Becoming a teacher – emerging teacher identity in mathematics teacher education

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INTRODUCTION

The original motive for undertaking this research topic emerged from observations about practice in the teacher education programme. Teacher education faces the challenge of paving the way for student teachers, who, after many years of academic studies in disciplines like mathematics, should internalise the idea of being a teacher within a one-year educational studies. Academic teacher education is founded on the idea that through disciplinary studies designed to learn the knowledge and skills, and with the help of limited practical experience and other interactional activities, an individual is transformed into a teacher. At least, an individual is to acquire the knowledge and skills for further development of emerging professionality. (Niemi & Jakku-Sihvonen, 2006; Westbury, Hansén, Kansanen, & Björkvist, 2005) In general, becoming and being a professional teacher is associated with cognitive expertise that includes the idea of knowing and mastering certain knowledge domains as well as readiness for applying one's own expertise in the classroom.

However, the cognitive approach is not the only perspective from which to consider 'becoming and being a teacher', as Atkinson (2004) claims. Personal identification with the teaching profession, the influence of the social environment, and the views of the teaching profession in general are also associated with being a teacher.Taking a role as a teacher in front of the classroom is a challenging task for many students at first. During teacher education, teaching practice provides an opportunity to face the role as a teacher and to have a feeling for 'being a teacher'. Two issues have to be addressed. Firstly, from an individual perspective, one needs to fully internalise and identify with being a teacher. Even at the beginning of the research project, a preconception was that attainment of the true image as a mathematics teacher was not easy. Secondly, in addition to the need for individual internalisation, recognition by others, including

pupils, other teachers and parents, is also essential. An individual needs to be seen as a teacher, to have a position as a teacher in front of others (Gee, 2000).

Given all this, cognitive expertise seemed to be too narrow and individualistic as a theoretical basis for undertaking this phenomenon, so that teacher identity has been chosen as the main concept in examining the process of becoming a teacher, emerging professionality. In this case study, the main purpose is to conceptualise the professional identity of a teacher, 'teacher identity', and then to explore the process of 'becoming a teacher' during mathematics teacher education through this theoretical framework, foregrounding an individual perspective for the process of 'becoming a teacher'. In the case of mathematics student teachers, the interest is what process takes place when an individual student involves with working on professional identity of a teacher and takes a step towards teaching profession during pre-service teacher education. Since practical experiences in a school community are limited in Finnish academic teacher education, the individual developmental process is more about the students' ability to imagine themselves as teachers than about development through hands-on experience mediated by 'real life'. The active role and the commitment of the individual are fundamental in constructing professional identity as a teacher based on academic university course. Conceptualisation of emerging teacher identity, an individual trajectory towards 'becoming a teacher' in terms of practical notions is essential.

However, individual development takes place in close association with the educational context. This research examines the formation of teacher identity in Finnish pre-service teacher education. Even though the main focus of the research is primarily on the individual perspective, the process of development is influenced and driven by contextual influences, for example, by shared conceptions of being a mathematics teacher in Finland. Firstly, the culture of trust can be seen at all levels of Finnish education as autonomous standpoint of teachers in school. Teachers are not

only those who implement the decisions of higher authorities, but who also take responsibility for making decisions about the curriculum through planning and writing the school-level curriculum in more detail within national guidelines (Westbury et al., 2005). Naturally, teachers take also responsibility for planning and implementing classroom activities and evaluation processes. A teacher is seen as a professional who is responsible for learning as well as for personal professional development later during his or her teaching career (Kosunen & Mikkola, 2002). There is a need for professional identity, identifying truly with being a teacher..

In order to educate such teachers, Finnish teacher education is designed on the main principle of the research-based approach, which prioritizes teacher pedagogical thinking and construction of a solid personal theory. In other words, the teaching profession is not only based on expertise in various disciplines but also on competence in applying such knowledge and skills to making decisions and justifying actions in the classroom (Lavonen et al., 2007). Furthermore, there is not simply one way to act as a good teacher but many. Individual students seem to develop in different ways and to value different elements subjectively. Since they experience the same kind of activities and interaction within the teacher education differently depending on their personal characteristics, motives, and background, a need to understand the complexity of formation of emerging teacher identity from individual perspective was foregrounded.

'Becoming a teacher' includes some notions that need to be taken into consideration in this research. On the one hand, as Beijaard, Meijer, and Verloop (2004) point out, being a professional teacher is a value-bound notion. The role that teachers have in the school system and, consequently, the skills, knowledge, and attitude to the teaching profession needed as a teacher are conditional on the context. Becoming and being a professional mathematics teacher has its special features that are embedded in the Finnish educational system and principles. Therefore, the

meaning of professionality needs to be elaborated in examining emerging professional identities of mathematics student teachers. In this research, particular cognitive and affective aspects associated with teaching profession in the Finnish educational context are to clarify the meaning of professionality. On the other hand, the interplay between individual and contextual dimensions in teacher identity formation emerges from practical notions. Teacher identity in general is of great interest in the educational field. Conceptualisation of teacher identity is various, as are research approaches to the topic. In this work, the interest was to build up a framework for teacher identity that could provide a tool for analysing the developmental process of student teachers during their teacher education. An individual student is considered to have an active role in the on-going identity construction that takes place in the academic context. Altogether, teacher identity is seen as something both personal and socially shared (e.g., Beijaard et al., 2004; Côté & Levine, 2002).

