from the perspective of the pre-service teachers themselves (cf. Goddard & Wierzbicka, 2004). Though such a focus could have explained the findings in a deeper way and thus contributed to a more robust understanding of pre-service teachers’ identity work, a focus on cultural scripts extends beyond the scope of this study and could easily form the focus of a separate study. In relation to cultural scripts, I also found it helpful to consult the uses and meanings of problematic words with my supervisor who is an insider in the Finnish context as well as an expert in the research focus of this dissertation.

Despite expressing themselves in a foreign language, the Finnish pre-service teachers were quite talkative (of course depending on the participant). However, after conducting the interviews with the Slovenian participants in their mother tongue, I did notice a difference between the two groups in terms of the length of the narratives. The Slovenian interviewees produced lengthier narratives, describing a greater number of episodes from their lives. One reason is surely a matter of foreign language use which usually involves slower speaking and less elaborated responses. I acknowledge this as a shortcoming because regardless of one’s command of a foreign language, much of the detail in narratives is perhaps omitted but, at the same time, may have been necessary in a study as this one. That said, my findings are consistent with existing research on Finnish pre-service teachers covering similar topics, which has indeed validated that the intended meanings of the phrases and concepts used by the participants were most likely extensively captured. However, it was useful to conduct interviews with Finnish cases myself as having a different interviewer could have altered the meaning of the pre-service teachers’ narratives as well as hindered my own analysis. For example, possible misunderstandings could have led to misinterpretations. Moreover, the interaction between us and the ability to recall the interviews with respect to the participants’ non-verbal expressions were both important. My first-hand knowledge of the non-verbal information was helpful to the transcription
and data analysis processes (Kvale, 2007) and contributed to a greater understanding of the meanings expressed in the narratives.

Second, I address the limitations of the translation of the interviews with the Slovenian participants. While I collected the data from the Slovenian participants in the Slovenian language, the analysis and presentation of the data was in English. This posed certain translation-related decision-making problems for me as a researcher. The advantage in the data collection with Slovenian students is certainly that the Slovenian language is our mother tongue and that I have insider knowledge of the Slovenian culture as well as the use of the language. This aspect certainly reduced problems with respect to understanding expressed meanings. My biographical background also includes such educational experiences that resemble the experiences narrated by the Slovenian pre-service teachers. In part, these experiences are also shared as I have gone through the same teacher education process as the participants in the study. It could thus be simplistically said that I knew exactly what they were talking about. Moreover, I evaluated my fluency in English as sufficient for conducting translations of the interviews. With this decision, I also aimed to minimise meaning losses with the translation.

The central focus in the process of translating the Slovenian data into English was on establishing a conceptual equivalence or comparability of meaning (Birbili, 2000). In the practical sense, this means that I first translated the data from Slovenian to English as literally as possible; however, when the same meaning was not possible to capture the literal translation, I had to search for its equivalence. For example, it was common for the participants to talk about memorisation in their mathematics learning. They would then state the following in the Slovenian language: ‘Veliko snovi, sem se morala naučiti na pamet’, which literally translates to ‘I had to learn much on brain’. Leaving this translation as such would not capture the meaning and would hinder readers’ understanding. The equivalent meaning in English thus translates to ‘I had to learn much of the content by heart’. I found this process quite easy as I have a proficient understanding of the Slovenian language and culture; I also feel that my English proficiency sufficed. Further, translators usually also focus on grammatical and syntactical equivalences (Birbili, 2000). Notwithstanding, for me, this was not of primary importance as my aim was to capture the meaning of what was said. The latter decision, in my opinion, also made translated words appear as direct quotes (Rossman & Rallis, 1998). Moreover, the verbatim translation also contributed to a better capture of the use of the Slovenian language as well as the Slovenian mentality than if a free translation were used (cf. Honig, 1997). I am also aware
that the verbatim translation might have hindered the readability and understanding of the biographies and data excerpts presented.

In the final report, the words used by the pre-service teachers were unified for the purposes of readability and understanding. For example, the Finnish and Slovenian participants inconsistently used the words ‘upper secondary school’, ‘high school’ and ‘middle school’ (which is a literal translation from Slovenian to English). All expressions are synonyms, however, I decided to use one term, ‘upper secondary school’ consistently throughout the report. This choice was made in order to maintain the coherence of the vocabulary in the report.

In keeping with the narrative perspective, I would like to conclude the discussion on language issues with reference to Ricoeur’s (2006) work On Translation. In Ricoeur’s view, translation has a two-fold meaning: 1) the one discussed here, which is translating the meanings of one particular language to another, and 2) translation can also indicate the ‘everyday act of speaking’ as a way of ‘translating oneself to oneself’ and also ‘translating oneself to others’ (Ricoeur, 2006, p. xiv-xv). As Ricoeur (2006, p. xiv) crystallises ‘just as in a narration it is always possible to tell the story in a different way, likewise in translation it is always possible to translate otherwise, without ever hoping to bridge the gap between equivalence and perfect adhesion’. In this sense, in contemporary cross-cultural research, whether this applies to collected data or mere publishing in international journals, eliminating shortcomings pertaining to language barriers might be a difficult endeavor; however, overtly addressing the issues, problems and decisions during the research process is of great importance (cf. Birbili, 2000).

On restricting/obtaining more data

The fact that saturation point was reached early in the data collection could also be understood as a need to collect other forms of data. Based on the article in which I considered Ulla’s case (Lutovac & Kaasila, 2011), valuable information was obtained from her portfolio. Therefore, it might have been useful to analyse the data from pre-service teachers’ portfolios. This would enable a deeper insight into their views. For example, Ulla elaborated on many of her views in writing. However, the portfolios were written in pre-service teachers’ mother tongues, which posed a challenge. In addition, the instruction portfolios between the two groups of cases differed significantly, thus, it would have been difficult to collect comparable data. For example, while in their portfolios the Finnish cases reflected
on the issues in line with the focus of this study (e.g. their mathematical background), the portfolios of the Slovenian cases did not include useful aspects for the purposes of this study.

In terms of the collected data, it would have been useful to see how narrative tools could have worked for the Slovenian pre-service teachers, especially considering that they seemed to have had tougher math-related experiences, particularly in upper secondary school where they faced failure because of inadequate performance – which further evoked more intense negative emotions in comparison to the Finnish pre-service teachers. My assumption is that these tools would have been helpful and might have led to similar processes (e.g. distancing from the negative past) as revealed in the findings on the Finnish cases. Alternatively, it would have also been useful to consider the meaning of the tools in relation to the Finnish cases whose negative mathematical experiences were closely related to inadequate performance and intense math anxiety.

10.4 Evaluation of the data analysis

While analysing and interpreting the data, I built on what Lieblich et al. (1998, p. 10) call ‘dialogical listening of at least three voices’: 1) of the narrator, 2) of the theoretical framework and 3) of a reflexive monitoring of reading and interpretation.

Firstly, my analysis was data-driven. This meant that I listened carefully to the pre-service teachers’ voices as they were represented in the narratives, and I based my interpretations on them. Because interview data is co-constructed, it ‘can assist in ensuring that the participant’s own voice is heard and that the text is not primarily an interviewer’s own creation’ (Polkinghorne, 2007, p. 482). I applied this by describing the pre-service teachers’ mathematical biographies in detail so that their voices would be sufficiently ‘raised’ (Kaasila, 2007a; Lutovac & Kaasila, 2010; see also Riessman, 1993). In order to avoid projecting categories from one cultural context to the other, I analysed the data without pre-determined categories. By doing this, I avoided culturally biased analyses and interpretations (see Jablonka et al., 2009). Polkinghorne (2007, p. 476) has stated that readers need to be convinced ‘of the likelihood that the support for the claim is strong enough that the claim can serve as a basis for understanding of and action in the human realm’. Accordingly, I made claims about the meaning that the pre-service teachers’ mathematical experiences had for them and about how they understood themselves and others. As suggested by Polkinghorne (2007), I
tried to display the reader the evidence - data excerpts, and at the same time, I provided the context for my claims. For example, considering the pre-service teachers’ narratives from the past- and future-oriented perspectives gave the reader the possibility of comparing the vocabulary that the pre-service teachers used before and after the turning points in their narratives. This substantiated whether a shift or change in their mathematical identities had actually occurred. Narratives have the power to explain (Polkinghorne, 1995). Accordingly, my aim was that the retrospective ‘explanation’ in narrative analysis and analysis of narratives, needed to assure that the reader understands the outcome of the stories (see Kaasila, 2007a; Polkinghorne, 1995).

Secondly, the theory also played a role in analysing the pre-service teachers’ narratives (Lieblich et al., 1998). Although the analysis was data-driven, the theoretical framework of the study did provide the concepts for the final interpretations. Interpretive decisions need to be justified (Lieblich et al., 1998; Polkinghorne, 2007), which is why I conceptualised and supported my findings with relevant existing research. I also explicated my process of interpretation. Readers should be able to evaluate whether the interpretations are trustworthy or not. Thirdly, reflexivity had a central meaning here as it involved consciously analysing my role as a researcher and critically evaluating the process of the data collection, analysis and interpretation (Ellis & Bochner, 2000). I was aware of bringing my prior theoretical knowledge and my personal experiences to the analysis (e.g. coding) and to the interpretations of the data (Bruner, 1986; Polkinghorne, 2005b, 2007). Throughout the study, I reflected on my own experiences as a pre-service elementary teacher. Moreover, I was aware of my decisions while drawing conclusions based on the data.

Throughout the process of data interpretation, I acknowledged the fact that my interpretations are personal; however, interpretations should not be seen as entirely speculative or intuitive (Lieblich et al., 1998). The general purpose of interpretation is ‘to deepen the reader’s understanding of the meaning conveyed in a story’ (Polkinghorne, 2007, p. 483). I offered interpretations of the data by linking them to the purpose of the study (Feldman, 1995) and a theoretical understanding of the phenomenon. The data excerpts reproducing pre-service teachers’ words were the evidence for the trustworthiness of my interpretations (Polkinghorne, 2007).


10.5 Evaluation of my role as a researcher in the study

A very common method for exploring various educational contexts has to do with brief fact-finding visits to a variety of schools and institutions. Crossley and Vulliamy (1984) discuss that such visits are usually prone to reproduce the rhetoric of policy. As the researcher of this study, I had the privilege of being an ‘insider’ in both contexts. I undertook the same programme at the same university as the Slovenian cases. I completed my teacher education studies only a few years ago, and therefore, I participated in the same courses and was taught by the same teacher educators as the Slovenian cases in this study. In 2009, I came to Finland for a study exchange and returned in 2010 where I have lived ever since. I have learned much about the Finnish school context as well as teacher training by conversing with teacher educators, teachers and pre-service teachers. Not only have I had the opportunity to observe school and university teaching, I have also been teaching several courses at the University of Lapland. Additionally, the collaborative experiences in both teacher education programmes enabled me to experience a variety of issues along the positive-negative continuum. That said, I was able to reflect beyond the ‘official’ versions of the processes in both educational contexts, which does not always hold true for brief visits (cf. Crossley & Vulliamy, 1984). My own personal experiences as a pre-service teacher and having an insider view of both contexts equipped me with a great level of understanding of the cases and their experiences.

As a researcher, I put a great deal of effort into being critical throughout the study. I was critical in my approach to the data. For example, in the data analysis process, I listened carefully to the pre-service teachers’ experiences, however, I also ‘constantly questioned, doubted, looked for contradictions, and the unsaid’ (Lieblich et al., 1998, p. 166). Further, I was critical towards my own research process. In seeking to understand the pre-service teachers’ mathematical identity work, I focused on the aspects of both educational contexts that were based on my ‘insider’ knowledge and experience rather than those aspects that are constantly repeated in literature but which seem rhetorical. In line with my critical stance, I also wish to emphasise that my aim here was not to praise one teacher and mathematics education context and criticise the other. I am aware that the results could have been different had the study have a different focus, for example, the development of pre-service teachers’ mathematical proficiency. I avoided producing an ‘idealistic’ description as well as being overly critical of the practices in the two contexts in question (cf. Jablonka et al., 2009).
Lieblich et al. (1998) regard insightfulness as one of the criteria for the evaluation of narrative studies and refer to the sense of innovation. Accordingly, seven peer-reviewed articles based on this research have been published: four journal articles (Lutovac & Kaasila, 2010, 2011, 2012, 2014), two papers published in conference proceedings (Lutovac & Kaasila, 2009, 2013) and one book chapter (Kaasila, Lutovac, & Lauriala, 2014). In addition, while working on them, I shared my own views and dilemmas and have been involved in a critical research dialogue with the co-authors and reviewers. Collaborative dialogue with my supervisor allowed me to test, share and challenge my research practices (Kaasila & Lutovac, 2014). Therefore, my work went through the process of what Lieblich et al. (1998, p. 173) call ‘consensual validation’, which informed me as a researcher in this study but also validated my findings. The authors further note that such validation is of the highest value.

Finally, throughout the entire research process, I documented my own reflections and insights as well as personal narratives about my experiences as a doctoral student in a research diary. This also allowed for an understanding of the importance that narratives have in the domain of educational research. Arguably, therefore, and building on Connelly and Clandinin (1990, p. 2), ‘educational research is also the construction and reconstruction of personal and social stories; learners, teachers, and researchers are storytellers and characters in their own and others’ stories’. Throughout the process, and along with my supervisor, I conducted research on developing doctoral supervision where our research diaries were used as data (cf. Ellis & Bochner, 2000). In this process, I engaged in dialogue that allowed me to look beyond myself (cf. Bullough & Pinnegar, 2004). Our studies addressed our individual as well as our shared experiences and academic identities, including supervisor and student benefits (Kaasila & Lutovac, 2012), the use of narrative teaching strategies in doctoral supervision (Kaasila & Lutovac, 2011) and the development of a research relationship towards a learning partnership (Kaasila & Lutovac, 2014). Reflexivity in the research diary and collaborative dialogue created a space for my own identity work as a researcher. Telling and writing narratives of my academic life (cf. Connelly & Clandinin, 1990) were important components of my communication about becoming a researcher; they shaped my professional development as a researcher and thus my academic identity. In line with the findings of this study, the affective dimension of my narratives also played an important role in my own identity work as it enhanced my psycho-social well-being throughout the process (Kaasila & Lutovac, 2011). Finally, I also wish to emphasise that despite the
collaborative research with my supervisor, I have conducted the doctoral research and this report independently.

10.6 Ethics in the study

Although I have discussed some ethical issues relating to the study in the methodology section, I build on Shamoo and Resnik (2009) and briefly summarise some ethical concerns that I have adhered to in this study.

I have honestly communicated about the research process—the processes of data collection, the analysis and interpretation of the data and the presentation of the findings. As discussed earlier, all possible misinterpretations of the data were avoided. I have thus avoided all kinds of bias in the data analysis and interpretation as well as in reporting about the findings. I committed myself to treating all the participants and the data equitably (Hammersley & Traianou, 2012) without favouring any particular case or group of cases. I wish to emphasise that my aim here was not to criticise individual pre-service teachers and the identity work they engaged in. Although this study did focus on pre-service teachers’ identity work in their personal narratives, my aim was to understand the contextuality of their identity work through their personal narratives. I was interested in the possibilities and constraints that the contexts posed for individuals’ experiences and their engagement in identity work. In addition, I carefully examined my own work and attempted to avoid careless errors. In this vein, this research did not cause any harm. The autonomy of the research participants in this study was respected, and they were able to decide freely on their participation. I have also adhered to rules on confidentiality; therefore, special care was taken to protect the privacy of the pre-service teachers. The pre-service teachers were informed about the study and potential publications containing their data to which they all gave their consent. Raw data and the personal information of pre-service teachers was accessible only to me and was kept confidential and strictly for the purposes of this study. However, whenever the data was used publicly in published articles or conference presentations, participants remained anonymous and were referred to by pseudonyms.