Research task

I now describe the steps through which the aim of the research was developed in order to help readers to understand why the research task is framed in such a way. Qualitative case study as a research approach is a basis of this research (Stake, 1995; Patton, 1997 and 2002). As Stake (1995, pp. 15-16) points out, it is thus essential to frame the purpose for research clearly enough and to keep the main focus in mind throughout the process. The research task, especially the specific questions, has been refined during the process based on both empirical and theoretical examination.

The research topic originally emerged within the developmental process of the mathematics and science teacher education programme at the University of Helsinki. Co-operation between the organisers, who represent university departments involved with the teacher education programme, has aimed at promoting the coherence of the programme. Along with the developmental project,

preliminary study was carried out to reveal how the study programme is actually implemented according to students (Krzywacki & Juuti, 2005). The present implementation of the programme was evaluated on the basis of student interviews and questionnaires. The evaluation information was used for developmental work, but it also improved the researcher's understanding of the context of teacher education. At the time, the meaning of the educational context for student development, social processes and the evaluative approach for teacher education were the main interests.

However, even if the educational context in which the beginning students take their first steps towards becoming a teacher is essential, the focus of the research was moulded to examine the nature of teacher identity more from an individual perspective, eventually producing the idea of conducting research on what is actually happening in understanding of student teachers during their studies. One of the most influential factors was the notion that individuals develop in different ways and value different elements subjectively. They experience the same kind of activities and interaction in their teacher education differently, depending on their personal characteristics. A need to understand the complexity of individual development within teacher education was considered of prime importance.

This research is about becoming a mathematics teacher, about the process of emerging teacher identity especially from the individual perspective. The aim is to understand the early steps of constructing the professional identity that will develop further along the whole teaching career. The research task is to examine **what the process of teacher identity formation is like in mathematics teacher education**. This case study on formation of teacher identity is limited to cases of student teachers who have mathematics as their major and to a collective case of teacher

educators representing the contextual influences on the process. The specific research questions are presented after the theoretical conceptualisation in a separate chapter.

The framework of 'teacher identity'

The overall framework for more detailed elaboration of teacher identity later on in this research will now be introduced. The concept of 'identity' is widely used in research, although no agreed definition exists in the literature because of the variety of disciplinary background (Beijaard et al., 2004; Eteläpelto & Vähäsantanen, 2006; Gee, 2000). In general, since identity has been embedded in various theoretical frameworks, including sociological, cultural, anthropological, philosophical, and psychological, it is natural that definitions and approaches differ greatly. Consequently, it was necessary to clarify the point of departure regarding the overall understanding and the locus of teacher identity in this research.

Despite my primary interest in the individual perspective of emerging professional identity, I regard teacher identity and its formation as an on-going process of change embedded in the context. Teacher identity cannot in fact be conceptualised without both perspectives, social and personal, as Eteläpelto and Vähäsantanen (2006) claim (see also Beijaard et al., 2004). For conceptualising the emerging professional identities of student teachers and taking the notion of building identity within a particular context into consideration, there was a need to establish the research on the framework that alouds me to discuss teacher identity from individual and social perspectives. Furthermore, since I understand professionality, in this case 'being a teacher', as context and value bound phenomenon involving both individual and socially shared ideas associated with teaching profession, the research framework needed to address the multidimensional locus of professional identity.

The multidimensional model of identity formation of Côté and Levine (2002) will clarify my understanding of teacher identity in general (see Figure 1). Côté and Levine (2002) founded their theoretical model of traditions of psychological and sociological approaches to identity on the work by Erikson (1968) especially. Even though they have designed the model for examining the societal viewpoint of reproduction of culture and identity in general, it is seen as a productive starting-point for this study, addressing both social and individual perspectives for identity formation.

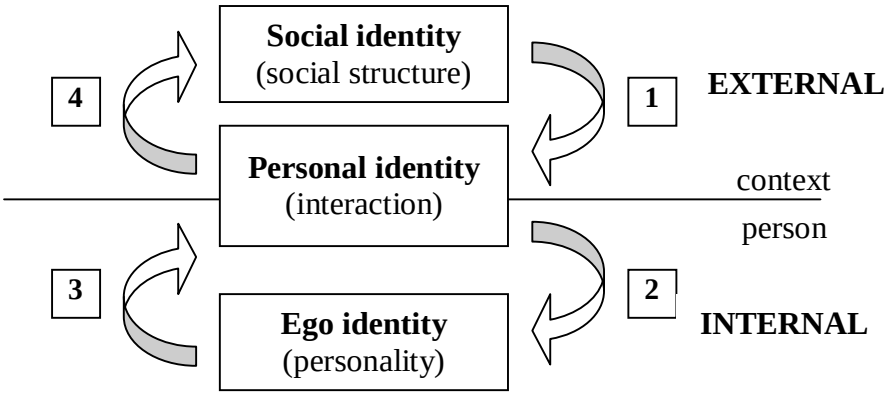


Figure 1. Côté and Levine's multidimensional model of identity formation (2002, p.134)

Identity in general, and teacher identity likewise, manifests itself at three levels. As Côté and Levine (2002, pp. 131-134) describe, teacher identity formation is a continuous process between ego, personal and social levels, through which identity can be approached. The ego identity represents internal mental processes that are the basis for individual understanding of one's own teacher identity. This level represents the personal continuity of one's own understanding and that to which a person attaches previous understanding, personal features and values within this on-going process. At the personal identity level, a person engages in interaction with others in a particular context. This involves behaviour and impressions that a person presents to others and oneself. Social identity represents a socially constructed understanding of reality, in this case,

socially shared perceptions of being a teacher, a social reality which influences a person and can be influenced by a person through everyday interaction with other people. Social structures, like norms, values, and traditions, are implemented and reproduced in concrete actions at the personal level.

The process of identity formation is divided into four phases between the components. The arrows between personal and ego identity components (2 and 3) represent the internal processes of teacher identity formation. A person constructs a subjective understanding of reality, of being a teacher, based on social influences. Not all socially shared perceptions will be automatically internalised as part of personal understanding. The other part of internal processes is about construction of a self-presentation as a teacher that is accords with previous internalisations and inner understanding in growing into being a teacher. Previous experiences have a role in this process.

The interaction between personal and social components represents the external processes of teacher identity formation, i.e., how a person engages in interaction with other people, and through that, is influenced by and constructs social reality with others. On the one hand, the relationships between social and personal identity components (arrow 1) represent how social reality influences interaction between people and through that the individual. Actual day-to-day interaction makes it possible for a person to experience socially shared principles and values, norms and ideals. Socialisation processes are a key issue for teacher identity during teacher education. On the other hand, people construct social reality and in this case, ‘teacher identity’, the socially shared understanding of being a teacher (arrow 4), in interaction with one another.

Particular aspects have to be considered in research on the formation of emerging professional identity since the model is designed for analysis of identity in general. First, teacher identity is something associated with a person who is becoming or is a teacher. Although the individual dimension and psychological aspects are essential for conceptualisation, the social dimension is fundamental for teacher identity as identity formation takes place through social interaction with others, as described in Côté and Levine's model (2002). In the context of teacher education, for example, mentoring in teaching practice and various academic learning activities influence the developmental process. Consequently, identity has to be something that can be recognised by an individual self as well as by others in particular times and places (Gee, 2000; see also Côté & Levine, 2002). As Danielewicz (2001, p.10) states, our understanding of who we are and who we think other people are as well as our understanding of other people's understanding of us is in the core of teacher identity and its developmental process. It follows that the locus of teacher identity is in **both individual and social processes**. Furthermore, components of teacher identity (ego, personal and social identity) are accessible through conceptualising an individual's own understanding, i.e., through explicating individual notions of professional identity.

Second, teacher identity is manifested through some characteristics associated with becoming and being a teacher. As Côté and Levine claim (2002, pp. 131-140), it is possible to recognise identity at different levels of manifestation, and the question of what is actually recognised is addressed through characterisation. In this research, the focus is on teacher professional identity, which is characterised by the features associated with the profession. Characterisation makes it possible to discuss teacher identity from an individual perspective, i.e., the individual developmental process, as well as from a social perspective, in terms of what are seen as desirable and valuable features of a good teacher and teaching. However, defining the essential characteristics of a teacher is not possible in only one way. As Beijaard et al. (2004) maintain, characteristics of teacher

professional identity emerge from perceptions of individuals, those who are involved in the internal developmental process, as well as from social perceptions by those who are involved with the developmental process through social interaction in various contexts. Professionalism is bounded by values and the context; in this case, the Finnish educational system.

Third, teacher identity is seen as an **on-going process,** meaning that identity cannot be seen as fixed but continuously in flux and dynamic (e.g., Beijaard et al., 2004; Côté & Levine, 2002). Identity is continually reshaped through individual experiences in social interaction with others in terms of personal identity. The processes which students are involved with can be considered as a series of changes, as Richardson and Placier (2001) indicate, leading towards 'being a (good) teacher'. The whole process of change is embedded in interaction, and the notion of difference from and similarity to others is essential (Danielewicz, 2001; Jenkins, 2004). However, despite the dynamic nature of teacher identity, it is possible to recognise the state of teacher identity at a particular time and place. Furthermore, when focusing on the formation of emerging teacher identity, the idea is neither to describe the situational series of change in themselves nor to discuss isolated individual experiences but to capture trends of this development and understanding of professional identity. I presume that an individual has an essential role in the process of teacher identity formation as s/he attaches values and meanings to personal experiences (see e.g., Beijaard et al., 2004; Sfard & Prusak, 2005), the one who filters and possibly directs professional development towards something better.

Structure of the research report

Finally, the structure of the research report will be described to clarify the totality of the work. The overall framework of teacher identity has been discussed above in order to provide the understanding for the elaboration that follows.

The theoretical part is divided into four chapters, beginning with a general overview of educational research on teacher identity. The idea is to inform the reader about various research approaches on this topic, and to position this study within the research field. The next three chapters lay the foundation for understanding teacher identity and its formation in this research. First, characterisation of teacher identity is one way to approach professionality and the features of the teaching profession. These characteristics allow us to elaborate processes and states associated with teacher identity as well as to define the meaning of being a professional teacher. Second, the significance of the image of an ideal teacher for the developmental process is dicussed. Tension between the present and designated state of individual teacher identity can be seen as a driving force in the developmental process (Sfard & Prusak, 2005). The ideal image is on the boundary between external and internal processes associated with identity formation, and thus is at the heart of developmental process. Third, on-going processes of identity formation, both internal and external, are discussed in more detail to show it as a dynamic and continuously changing entity.