In considerations of research ethics, there is often a question of reciprocity (Hammersley & Traianou, 2012). This research, like any other, depended heavily on the data and thus the willingness of research persons to participate in this study. As I began the phase of data collection, I acknowledged that the participants had to give up their time in order to participate in the interviews, and
for this reason, I remained committed to being flexible. The interviews were thus arranged whenever it was suitable for the research participants, and I was willing to adapt to timetable changes. The pre-service teachers who decided to participate expressed before or after the interview that participation was meaningful to them. It was the opportunity in which they were given voice. They were grateful for my willingness to listen to their stories as some had lacked such opportunities. Moreover, for some, this was their first experience of telling their story aloud. They also appreciated my intent to come to an understanding of the challenges they were facing, particularly in the hopes that this research could enhance the experiences of future generations. In all, there was mutual reciprocity; I am grateful for the valuable and insightful data, and they were grateful for the opportunity and voice.

Hammersley and Traianou (2012) have discussed that research ethics is also about how research affects people generally, for example, the public reputation of institutions, occupations etc. I took these broader issues into account and wish to emphasise that the findings of this study are contextualised; thus, all generalisations were avoided. In addition, my task as a researcher was in line with the research goals—elaborating mathematical identity work as a concept and understanding the meaning of context for pre-service teachers’ identity work. In providing answers to these questions, the findings might appear more or less favourable to one or the other context; however, as discussed earlier, I do not praise one teacher education programme over the other, and neither does this study intend to positively or negatively affect the reputation of any of the two contexts. Both contexts have their own foci and aligned approaches. This study was rather a learning opportunity, especially in understanding identity work as a concept and contributing to the body of knowledge on this issue, but also in finding ways to design teacher education in a manner that is best suited to future teachers’ needs.

Finally, throughout the process, I adhered to openness and integrity. I engaged in discussions about the data and findings with the supervisor and reviewers of the published articles and have also been open to criticism and proposals. This research was granted several times by Finnish foundations, such as the CIMO Fellowships Programme, Alfred Kordelinin Säätiö, and the Finnish Cultural Foundation (Suomen Kulttuurirahasto). I have therefore acted according to the terms and conditions stipulated in the research agreements.
11 Discussion

This study explored mathematical identity work by drawing on the cases of Finnish and Slovenian pre-service elementary teachers who reported having had negative experiences with mathematics during their years at school. The findings of this study provided theoretical and practical contributions for mathematics education research as well as for the development of teacher education. The study enabled a better understanding of pre-service teachers’ identity work, particularly the link between pre-service teachers’ identity work and approaches in teacher education programmes. Moreover, the tools used in mathematics education courses advanced the understanding of how pre-service teachers’ identity work can be enhanced as well as the many factors that can hinder this process. This is of great importance for teacher educators internationally and provides ways of addressing pre-service teachers’ identities and identity work in order to prepare them for teaching mathematics. The significant theoretical contribution of the study is the conceptualisation of ‘mathematical identity work’ (see Chapter 9).

In the following sections, I first discuss the findings of the study, the bridging of pre-service teachers’ identity work and the context in which it occurred. Second, I discuss educational implications, and finally, I outline the directions for possible future research.

11.1 Discussion of the findings

I argued in this study that pre-service teachers’ narratives offer a view of the social dimensions of mathematics teaching and learning processes (cf. Martin, 1984). I now tackle these issues by first discussing the meaning of the school context for pre-service teachers’ mathematical identity work. I focus on their mathematical experiences throughout their school time through the lens of the mathematics curriculum and the meaning of mathematics as a subject in the two educational contexts. Second, I discuss the meaning of teacher education programmes for pre-service teachers’ identity work. I focus on the tools used to facilitate pre-service teachers’ learning during mathematics courses and more widely on teacher education paradigms and approaches.
11.1.1 The role of school-time mathematics in pre-service teachers’ mathematical identity work

Based on the findings of this study, the mathematical identity work in which the pre-service teachers engaged was reflective of the mathematics they undertook during their school time. The Finnish and Slovenian cases seemed to have had similar school-time experiences and constructed similar mathematical identities. These were in line with mathematics teaching and learning focused on performance, an emphasis on math ability and, consequently, success or failure. All the cases identified themselves as victims in relation to mathematics and thus engaged in outsider identity work. However, the differing experiences of failure (actual vs. perceived) between the Finnish and Slovenian cases appeared to stem from wider educational practices in the two contexts, such as the role and organisation of mathematics in upper secondary school. The following issues appear to be linked to how the pre-service teachers experienced learning mathematics and, consequently, whether they experienced failure.

Mathematics overload

Based on the characteristics of the mathematics curriculum for general upper secondary school in the two contexts, the Slovenian cases might have experienced mathematics overload; the number of hours and the amount of content were higher in comparison with the Finnish cases. Even when comparing the Slovenian curriculum for mathematics with the Finnish advanced syllabus in mathematics, the amount of math content and the level of difficulty appeared higher. In addition, unlike the Finnish, the Slovenian cases did not have the option of choosing between basic and advanced syllabuses in mathematics. Therefore, all the Slovenian cases underwent the same difficulty level and experienced a demanding content. Additionally, as suggested by the Finnish cases, the possibility of choosing the level of mathematics during upper secondary education might have unloaded some burden from pupils. Not only did they have the possibility of choosing the level, they could also choose the courses. This also enabled them to focus on the contents about which they felt more confident.

In order to successfully complete the school year in Slovenia, students have to pass all subjects, including mathematics. Additionally, the grade for the overall subject is determined as the average grade of all the assessments in mathematics, and all assessments must be successfully completed. This means that every failed
assessment has to be repeated. On the other hand, the grade for the overall subject syllabus in Finland is determined as the average grade of the individual courses, which leaves some room for unsuccessful experiences without being ‘punished’. If a pupil in Slovenia obtains a failing grade in mathematics, he/she must take a repeat exam. Repeat exams consist of all the mathematics contents in the particular school year. Pupils who fail the repeat exam in mathematics must repeat the year in the same educational programme.

Moreover, the Slovenian cases perhaps experienced additional pressure due to the fact that students in the same class have to proceed in their studies as a group (a class). However, if a student repeats the year in the same educational programme for reasons of non-approval, he/she changes the class and thus the social context. This further carries negative social consequences, such as falling behind for an entire educational year as well as various difficulties with integration into a new class environment. On the other hand, ‘upper secondary schooling in Finland is more flexible than in most countries in terms of how classes are organised and sequenced and the variety of student choice available’ (Brown-Ruzzi, 2005, p. 6). Because students can graduate in less or more time than anticipated, thus creating less pressure on students.

Further, the matura or matriculation examinations in mathematics seemed to be yet another stress factor for the Slovenian cases and especially since it is notorious for being challenging. Success in the matura examination determines whether and which university studies students can enrol in. Experiences with mathematics can therefore limit students’ higher education possibilities and future professional choices. In the matriculation examination, mathematics was optional for the Finnish cases, which seemed to ease stress and pressure. Moreover, the Finnish school context also gives students more independence and responsibility for their own learning, which is a possible explanation as to why the Finnish cases showed some improvement in their experiences and how they saw mathematics and themselves in relation to these experiences. On the other hand, due to the challenges contributing to students’ failure, mathematics tutors seem to be quite a common phenomenon in the Slovenian context for the purposes of handling failure (see Lipovec, Antolin, Lutovac, 2010; Lipovec & Antolin, 2014). In all, based on the abovementioned issues faced in upper secondary school, and despite the fact that mathematics is one of the central subjects in both contexts, what counts as knowledge, taught and learned, as well as the quantity of such knowledge depends of the context (cf. Lerman, 2013b). Nevertheless, the
Slovenian context, particularly upper secondary school mathematics, appears to pose more demands on students.

**Relationships of authority and persuasions of inability**

One similarity between the Finnish and Slovenian cases was that relationships and interactions in the mathematics context had a particularly negative meaning for their mathematical identities. The question remains, however, as to why this is the case in the mathematics context. Following Young (2008), mathematics as a subject is understood as powerful knowledge. Similarly, Shaw (2009, p. 90) has described such power as ‘an unforgiving “Old Testament” finality about mathematics, an un-negotiable sense of being right or wrong, of being a success or a failure, of life or death, and of there being nothing in-between’. Building on Hodgen and Marks (2009), it is then, the power of mathematics as a school subject that makes ability essential to pre-service teachers’ mathematical identities. As Brodie (2011, p. 238) argues, those who are successful in mathematics are seen as ‘different, special and from another world, which is completely inaccessible to those who are not’. Arguably, and building on Amit and Fried (2005), if mathematics is seen as an authoritative subject, teachers carry great authority and are consequently enacting and conveying this to pupils. Moreover, based on the findings, teachers did embrace this authority. This led to relationships of ‘domination and obedience’ (Amit & Fried, 2005, p. 164), which was similar for all the pre-service teachers interviewed. Notwithstanding, this might have been manifested to a greater extent in the experiences of the Slovenian cases.

Moreover, these issues contributed to the construction of failure (Boaler et al., 2000). Many examples of teachers’ reported speech in this study illustrated their suggestion to pupils that success in mathematics would determine their success in life. These persuasions of inability were shown to have a strong link with the fear emerging from the math relationships (cf. Newstead, 1998; Usher, 2009), which was particularly evident for all cases in this study and, to even greater extent, for the Slovenian cases. Therefore, the mathematics context arguably keeps students out of power (Young, 2009). Unfortunately, many years of designations about one’s lack of math ability and powerlessness cannot be reversed; however, it does not mean that it should not be addressed. In all, the issues discussed here support Brodie’s (2011, p. 237) argument that learning mathematics is also ‘the process of
developing mathematical identities and relationships’ (see also Black et al., 2009).

11.1.2 The role of elementary teacher education in pre-service teachers’ mathematical identity work

Here, I discuss the role of elementary teacher education settings in relation to future-oriented mathematical identity work. I see some interrelated aspects as particularly meaningful with respect to pre-service teachers’ mathematical identity work: first, the role of the facilitators in mathematics courses; second, the role of admissions procedures in teacher education and the status of teachers in the social contexts and, third, the role of teacher education approaches. I acknowledge that these aspects may greatly reflect the wider academic cultures of the contexts in question and the discussion could perhaps extend well beyond the scope of the study. Therefore, I here theorise only about certain contextual issues in relation to pre-service teachers’ mathematical identity work.

Facilitators in mathematics education courses

One of the central findings of this study is that particular facilitators, namely, narrative tools, were identified as central in the pre-service teachers’ identity work. Though insufficiently used in mathematics education research (Kaasila, 2007a; Wilson, 2009), the use of identity narratives as therapeutic approaches and facilitators of change is not new. As part of psychotherapy practice, the field of narrative therapy (Laszlo, 2008) uses identity narratives for the therapeutic purpose of assisting people with ‘forming a more agentic identity story in which they assume control over their own lives’ (Polkinghorne, 1996, p. 366). The same premise seems to be evident in the teacher education approach that the Finnish cases underwent. In this approach, their identity work became more intentional. The intentionality of their identity work in the mathematics education course was manifested in two ways. First, the teacher educator planned activities for the pre-service teachers in such a way that they enhanced shifts in the pre-service teachers’ mathematical identities and therefore promoted their identity work. Second, the pre-service teachers were also acquainted with the facilitators and their objectives and were therefore aware of the process. Because the central aspect seemed to be to promote identity work rather than performance or ability, it allowed the pre-service teachers to deal with their past experiences, including, for
example, the perfectionism they experienced. It appeared that reduced attention on performance propelled the pre-service teachers against striving for perfection. Instead, through telling their stories, they were actively involved in interpreting and re-interpreting experiences, and through these interpretations, they reconstructed their new mathematical identities (cf. Ricoeur, 1991). The fact that the identity work among these cases was intentionally facilitated further promoted their engagement in decisive identity work. Conversely, in the teacher education context of the Slovenian cases, the pre-service teachers’ identity work appeared to be less intentional. Teacher education consisted of different objectives and prioritised other processes (e.g. educating competent teachers) rather than pre-service teachers’ identity work.

The findings of this study showed that pre-service teachers’ mathematical identity work can be enhanced within teacher education. However, we have to be aware that identity work is a creative process (Fraser et al., 1997) in which pre-service teachers engage also without being assisted by teacher education programmes; not all teacher education contexts try to promote pre-service teachers’ identity work. However, identity work without assistance might also include certain dangers. Some pre-service teachers might not find appropriate ways of addressing their problems on their own. For example, some might rather avoid their problems than face them. Others might think or feel that new, more positive experiences will automatically distance them from their problems. This is associated with seeing certain experiences as a salvation, as if all other ways of feeling more positive would have been exhausted (cf. Fraser et al., 1997). However, memories and emotions related to the actual problem might persist, as observed in some of the Slovenian cases in this study. It is important therefore for all pre-service teachers to find ways of coping with their problems; however, I emphasise here that not all coping will be productive in the long run, which is why it is especially important that pre-service teachers’ identity work is assisted by teacher education.

I discussed (see Chapter 9.3) the importance of narrative tools in facilitating positive change among pre-service teachers who earlier experienced mathematics negatively. However, I acknowledge that the argument about the effectiveness of these tools is perhaps not a sufficiently solid one because they were applied only in the Finnish context in question. The Finnish and Slovenian cases in this study differed with respect to their mathematical experiences. Perhaps it was easier for the Finnish cases whose failure was only perceived (i.e. self-oriented perfectionism) to overcome their negative view of mathematics than it was for the
Slovenian cases who actually experienced inadequate performance in mathematics. In order to build a stronger argument about the tools, it would be even more important to do similarly intentional mathematical identity work with the Slovenian cases.

*Admission procedures to teacher education and the status of teachers in the social contexts*

I discussed the finding on the variation between pre-service teachers’ experiences of failure in light of wider educational practices, particularly based on the organisation of mathematics in upper secondary schooling. With respect to the fact that both the Finnish and Slovenian cases had been performing very well in most other subjects and were thus academically successful, differing demands, particularly in upper secondary mathematics, might have been one reason for these differences. However, the finding on actual failure (i.e. inadequate performance) vs. perceived failure (self-oriented perfectionism) should also be discussed from the viewpoint of the institutional settings, particularly the admissions procedures of both of the teacher education units in question. I discussed earlier that Finnish pre-service teachers undergo a highly competitive admission procedure. The Finnish teacher education unit in question carefully selects future pre-service teachers based on their academic ability as well as their potential and motivation for being a teacher. This selection criterion arguably attracts students with perfectionist tendencies, including mathematically higher performing students. On the other hand, Slovenian pre-service teachers enter teacher education fairly easily. The Slovenian teacher education unit in question does not have any particular selection criteria, which suggests that lower achieving students also gain admission. This is well-founded, particularly in terms of the rate of pre-service teachers who report having a negative view of mathematics—22% of Finnish pre-service teachers (Kaasila et al., 2008a) versus more than 70% of Slovenian pre-service teachers (Lipovec, Antolin, & Lutovac, 2010).