The research engages with the qualitative case study approach. A brief conclusion after the theoretical part discusses the specific research questions. The report continues by considering the paradigmatic background of the research, and then describes the conduct of the research. The teacher education at the University of Helsinki is described in order to outline the educational context of this research. The empirical part of the research is based on two sources: student cases approaching the process of ‘becoming a teacher’ from the individual viewpoint, and the collective case of teacher educators representing informants for examining the socially shared view of teacher identity. At the end, after displaying the cases, the research questions are answered in the section concluding the empirical part.

TEACHER IDENTITY IN EDUCATIONAL RESEARCH

This chapter reviews educational research on professional identity of teachers. The review is not intended to survey the whole research area thoroughly but to help in positioning this work in the educational field. The various schools of educational research on teacher professional identity are of particular interest.

According to Beijaard et al. (2004), identity has been seen as socially embedded trail of individual development in interaction with the environment. The steps of personal development have been examined from the individual perspective, particularly in regard to the characteristics of stages in the process. According to Côté and Levine (2002), a starting-point has been the psychological approach based on Erikson's theory of identity (1968), in which the relationship between self and identity is examined. From the individual perspective, identity is associated with inner workings and internal processes. Criticism of Erikson's theory is about missing the point of social interaction, explaining the on-going social force manipulating an individual.

The sociological viewpoint is another way to approach identity. Identity is not owned but constructed by a person in interaction in the society that directs the development (Côté & Levine, 2002; cf. Wenger, 1998). Criticism of the sociological approach is that it lacks an empirical basis and consensus about the nature of key issues. Côté and Levine (2002) conclude that both perspectives are needed and their solution is the social psychological framework of identity, as is the case in this research. They rationalise their theoretical framework with the notion that both perspectives were originally influenced by Erikson's model, but the locus of identity differs.

Educational research thus provides no clear traditions in professional identity either, especially teacher identity. Firstly, Korthagen (2004) points out that the concept of 'self' and linking it with

professional identity is problematic causing differences over common understanding of the phenomenon. Besides, it seems that theoretical frameworks have been used in disparate ways. Secondly, various topics are associated with the professional identity of the teacher. According to the research review by Beijaard et al. (2004), 'professional identity' was associated with teacher knowledge (Arnon & Reichel, 2007; Beijaard, Verloop, & Vermunt, 2000; Smith, 2007), professional environment (Moore & Hofman, 1988; Samuel & Stephens, 2000), self-image and self-evaluation (Beijaard et al., 2000; Korthagen, 2004), social structure and traditions (Coldron & Smith, 1999), and reflection, beside personal and social history (Antonek, McCormick, & Donato, 1997), as well as narratives (Connelly & Clandinin, 1999; Nelson, 2008). Furthermore, in the narrative approach, teacher identity has been equated with stories told by teachers (e.g., Sfard & Prusak, 2005). Altogether, the concept of teacher identity has been defined in various ways, if defined explicitly at all.

In order to give an overview of research on teacher identity, two subsets described by Beijaard et al. (2004) are used to structure this chapter: (1) research on professional identity formation, and (2) research on identification of the characteristics of the teacher's professional identity. The categorisation by Beijaard et al. (2004) was of help in examining the broad and incoherent educational research field of teacher identity. A brief overview about how this research is positioned in the field will appear at the end of both sections. Besides, reasons for structuring the theoretical part of this study based on three themes, characterisation of teacher identity, on-going process of teacher identity, and the importance of the image of an ideal teacher, are given.

Formation of teacher identity

Formation of professional identity has been important in educational research (Beijaard et al., 2004). Research on teacher change, a widely examined topic, is considered here as one point of departure. Richardson and Placier (2001) have distinguished two positions in research on teacher

change and changes in teaching. While the cognitive, affective, and behavioural change processes affecting individual and small group processes have been examined, teacher change and its cultural, structural, and political aspects has been significant from the organisational perspective. In general, Richardson and Placier (2001) have paid attention to issues related to defining the change: who has the power over change and how is the change oriented during the process? How is change defined and verified? In what direction do teachers change? What is the process of change like? Richardson and Placier claim that, despite the perspective on teacher change, instructional changes in school environment involve both individual change in beliefs and knowledge and cultural change at the organisational level (see also Coldron & Smith, 1999).

Firstly, internal processes regarding integration of the personal with professional as well as the relationship between self and identity have been investigated (Korthagen, 2004). Teacher's professional identity formation is influenced by beliefs that are determined by the biographies of individuals (Kagan, 1992; Knowles, 1992; Beijaard et al., 2004). In addition to biographies, Richardson and Placier (2001) also regard personhood and experiences as influential factors for individual change. Consequently, the mechanism of promoting change is complex and, as Richardson and Placier state, research documents the difficulties of making a deep and lasting impact on the beliefs and conceptions of the students (see also Settlage, Southerland, Smith & Ceglie, 2009). Individual change can be seen as naturalistic, not deterministic, and as based on individual choice and autonomy. In addition, 'many of the changes that are studied, such as learning from experience, may not involve a completely conscious process' (Richardson & Placier, 2001, p. 909). Understanding internal processes is important for promoting teacher change, at least for supporting the individuals in practice. While the idea of closing the gap between the designated and present state of teacher identity is used for describing developmental process in the narrative approach of Sfard and Prusak (2005), Beijaard et al. (2004) have paid

attention to the gap between personal and professional that should not be too great so as to avoid friction in the formation process.

Another approach to individual development is professional growth and development during the teaching career (e.g., Kagan, 1992; Richardson & Placier, 2001). In developmental stage theories, not only are the individual's former experiences and biography essential but teaching experiences in the school context and changes in the image of self as a teacher (e.g., Grossman, 1990). Models for teacher development are based on the idea that all teachers change through the same steps and processes during their teaching career. However, Richardson and Placier list influential factors based on research literature: biography, experience, context, personality, and beliefs. Similarly, McCormack, Gore, and Thomas (2006, p. 106) emphasise the meaning of context and experience for professional learning at the beginning of one's career; 'constructing a professional identity is a complex and ongoing part of teacher learning during and continues beyond the induction phase of teaching'. Lately, research on developmental stages has favoured the more flexible idea of multiple factors, which influence progress and shifting from one stage to another through non-deterministic changes (Richardson & Placier, 2001).

Secondly, the interplay between internal and external, individual and social factors has been critical to research. According to Beijaard et al. (2004), describing formation of teacher identity occurs through notions about the nature of the process. This formation is presented as a complex, on-going process in which an individual struggles with the tension between the personal dimensions of being a teacher and the socially structured view of teaching and being a teacher (e.g., Assaf, 2008). For example, Walshaw (2004) in her research on identity in the context of the elementary mathematics classroom engages with post-structural ideas, taking the stance that political and institutional processes are central to identity formation. Identity cannot then be

defined as simply only a particularity of an individual, and it would be seen as synonymous with the teacher's role and function if only knowledge and beliefs are taken into account.

Eteläpelto and Vähäsantanen (2006) highlight the significance combining these two contrasting approaches. Both are needed, and dialogue between the two is the way for the development of professional identity. The individual confronts external forces compelling him or her toward professional development (Coldron & Smith, 1999). In considering the demands of society, the individual has to be willing and able to define his or her own strengths and attitude towards the occupation as well as to embrace continuous construction of professionalism. For example, Beijaard et al. (2004, p. 123) conclude that 'identity formation is a process of practical knowledge-building characterised by an on-going integration of what is individually and collectively seen as relevant for teaching'.

Now, I position this research in the field regarding the notions of identity formation. Firstly, the focus of this research is primarily on internal processes associated with teacher identity formation. As described in Côté and Levine's (2002) multidimensional model, the ego and personal levels on which teacher identity emerges are of special interest. Even if experience and personal features are seen as influential in the developmental process, examination is primarily about professional growth that student teachers are involved with during the teacher education than about defining the relationship between personal with professional (Korthagen, 2004). The relationship between personal and professional cannot be ignored but it is considered as influential in the process but not as a main focus. Furthermore, the developmental process concerns, without question, unconscious notions, like Richardson and Placier (2001) claim, but here, conscious understanding of the state of teacher identity and ability to conceptualise the process are regarded as a point of departure for the study.

Secondly, this research is limited to examining student development that takes place in pre-service teacher education. Emerging teacher identity does not concern only continuous professional development but understanding the early steps of becoming and establishing the basis for professional development also after the teacher education. Moreover, formation of teacher identity is not enabled through particular developmental steps but constructed individually in social interaction (see Richardson & Placier, 2001). Therefore, the aim is to conceptualise the process of becoming a teacher, emerging teacher identity, in a way that individual developmental processes of becoming a teacher can be approached.

Thirdly, research on formation of identity highlights processes of change, which is promoted by experiences. In this research, teacher identity is seen as an **on-going process,** as a dynamic and continuously changing professional state. On the one hand, an individual engages with internal processes that take place on ego and personal identity levels (Côté and Levine, 2002). Change involves development towards 'being a good teacher' through experiences, in which respect the notion of the image of an ideal teacher is influential (designated state as a teacher according to Sfard & Prusak, 2005). The individual has an active role in the process through recognising one's own state as a teacher (the present image of teacher identity) and through becoming aware of the features that s/he considers desirable as a teacher in future (the image of an ideal teacher). Here, filling the gap between **the ideal and present state of teacher identity** is in the heart of individual developmental process (see also Arnon & Reichel, 2007).

On the other hand, on-going process is seen as the interplay between external and internal, in Côté and Levine's model (2002) between the social and personal identity levels. Individual development is promoted by social interaction, and I assume that the image of an ideal teacher is

the notion that mediates the boundary between internal and external processes. Becoming a good teacher is the main aim. The purpose is neither to distinguish between internal and external perspectives nor to claim that either perspective is more essential for discussing teacher identity (see e.g., Eteläpelto & Vähäsantanen, 2006; Samuel & Stephens, 2000; Bohl & van Zoest, 2002). Wenger (1998) discusses the dual nature of identity without the need to juxtapose perspectives:

> We cannot become human by ourselves; hence a reified, physiologically based notion of individuality misses the interconnectedness of identity. Conversely, membership does not determine who we are in any simple way; hence generalizations and stereotypes miss the lived complexity of identity. (p. 146)

Altogether, emerging teacher identity takes place on all three levels described in Côté and Levine's model (2002). The on-going process emerges between the levels and is mediated by experiences. However, this research is limited to approach formation of emerging teacher identity primarily from individual perspective and to consider external processes as influential in this process.

Teacher identity through characterisation

The other approach to teacher identity is to conceptualise it through various characteristics. However, as Beijaard et al. (2004) note, only a little research has been done on the characteristics of teacher identity. The teacher knowledge domains needed in the teaching profession have been one means of profiling professional identity (e.g., Bohl & van Zoest, 2002; Smith, 2007; Hodgen & Askew, 2007). In addition, as Richardson and Placier (2001, p. 905) mention, teacher change is described in various developmental terms, like socialisation, growth, and cognitive and affective change. They continue that examination of teacher change has focused on processes concerning the cognitive, affective, and behavioural features of individual teachers or groups of people.