The bottom line here is that these differing admissions procedures attract different profiles of pre-service teachers. The careful selection of Finnish pre-service teachers calls for students with a certain disposition towards the teaching profession (cf. Oliveira & Hannula, 2008) or perhaps a certain identity. I believe this identity then needs to be in line with the wider nation’s academic culture that sees ‘teaching as a noble, prestigious profession—akin to medicine, law, or
economics—and one driven by moral purpose rather than material interests’ (Sahlberg, 2010, p. 1). In this sense, teacher education programmes have the task of ‘producing’ such teachers that will fit the needs of the society. Reflecting on the findings of the study and taking these assumptions into account, it is not surprising that the Finnish cases displayed self-development talk and decisiveness as these characteristics seem to fit with how the Finnish society sees teachers. Moreover, these are precisely the teachers that the society wants. Similarly, Gellert et al. (2013, p. 537) have discussed that the formation of professional identity requires the fitting of the ‘individually centered social processes into the socially constructed institutionalized world’. Following this view, I argue that the conceptions of what it means to be a good teacher are embedded in larger social and institutional frameworks. The same applies to conceptions of what kind of teachers we want teacher education programmes to ‘produce’.

On the other hand, the relatively low status of teachers in Slovenia, combined with low demands to enroll teacher education studies, may attract a rather wide profile of students, and high achievers may not be particularly interested in becoming teachers. At the same time, the focus on performance and competencies might actually worsen the problem by leaving low achievers with a feeling of inadequacy (discussed below). Additionally, pre-service teachers’ self-confidence might be further undermined as these individuals become aware of how they will be as future teachers perceived by others – in the eyes of the society. The finding that the Slovenian cases engaged in irresolute identity work is therefore not surprising. Though this view might seem polemic, perhaps the nation’s wider academic culture does not need teachers who are agentic and decisive as this then creates the situation whereby teachers are less likely to passively adopt knowledge that has been predetermined for them (Lauriala, 2013; see also Barle & Bezenšek, 2006). At the same time, in this context, there is perhaps no need for what Sahlberg (2010, p. 2) tells us about the Finnish system that ‘relies on the expertise and accountability of teachers who are knowledgeable and committed to their students’. In a context that does not trust teachers that much and that employs other mechanisms to drive performance in schools, accountable teachers might not be needed, and neither does indecisiveness seem problematic. This is also in line with the discussion on paradigms and their influence on teacher education considered in the following sub-section (Lauriala, 2013; see Chapter 4.3).
'Competency-based' versus 'humanistic identity-based' teacher education approaches

The Finnish cases in this study underwent teacher education which was underlined by the interpretive paradigm whereby identity formation is of key importance (Lauriala, 2013). Consequently, courses within this teacher education paradigm are designed to provide students with new ways of looking at themselves and their possibilities (cf. Fraser et al., 1997), as seen above. I labelled this an 'identity-based' teacher education approach (Lutovac & Kaasila, 2012, 2013, 2014; see also Korthagen, 2004). The Slovenian cases, on the other hand, underwent teacher education which was underlined by the positivist research paradigm, that is, an emphasis on knowledge, skills, and attitudes (cf. Korthagen, 2004). This teacher education subscribes to a 'competency-based' approach (cf. Korthagen, 2004; Lauriala, 2013; Marentič-Požarnik & Šteh, 2013). On the level of curriculum, both teacher education units in question address knowledge, skills and attitudes regardless of their approaches; however, in the identity-based approach, these issues are addressed within a broader framework. Considering that the research literature suggests that teachers are reflective, thoughtful, social, affective as well as experiential individuals (see Namukasa et al., 2009), the latter perspective on teachers requires a more holistic approach to educating future teachers (cf. Korthagen, 2004), such as an identity-based approach. In this sense, the positivist paradigm with its competency-based approach neglects an important aspect of who pre-service teachers are, for example, their autobiographical context (see Lutovac & Kaasila, 2010).

Teacher education approaches seem to play an important role in what is happening in mathematics education courses. Tsamir and Tirosh (2009) claim that mathematical content knowledge, pedagogical knowledge and affective factors are entwined and influence greatly teachers’ practices. Arguably, mathematics education courses within the identity-based teacher education approach take these factors into account. The pre-service teachers were thus given the opportunity to distance themselves from their past and begin their identity work, thus emphasising their agency. The re-establishment of agency was especially possible as the course was designed so that pre-service teachers’ self-confidence would be enhanced. Furthermore, I concur with Hodgen and Askew (2007, p. 41) that mathematics education courses for future elementary teachers are ‘doomed to failure unless placed within an affective frame in which teachers have space to question mathematics and mathematics teaching’. This affective frame was
largely neglected in the competency-based teacher training of the Slovenian cases. The focus was confined to developing mathematical content and pedagogical knowledge which emphasised the importance of pre-service teachers’ ability and performance. In this sense, the pre-service teachers might have perceived their past and present mathematical experiences quite similarly. It also seemed that there was not enough room to recover from their negative past. Instead, the approach seemed to be reminding them of their inadequacy, and further, though unintentionally, it seemed to hint at their inadequacy as future teachers of mathematics.

The findings also show that all the pre-service teachers in question seemed to be particularly empathetic, especially due to their own struggles as learners and their experiences of teaching mathematics. In general, the existing research supports that elementary pre-service teachers are empathetic by nature (Di Martino & Sabena, 2011; Di Martino & Zan, 2010, 2011; Gellert, 2000; Laine & Kaasila, 2007). However, it seems that along with the restoration of agency, cognitive empathy was implicit in the decisive cases and not in the irresolute cases. Based on the substantial amount of mathematics lessons throughout the years of schooling and the focus on mathematical content knowledge in the mathematics education course, the finding that the irresolute cases did not exhibit cognitive empathy is surprising. It further raises doubt about whether teacher education programmes whose aim is to develop one’s competency can actually succeed, particularly if we take into account pre-service teachers who experienced mathematics negatively in their past. This does not suggest that such programmes do not educate competent teachers; however, there is a question as to whether they can develop one’s competency when one has vivid memories of negative experiences and deep-seated beliefs of inadequacy. In addition, with respect to admissions procedures, it also seems contradictory to the aim of developing one’s competency and yet not assuring, through the admissions requirements, that one has a disposition to develop a particular competence, such as for teaching mathematics.

One of the findings also suggested that the rhetoric in pre-service teachers’ narratives differed between the Finnish and Slovenian cases. One possible explanation could be related to the ever-present debate about the position of theory and practice in teacher education and the persuasive power of narratives. The Slovenian cases had much less teaching practice during their studies, which they also told they were disappointment about. In this sense, they might have felt distanced from the practice; they were not able to experience and test what they
learned in the courses. Quite the contrary, they seemed to be overloaded with the theory. Additionally, they perceived teaching experience as an act rather than what teaching looks like in real life. These issues laid a good ground for being perceptive about stories of practice, for example, those they hear from in-service elementary teachers. The elementary teachers in this case become what Sfard and Prusak (2005, p. 18) call ‘significant narrators, the owners of the most influential voices’. Therefore, pre-service teachers look up to the experiences of elementary teachers, identify with them and incorporate their stories into their possible selves. This means that elementary teachers’ narratives become the first person narratives which pre-service teachers include into their own identities (cf. Sfard & Prusak, 2005). Additionally, applying Sfard and Prusak’s (2005, p. 18) notion, significant narrators carry ‘those cultural messages that will have the greatest impact’ on pre-service teachers’ actions. This notion might be of importance for teacher education programmes and teacher educators in terms of how to assure significant narrators within teacher education programmes whose stories will help enhance future teacher practice.

Arguably, therefore, the identity-based approach, with its tight link between theory and practice, is the key aspect that made it possible for the Finnish cases to see teacher educators as significant narrators. Theory and practice in the identity-based approach are integrated within the development of pre-service teacher’s professional identity (cf. Beattie, 2000). Personal meanings are thus made explicit and placed alongside the concepts and theories (Kaasila et al., 2014; Lauriala, 2013). The link between theory and practice is also enacted in the fact that practicum takes place every year and in diverse school environments (e.g. training and field schools) with the crucial role of the teacher training school. As a collaborative partner of the teacher education department, training school is a key aspect here and might be in greater agreement with teacher education programmes about the principles that pre-service teachers should adopt during their teaching practice. The boundaries between the university and training school appear blurred. Not only are pre-service teachers more exposed to practice and are taught to understand theory and practice as connected, they also see these links in their environment. The narratives of teacher educators and elementary teachers in the training school might, in this sense, be substantively close. Therefore, when pre-service teachers incorporate narratives they hear into their identities, they adopt what is expected from them by the teacher education programmes.
Importantly, life-long learning is currently the wider goal of most educational institutions, including teacher education departments. The self-development rhetoric (Kaasila, 2007b; Kaasila et al., 2012) displayed within the decisive cases resonated well with this idea (Lutovac & Kaasila, 2014). Further, following Mayer (1999), the concept of teacher identity is necessary when developing the life-long learner. The identity-based approach appears to be parallel to the concept of life-long learning as it is also underlined by the recognition that learners’ experiences are the resource of the highest value and that what is being learnt should be built around learners’ needs and interests. Additionally, teacher education programmes that subscribe to such an approach convey the idea that teacher training is just one phase in learning to become a teacher. However, the question here is whether teacher education programmes that emphasise competency are aligned with this goal beyond mere rhetoric.

I discussed earlier the link between school mathematics and relationships in that context. I argue that there is also a link between teacher education approaches and relationships that are consequently established between teacher educators and pre-service teachers. In my view, the identity-based approach promotes closer, supportive and collegial relationships, for example, such that resembles mentoring (cf. Walkington, 2005; see also Kaasila & Lutovac, 2011). According to this approach, teacher educators try to create an open conversation with and between students sharing personal experiences and views; the focus is on learning rather than who is right or wrong. Such relationships might be very beneficial for pre-service teachers who had negative experiences in the past, particularly if those experiences were related to teachers’ actions. On the other hand, the competency-based approach, whereby performance plays a central role, might form distant relationships in which the teacher educator plays the role of the evaluator and thus has high authority. This might erect barriers to an open discussion as the fear of being evaluated and seen in a certain way may hinder students from telling how they really think or feel.

I assert that the sites to encourage identity work are a necessary part of teacher development during teacher education as well as later on (cf. see Freese, 2006; Sachs, 2005; Thomas & Beauchamp, 2007). Applying Beauchamp and Thomas (2009, p. 175), pre-service teachers ‘must undergo a shift in their mathematical identity as they move through the programme of teacher education and assume positions as teachers in today’s challenging school contexts’ (see also Cattley, 2007). The findings show that pre-service teachers can undergo the shifts in their mathematical identities even in aspects that are considered resilient to
change (e.g. views of themselves as mathematics learners). The narratives in this study showed a close relationship between pre-service teachers’ perceived math ability and their self-confidence. However, on the basis of my data, while perceived ability seemed to remain unchanged, changes in self-confidence were manifested. In addition, the importance of therapeutic tools (Hannula et al., 2007b) for enhancing shifts seems to be well-founded. In all, teacher educators need to be aware of the aspects of mathematical identities that pre-service teachers bring with them and explicitly address them. Therefore, addressing identities and promoting shifts are crucial to identity work.

Finally, I wish to emphasise that my aim is not to praise identity-based teacher and mathematics education contexts and criticise competency-based contexts as I am aware that the results could have been different had the study focused on competency. I only want to highlight that regardless of their different foci, mathematics education courses should overtly address identity work while preparing pre-service teachers for future teaching (Beauchamp & Thomas, 2009; Brown & McNamara, 2011). Invoking Walshaw (2004, p. 557), ‘teacher education must engage the identities of pre-service students’ so they can learn who they might become as teachers of mathematics. Moreover, as a starting point of this research, I argued that pre-service teachers’ negative view of mathematics is an issue, however, I can now see that their irresolute identity work is of even greater concern, especially upon completing their studies.

11.2 Educational recommendations

The findings in this study provide knowledge for designing teacher education programmes in a better way, specifically mathematics education contexts. Particularly, notions on the manner in which pre-service teachers’ identity work is reflective of the two contexts in question may be useful for other teacher education programmes when helping pre-service elementary teachers to develop strong mathematical identities in positive ways (cf. Beauchamp & Thomas, 2009). In addition, based on the findings, some recommendations for mathematics during the formative years of schooling are also given.

First, teacher education programmes should embrace a more holistic approach, thus assisting in the development of pre-service teachers’ identities (Beattie, 2000; Geijsel & Meijers, 2005; Korthagen, 2004). The dominant perspective on a ‘competent’ teacher in many teacher education programmes has been criticised (e.g. Lauriala, 2013) as it neglects the complexity of who teachers
are. As such, a more holistic approach to teacher education is needed (cf. Beattie, 2000; Hoban, 2007; Korthagen, 2004; Meijer, 2011). It is important to acknowledge that pre-service teachers have a significant amount of knowledge based in their autobiographies and that this knowledge can be examined and then reconstructed during their studies (Beattie, 2000). Accordingly, putting the stress on changing the meaning of the stories in order to change identities is essential. Facilitating turning points in pre-service teachers’ narratives might thus help to educate better teachers (Drake, 2006), strengthening their engagement in the learning process (Wilson, 2009) and, as seen in this study, promoting decisiveness and self-development. As Mayer (1999) maintains, it is possible to become an expert teacher by performing the skills. Notwithstanding, I am of the view that true professional teaching involves identity. Moreover, teacher education programmes should re-think their educational policy regarding admissions procedures. Perhaps, a better fit between the kind of teachers that are needed and the kind of students that are enrolled in teacher education is needed. If we want a particular calibre of teachers, we must look for students who display a disposition or a potential to become this ‘ideal’ type.

Second, education courses that prepare pre-service elementary teachers to teach mathematics should strive to enhance their mathematical identities. Teachers who have ‘well-developed’ mathematical identities (see Grootenboer & Zevenbergen, 2008, p. 243) and feel comfortable to teach mathematics (Wilson, 2009) are essential for students’ learning. This is why is it especially important to address the challenges that elementary teachers often face with mathematics. However, this cannot be reached with an increase in subject-matter knowledge and being good at mathematics. The affective aspect is essential in the process of becoming a teacher and in teachers’ professional practices (Pezzia & Di Martino, 2012). Teacher educators therefore need to understand and address affective barriers related to mathematics that many pre-service teachers have. As seen in this study, it is easier to engage in cognitive issues of teaching and learning when emotional difficulties have been handled.