Beijaard et al. (2000) have profiled teacher identity using three categories of teacher knowledge needed in the teaching profession (cf. Bohl & van Zoest, 2002), examining teachers' perceptions of their expertise, i.e., how they perceive and derive themselves as teachers through expertise in subject matter, didactics, and pedagogy. As a result of this study based on questionnaire data, the subject teachers involved saw themselves mostly as subject matter and didactical experts, even though professional identity was a combination of these three categories. However, the differences among their current perceptions were not related to contextual, experiential, and biographical factors, which might have influenced their perceptions. Beijaard et al. (2000, p. 751) state that it is challenging to clarify one's perceptions of aspects of teacher identity, for example, when something is taken for granted and is immune to reflection in that sense.

Another approach is to characterise professional identity through different aspects collectively, i.e., 'to make explicit what the occupational group shares or should share' (Beijaard et al., 2004, p. 115; see also Fajet, Bello, Leftwich, Mesler, & Shaver, 2005). Shared conceptions of being a teacher can form a norm for being a good teacher. This kind of research is related to educational policy and documents for directing national education, for example, in the Netherlands or England (Coldron & Smith, 1999; Korthagen, 2004), and identity formation through social interaction (J. Cohen, 2008). Beijaard et al. (2004) claim that, partly because of not explicitly defining 'teacher professional identity', aspects, roles, and characteristics related to this varies a lot. From the collective perspective then, professional identity is seen as a collection of aspects relevant to becoming and being a teacher in general.

The characteristics of teacher identity have been researched by connecting individual and social perspectives. Bohl and van Zoest (2002) have situated aspects of individual teacher identity, which they call self-in-mind, within varied communities of practice as socially-embedded self-in-

community. Their starting-point in developing a unit for examining teacher development is both the socio-cultural background as well as teacher knowledge, which forms a central part of mathematics teacher learning (cf. Carlsen, 1999). According to Bohl and van Zoest (2002), a cognitive-social continuum is needed to provide a broader understanding both former research on different types of teacher knowledge and learning as socially situated action. They take Wenger's social theory of learning and identity construction (1998) as a framework of their study. Besides, given Shulman's division of teacher knowledge (1987), they address a need to have explicit and concrete dimensions of teacher learning. The change in teacher identity is seen as the result of learning through interaction with others; for example, based on getting feedback, adjusting one's own beliefs to align those of the school community, or trying to change the practices of the community.

In this research, as Beijaard et al. (2004) suggest, the **characteristics of teacher identity** are defined both individually and collectively. In Côté and Levine's model (2002), characterisation is the way to make the notions of teacher identity approachable in the on-going process of identity formation. The collection of characteristics associated with being a professional teacher is constructed in the influence of contextual values and the educational structures. Especially, the image of an ideal teacher at the boundary of external and internal processes is seen as a range of desirable characteristics associated with a good teacher.

From the collective viewpoint, teacher identity emerging at the social identity level in Côté and Levine's model (2002) is seen as shared understanding what is seen as valuable characteristics of a good teacher and teaching. In this research, the basis for framing these characteristics is teacher knowledge and knowledge-building that can be considered as fundamental to being a professional teacher (e.g., Beijaard et al., 2000; Hodgen & Askew, 2007). The main reason for this is the

features of Finnish teacher education, which highlight the importance of academic competences, professional knowledge, and skills needed in taking the moral responsibility for education.

However, even if mastering several domains of teacher knowledge is seen as the main source for being a professional teacher in Finnish educational community, individuals stress differently on characteristics depending on their personal values and experiences. In previous research on teacher identity, characterisation has been mainly based on cognitive aspects of becoming and being a teacher. However, since cognitive characteristics are not enough to define the individual's internal processes in which subjective and affective viewpoints arise (Atkinson, 2004; Hodgen & Askew, 2007), affective aspects associated with teacher identity are also addressed in this research. Here, formation of emerging teacher identity is made approachable through describing the notions of teacher identity regarding both affective and cognitive characteristics.

CHARACTERISTICS OF TEACHER IDENTITY

In the present research, teacher identity is seen as the flexible and continuously reconstructed state of being a teacher, as in Côté and Levine's model (2001). However, the processes and phases of emerging teacher identity regarding the present state of teacher identity as well as the ideal image of a good teacher can be described through various characteristics. Besides, characteristics allow us to define what it means to be a professional mathematics teacher in general. As teacher identity is recognised both individually and collectively, definitions of its relevant characteristics differ, depending on person and context (Beijaard et al., 2004). In the present research, the structure of the teacher education programme as well as a review of existing research literature has influenced the way the division of characteristics is formulated. The Finnish teacher education, especially the division of the courses and teaching practice periods as well as academic approach to support individual development has been influential in structuring the theoretical part of characterisation of teacher identity. The division has been a way to address a need to approach the formation of teacher identity within this particular educational context.