Therefore, specific recommendations for teacher educators for enhancing identities are needed. Pre-service teachers’ should engage in future-oriented talk, which is essential in their identity work (Urzua & Vasquez, 2008). The construction of identity narratives will promote anticipatory reflection – reflection upon the future – and will enable pre-service teachers to imagine themselves as mathematics teachers (cf. Chapman, 2008a). This may be accomplished by encouraging them to reflect on their possible selves. The findings also suggest
that pre-service teachers who reported having had negative experiences with mathematics have a desire to compensate for the negative past experiences in their future teaching. Building on Di Martino and Sabena (2011, p. 104), I argue that compensating for the negative past with a good teaching ‘may be an important motivation for future teachers: a point of discontinuity’. This view is in line with the emphasis on possible selves. Combining both aspects in such way that good teaching is considered as a possible self might encourage pre-service teachers to engage in decisive identity work. Pre-service teachers should be assisted with balancing positive (e.g. expected, hoped-for) and negative (e.g. feared) possible selves to increase their confidence in the future (cf. Hamman et al., 2010; Urzua & Vasquez, 2008). The use of therapeutic narrative tools (Lutovac & Kaasila, 2011, 2014) is one way of facilitating resistance to negative possible selves as they enable pre-service teachers to reflect and re-construct their mathematical identity (see also Wilson, 2009). These tools can be applied in any other subject domain in higher education. For instance, earlier, I considered narrative rehabilitation and bibliotherapy as tools for handling researchers’ experiences and for enhancing their professional (researcher) identity (Kaasila & Lutovac, 2010).

Third, (pre-service) teachers should strive to build positive relationships with pupils; however, these relationships need to be mathematical (Gellert, 2000; Hackenberg, 2005; Hodgen & Marks, 2009). What stood out in this study is that relationships and interactions provided the grounding for the overwhelming episodes in the mathematical identity narratives. Hence, the success or one’s feeling of success is undermined if relationships and interactions are not positive. Brodie (2011, p. 240) argues that ‘there is potential for mathematics to connect with people in different ways so that a broader range of identifications and relationships with the subject becomes possible for all’. It might make a difference, as the findings of this study show, if these relationships are supportive and caring so as to enable the possibility for each student to see himself/herself as mathematical. However, good relationships are insufficient for students to develop more favourable mathematical identities (Hodgen & Marks, 2009; see also Hackenberg, 2005). I build on Ng and Anderson (2011) that drawing awareness to cognitive empathy during education courses is necessary and might help in motivating pre-service teachers to work towards improving their proficiency. Mathematical proficiency was not explored in this study, however, the fact that many studies showed that pre-service elementary teachers lack a deep understanding of mathematical concepts, they might also have difficulties
engaging with pupils in a cognitively-empathetic math relationship. Following
Hodgen and Askew (2007), the ‘caring’ notion of a teacher and care for the
discipline (e.g. becoming more proficient at mathematics) should go hand in
hand. Similarly, Hackenberg (2005, p. 47) conceives of ‘mathematical caring
relations as inseparable from learning’. Therefore, developing positive
mathematical relationships means that these relationships relate to students’
emotions in positive ways and that they are also ‘explicitly and deeply
mathematical’ (Hodgen & Marks, 2009, p. 39; see also Brodie, 2011).

Fourth, alternative ways of dealing with failure or perceptions of failure are
needed. Based on the data, it seems that school mathematics does not offer
enough space ‘for knowing and not knowing simultaneously and for being seen
and valued regardless of whether one is right or wrong’ (Brodie, 2011, p. 239).
‘Punishment’ of failure results in very little space for students to continue to learn
while also maintaining a positive view of mathematics. It is therefore necessary to
support students in constructing their identities in such way that they can find
positive meanings in their failures (cf. Fredrickson, 2001). Efforts should be put
into helping students to find their own strengths rather than inputting on them a
need that one has to master all the school subject domains while anything less is
considered a failure. The focus should shift to what students can do rather than
what they cannot. Moreover, finding positive meaning is important when trying to
maintain positive emotions during struggles (Fredrickson, 2001). This is much
needed, especially in a mathematics education context. In all, positive psychology
theories can offer many new perspectives for the development of teacher
education in general and mathematics education contexts in particular.

All the cases in this study were academically successful in their school years.
For most of them, mathematics was the only ‘weakness’. However, what we have
learned from some of the Finnish cases is that even students who are successful at
mathematics perceived themselves to have failed the subject, particularly if they
exhibited perfectionist tendencies. If students define themselves and their self-
worth according to their performance or ability (cf. Covington, 1984), the focus
on performance in school further supports students’ high demands on themselves.
Therefore, for the benefit of all students, the focus on performance should be
minimised, if not eliminated. This may consequently affect how we perceive
failure. As teachers and teacher educators, we should keep in mind that our talk
and actions matter in how our students define themselves. In order to understand
this matter better, we must be aware that teachers also define themselves in terms
of their ability and performance (Black et al., 2009). As such, Hodgen and Marks
(2009, p. 40) assert, they reproduce ‘the inequitable mathematics that they themselves experienced’. Therefore, support for in-service teachers is also necessary as it has been suggested by Pezzia and Di Martino (2012) that it is never too late to facilitate change. Perhaps the focus on identity work in the professional development of in-service teachers might bring positive change.

Finally, identity work is central and should be encouraged in all stages of education. Successful identity work is known to increase coherence and may protect against challenging experiences (cf. McAdams & Janis, 2004). Not only should we encourage and assist pre-service teachers’ identity work, but the same applies for pupils in basic and upper secondary education. Focusing on assisting students in their development might also bring more humane relationships in schools; students should feel supported and believed in and should feel that teachers want them to succeed. Teachers should thus assist students’ in their identity work in non-threatening ways (cf. Hannula et al., 2007b). In all, what makes a difference in the kind of students we educate depends not only on the tools teachers use to promote identity work; it also depends on the entire educational approach.

11.3 Future research

Owing to the fact that much research on identity has been conducted in recent years, there are still multiple open questions to be explored. This study had shown that mathematical identity work is a topic of interest for teacher educators within elementary teacher education; however, it might also be of interest to those teaching pre-service mathematics teachers. Studies comparing these two groups are scarce; therefore, one possible direction for future research would be to compare and contrast pre-service elementary and mathematics teachers’ past experiences and how these two groups of pre-service teachers see their future as teachers of mathematics. This would give more information on the kinds of possible selves they project and how their identity work differs. Further, such information would provide knowledge on how to better design elementary and mathematics teacher education.

The findings on the pre-service teachers’ experiences of failure call for more international research on this topic. Future research could focus on exploring failure under different national and cross-cultural institutional conditions. It has also been evident here that many pre-service teachers are particularly empathetic as many see their mission in ensuring that their students will not experience
similar struggles as they did as learners of mathematics. I have argued here for balance between cognitive and affective aspects of empathy as both are important for mathematics teaching (cf. Ng & Anderson, 2011). However, future research could focus on finding ways to reach a balance between affective issues on one side and cognitive and pedagogic issues on the other (cf. Hodgen & Askew, 2007). It would be useful to identify particular tools that would influence pre-service teachers’ mathematical identity work in such a way as to balance the caring aspect of the teacher with his/her strong focus on mathematics.

I have also argued that identity work is a creative process in which pre-service teachers, like other individuals, engage without intentional assistance from teacher education programmes. It would be useful to obtain a more detailed view on this issue. Analysing pre-service teachers from various teacher education contexts that do not prioritise identity would give more information on how these students cope with their challenges. We could ask, for example: what kind of coping strategies do pre-service teachers who report having had negative mathematical experiences use when teaching mathematics? In what way can these coping strategies shape mathematics learning and teaching? What can be learned from the coping of those pre-service teachers who report positive mathematical experiences?

This study showed that by applying the narrative approach, especially by focusing on the ways pre-service teachers talk about their experiences, we can obtain useful knowledge on their mathematical identity work. Focusing on the rhetorical dimension of their narratives, as seen here, is one way of widening the methodological possibilities of narrative inquiry. Furthermore, it would be useful to apply diverse methodological approaches in future research in mathematics education. For example, combining multiple research methods (cf. Kaasila et al., 2012; Oslund, 2012) would deepen our understanding of research topics.