Teacher identity can be recognised and profiled through cognitive and affective aspects essential to being a mathematics teacher (Fajet et al., 2005; see also Beijaard et al., 2000). In this research, teacher knowledge domains form a starting-point for characterising being a professional teacher (see e.g., Carlsen, 1999; Hashweh, 2005; see also Shulman, 1987). Teacher knowledge domains open up one way to discuss emerging teacher identity, especially from the viewpoint of knowledge and skills that a mathematics teacher should acquire during the teacher education. In addition to these cognitive aspects, subjective viewpoints on becoming and being a teacher like personal feelings and motivation are relevant (e.g., Atkinson, 2004; Eagly & Chaiken, 1993; Hodgen & Askew, 2007; Weissglass, 1993). However, the division into cognitive and affective aspects and the role of subjectivity need to be clarified.

There seems to be a general understanding of the importance of affective aspects in teaching and learning. However, no common theory exists, which causes an immense variety in the conceptualisation used in educational research. Emotions are usually distinguished from motivation (e.g., Hannula, 2004; Hoekstra, Beijaard, Brekelmans, & Korthagen, 2007), and emotional reactions associated with personal aspects of teaching have been stressed, like willingness to act in certain way, situational reactions, values, and attitudes (see Eteläpelto & Vähäsantanen, 2006; Hargreaves, 1998). In addition to differences in the theoretical framework, research contexts vary as well. Affective aspects have been examined from the viewpoint of learners, for example, as a part of a self-regulative system in learning (Boekaerts, 1999; Hannula, 2004) as well as from the perspective of the teacher and professionalism (Hargreaves, 1998; Hodgen & Askew, 2007; Korthagen, 2007). As this research concentrates on emerging teacher identity, these 'non-rational' aspects (after Atkinson, 2004) of the teaching profession in general as well as situational emotions that arise through personal experiences of teaching need to be taken into account. Here, the division into three different but related systems, *cognition*, *motivation*, and *emotions*, through which regulation of behaviour and relationship with the environment is understood, forms a clear starting-point for discussing the characteristics of teacher identity and its formation (Hannula, 2004; see also Hoekstra et al., 2007; Schutz & DeCuir, 2002; cf. Fajet et al., 2005).

According to Hannula (2004, p. 35), 'cognition codes information about self and environment. It is embodied in neural connections of the brain, and abstract thought is based on metaphors'. In the context of teacher identity, expertise in particular knowledge domains and the ability to apply this knowledge in practice is seen essential for fulfilling the requirements as a professional. The state of mathematics teacher identity can be characterised according to various **cognitive aspects** based

on domains of teacher knowledge (Beijaard et al., 2000; Bohl & van Zoest, 2002; Smith, 2007). In order to keep the outline of knowledge domains sufficiently clear, teacher knowledge is divided into three main subsets proposed originally by Shulman (1987) (cf. Grossman, 1990; see also Carlsen, 1999). For example, Beijaard et al. (2000) understands teacher identity as associated with professional knowledge in terms of expertise in subject matter, pedagogical, and didactical issues (see also Bohl & van Zoest, 2002).

In addition to the domains of teacher knowledge, meta-cognitive skills form a subcategory of cognitive aspects of teacher identity. Cognitive aspects are not only understood as knowledge of and about something but as skills related to specific content, including the ability to express oneself, to act and to reflect on the cognitive aspects of teaching (Walkington, 2005). Finnish teacher education in particular emphasises the idea that all teachers should be able to think analytically for further self-development and to apply their knowledge in dynamic situations (Niemi & Jakku-Sihvonen, 2006; Lavonen et al., 2007).

Affective aspects that are also crucial for the teaching profession can be used in characterising the state of teacher identity (e.g., Atkinson, 2004). Hannula (2004, p. 35) defines the second category, motivation, as 'the energizing principle for human behaviour, originating from needs, and represented in a hierarchically organised structure of needs and goals'. Needs are seen as the basis of motivation. A person directs him/herself towards and commits to something; for example, becoming and being a teacher. The third category, emotions, 'code information about progress towards personal goals…', as Hannula (2004, p. 35) continues. In other words, emotions are understood as situational and momentary, and are associated with situations that an individual experiences (Schutz & DeCuir, 2002; see also Korthagen, 2007). Affective aspects associated with the teaching profession in general (being a teacher) have to be distinguished from the viewpoint of

on-going formation process based on series of experiences in particular situations (becoming a teacher) described in Côté and Levine's model (2002). Therefore, affective aspects of teacher identity include motivation (after Hannula, 2004) as well as subjective characteristics describing the state of emerging teacher identity or the general view of being a good mathematics teacher (Fajet et al., 2005). Emotions are discussed in the context of an on-going formation process associated with experience that promotes the change.

In what follows, I discuss two subsets of characteristics, the cognitive and affective aspects associated with teacher identity emerging during the teacher education. First, three main knowledge domains, content knowledge, pedagogical content knowledge, and pedagogical knowledge, and the category of thinking skills comprise the basis for cognitive characterisation. This division is in accordance with the structure of the teacher education programme (described in more detail in the chapter 'Conduct of the research') and with the aims that are set for prospective teachers. Second, affective aspects are elaborated in more detail in addition to cognitive aspects. Especially, when focusing on the early steps of teacher identity formation the affective notions, for example, a need to commit to teaching profession and ability to identify with being a teacher come up.