Finally, this study opened up a debate on the relationship between the paradigms and approaches of teacher education and pre-service teachers’ identity work. However, more notions are needed in this direction. Future research should provide more national and cross-national qualitative and quantitative data that would be valuable in exploring what kind of education is needed to promote the kind of identity work that would be most beneficial for pre-service teachers’ future identities as teachers in various social contexts.
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Appendix 1: Information letter for pre-service teachers in Rovaniemi (translated from Finnish)

Dear all,

Sonja Lutovac, from the University of Maribor, Slovenia, is visiting our faculty. She came here at the beginning of the year and will stay until the end of June. Sonja’s dissertation is in the area of emotions in mathematics learning, specifically in relation to math anxiety. I am the supervisor of her thesis.

Sonja aims to interview five–seven pre-service teachers who have had negative or even anxious experiences about mathematics learning during their years at school. In the autumn, she will also collect data from pre-service teachers at Maribor.

Sonja is 25 years old, and she has done the elementary teacher exam at the University of Maribor. She is friendly and is fluent in English. I hope that many students from our faculty will be willing to participate in her interviews, which will be conducted in English. If you are willing to participate in her study, it is not expected that you have a very good command of English; average skills are definitely sufficient. Sonja has indicated that the schedule of the interviews can be arranged so that they fit with students' timetables as much as possible. Of course, your participation in the study will be anonymous and the data gathered will be treated confidentially.

In all, if you have had negative experiences about mathematics lessons during your school years, and if you are willing to help Sonja, please contact her by 15 March via email.

Her email address is: sonja.lutovac@triera.net

Have a nice spring!

Best regards,
Raimo Kaasila
Appendix 2: Information letter for pre-service teachers in Rovaniemi in Finnish (original)

Hyvää luokanopettajaoopiskelijaa


Sonja haluaisi haastatella 5 - 7 sellaista luokanopettajaoopiskelijaa, joilla on ollut omaan kouluaikanaan negatiivisia tai jopa ahdistavia kokemuksia matematiikan oppimiseen liittyen. Sonjan tarkoituksena on koota ensi syksynä samantyyppinen aineisto Mariborista.


Jos sinulla on omaan kouluaikani ollut kielteisiä kokemuksia matematiikan tunneilla ja jos olet kiinnostunut auttamaan Sonjaa, niin toivon, että olet 15.3. mennessä yhteydessä suoraan häneen sp-postin kautta.

Sonjan sp-osoite on:
sonja.lutovac@triera.net

Hyvää kevään alkua!

Terveisin Raimo Kaasila
Appendix 3: Information letter for pre-service teachers in Maribor (translated from Slovenian)

Dear all,

I am Sonja Lutovac, a doctoral student in the elementary education programme. I am writing to invite you to participate in my doctoral research.

The study is about negative school-time emotions and experiences with mathematics among students – future elementary teachers. I aim to compare and contrast the experiences of Finnish and Slovenian pre-service elementary teachers. There was a time during my schooling when I had a negative experience with mathematics, which also led to many negative emotions towards the subject. As a pre-service teacher, I have observed that my classmates have also reported similar experiences. It seems that mathematics is one of the subjects that makes many students feel uncomfortable or even afraid. These views encouraged me to begin research on this topic. From the beginning of January 2009, I did the Erasmus exchange in Rovaniemi, Finland, where I conducted interviews with Finnish pre-service teachers. I am now also asking for your help.

If you have any negative school-time memories of mathematics, you are very welcome to participate in an interview. Interviews are predicted to last about one hour and are quite informal. With the help of some questions, I would like to encourage you to tell your story and share your experiences. Moreover, studies about emotions and experiences with mathematics are rare in Slovenia, which is why your input is very valuable.

I also want to emphasise that your participation in the study will be anonymous and the data gathered will be treated confidentially.

If you are interested or would like to know more about the study, please feel free to contact me.

Thank you for your help.

Best regards,
Sonja

Sonja Lutovac
Email: sonja.lutovac@triera.net
Appendix 4: Invitation letter for pre-service teachers in Maribor in Slovenian (original)

Pozdravljeni!
Sem Sonja Lutovac, študentka doktorskega študija Izobraževanje na razredni stopnji. Pišem vam v zvezi s svojo raziskavo, ki jo bom izpeljala v okviru svoje doktorske naloge.

Gre za raziskavo o negativnih izkušnjah in čustvih povezanih z matematiko pri študentkah(ih) – bodočih učiteljicah(ih) razrednega pouka. Raziskava bo mednarodno obarvana, saj nameravam narediti primerjavo med izkušnjami finskih in slovenskih študentk(ov) razrednega pouka. V času svojega šolanja sem imela kar nekaj negativnih izkušenj povezanih z matematiko, kar je povzročilo tudi marsikatera negativna čustva do predmeta. Ko sem študirala na razrednem pouku, sem opazila, da imajo tudi številne druge študentke veliko podobnih izkušenj. Matematika je eden izmed predmetov, ki kar precejšnjemu številu učencev, dijakov in študentov zbuja nelagodje ali celo strah. To me je spodbudilo k raziskavi, ki jo sedaj izvajam. Od januarja 2009 sem bila v sklopu Erasmus izmenjave v Rovaniemiju na Finskem. Pri raziskavi so mi že pomagali finski študenti, sedaj bi pa potrebovala še vašo pomoč.

Vse, ki imajo kakršne koli negativne izkušnje povezane z matematiko, negativna čustva iz česa šolanja, bi pozvala k intervjuju. Intervju bo trajal približno eno uro. Ni nikakršna formalna zadeva, gre bolj za sproščen pogovor o vaših izkušnjah. Preko vprašanj vas želim zgolj spodbuditi, da poveste svojo zgodbo, da delite svoje izkušnje. Dodala bi še, da so raziskave, ki obravnavajo emocije v matematiki zelo redke, sploh pri nas, zato bi bil vaš prispevek še posebej dragocen.

Naj poudarim še, da je vaše sodelovanje v raziskavi popolnoma anonimno in da bodo pridobljeni podatki zaupni.

Kdo koli je zainteresiran in bi rad sodeloval ali izvedel več, me lahko kontaktira.
Hvala za vašo pomoč.

Lep pozdrav,
Sonja

Sonja Lutovac
Email: sonja.lutovac@triera.net

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Appendix 5: Interview questions

1. Tell me about your experiences with mathematics.
   Tell me about your experiences in basic school.
   ...upper secondary school.
   ...teacher education.

   Possible follow-up questions:
   - What are the reasons for your negative experiences with mathematics?
   - What was the role of your teachers in these experiences?
   - What was the role of your classmates in these experiences?
   - What was the role of your parents in these experiences?
   - What was the role of your siblings in these experiences?
   - What do you think your role was in these experiences?
   - What could have been different during your school time so that you would not have experienced mathematics negatively?

2. Can you describe your emotions when you were faced with mathematics?

   Possible follow-up questions:
   - How did you feel in mathematics classes?
   - How did you feel in testing situations?
   - Tell me about what lead to your negative emotions.
   - What would you say was the biggest reason for your negative emotions?

3. Tell me about your teaching experiences.
   How do you feel now that you know that you will someday also teach mathematics?
   Do you think your negative experiences can hinder you from doing a good job in your future teaching?
   Do you think that your negative experiences might benefit you in some way?


130. Louhela, Virpi (2012) Kuulluksi tulemisen pedagogiikkaa kaikille yhteisessä koululikunnassa

131. Heikkinen, Mervi (2012) Sexist harassment as an issue of gender equality politics and policies at university


134. Aikkiä, Tuomas (2013) Pedagogiikka Tapiolan kuorossa ja Kari Ala-Päälminen yhteisöllisissä lapsikuoronjohtajana


Book orders:
Granum: Virtual book store
http://granum.uta.fi/granum/
Sonja Lutovac

FROM MEMORIES OF THE PAST TO ANTICIPATIONS OF THE FUTURE

PRE-SERVICE ELEMENTARY TEACHERS’ MATHEMATICAL IDENTITY WORK