Cognitive aspects

The theoretical framework for aspects of teacher identity is founded on the concept of 'teacher knowledge', which is widely researched but forms an incoherent entity (Gess-Newsome, 1999b; see also Berry, Loughran & van Driel, 2008). Teacher knowledge and special domains of professional knowledge have been widely discussed in recent years from the viewpoint of teaching and educational research, as Gess-Newsome (1999a) states. On the one hand, research on teacher knowledge has been about domains of knowledge, such as content knowledge in specific disciplines like mathematics (e.g., Ball & Bass, 2000; Kahan, Cooper & Bethea, 2003). The

structure of a teacher's knowledge base, especially the role of content knowledge and pedagogical content knowledge, identifies secondary teachers in specific subjects, and is the basis of professionality (Gess-Newsome, 1999b; see also Berry et al., 2008). In addition to content knowledge, pedagogical content knowledge has been of special interest since Shulman's argument concerning the 'missing paradigm' (1986; 1987). That pedagogical content knowledge is the domain that distinguishes and identifies teachers from experts on content (Shulman, 1987). On the other hand, the origin of teacher knowledge has also been of interest. For example, Hiebert, Gallimore, and Stigler (2002) have examined the epistemological features of teacher knowledge by distinguishing between knowledge constructed in practice and knowledge based on educational research. D. Cohen (2008) discusses the requirements that teacher knowledge should meet the need to make a teacher's expert knowledge accessible to learners.

The structural perspective for teacher knowledge is based on domains such as content knowledge, pedagogical content knowledge and general pedagogical knowledge, and distinctions between them (Carlsen, 1999; Hashweh, 2005; see also Shulman, 1987). In general, teacher knowledge has been conceptualised in many ways and categories of knowledge have varied, starting from Shulman's structural model (1987) in which pedagogical content knowledge, content knowledge apart from knowledge of curriculum were all included in the domain called 'content knowledge'. Later, for example, Hashweh (2005) introduced a model of pedagogical constructions as a substitute for pedagogical content knowledge. His model develops these constructions based on solid knowledge categories through repeated planning and practical experience.

The structural model of teacher cognitions has its disadvantages, like being static, rigid, and systemic without taking individual differences into account. Neither are the cognitions of teachers such as the ability to make pedagogical decisions addressed in structural models (Carlsen, 1999;

cf. Hashweh, 2005). However, the model does provide established and clear categories through which individual development and emerging teacher identity is possible to profile. Teacher knowledge based on Shulman's original model (1987) is seen as essential for teacher identity (as in Beijaard et al., 2000; Bohl & van Zoest, 2002; Smith, 2007). Smith (2007), as well as Beijaard et al. (2000), considers expertise in knowledge as a part of being a professional, teacher identity. Smith (2007) starts with the idea of developing teacher knowledge and identity in interaction with each other, suggesting that identity work should be seen as related to knowledge growth, not as an alternative. In this research, different knowledge domains provide a structure through which examining the individual development accordance with the structure of this particular teacher education programme is possible.

As Gess-Newsome (1999a) points out, research on teacher knowledge is not a coherent field. Terms relating to teacher knowledge, like knowledge, conceptions, attitudes and values, are used inconsistently. According to Bohl and van Zoest (2002), since not only development of knowledge in different domains but the development of beliefs, commitments and intentions with regard to the domains which is important for teacher identity, neither there is need to make a special distinction between these concepts in this research. Knowledge areas and contents that a person has a view of, knows about or entertains beliefs about are of importance. An individual does not necessarily distinguish between the quality of interrelation with certain epistemological domains during the developmental process (see also Foss & Kleinsasser, 1996). Furthermore, as Bohl and van Zoest (2002) claim, response in practical situations and justification for actions are embedded in various dimensions, like knowledge, intentions, commitments, and beliefs, and the relations between them.

Content knowledge

Expertise in content knowledge is a special competence for subject teachers in secondary and upper secondary schools (Gess-Newsome, 1999b; see also Danielewicz, 2001). The meaning and definition of content knowledge differ slightly in educational research on teacher identity. Bohl and van Zoest (2002, p. 140) unite content knowledge with curricular knowledge, which they call the 'content area and curriculum dimension', as it deals with what is to be taught in school mathematics (cf. Grossman, 1990). Beijaard et al. (2000), as well as Smith (2007), however, have examined teachers' perceptions of their professional identity through three main knowledge domains based on Shulman's original model (1987). Despite the slight differences, knowledge of subject matter is traditionally seen as a relevant part of a teacher's professional knowledge base (Bromme, 1995; Gess-Newsome, 1999b), and thus, as an integral part of teacher identity. Furthermore, research knowledge about teachers' subject matter understanding can be divided into sub-categories as Gess-Newsome (1999b) has done. According to her, approaches to content knowledge as a part of professional knowledge are (1) conceptual knowledge, (2) subject matter structure, (3) the nature of the discipline, (4) content-specific orientations to teaching, and (5) contextual influences on curricular implementation. The distinction between the various categories is not easily defined, however.

The teacher's expertise in content knowledge is central in teacher identity formation. According to Hodgen and Askew (2007), all teachers should have a well-established relation with what they teach. A positive relationship with mathematics itself is of importance (see also Smith, 2007). Their study focuses on the identity of primary school teachers who seemed to struggle between the caring and nurturing aspects of identity and the strong disciplinary focus of mathematics. They conclude that developing a strong disciplinary bond is also crucial for primary student teachers in teaching any subject. Teachers should therefore have opportunities to explore their identities as mathematics teachers and learners and to develop both disciplinary intimacy and integrity

(Hodgen & Askew, 2007). Similarly, Smith (2007) has examined primary school teachers and their teacher identity development in relation to knowledge growth. Growth in content knowledge, science in his study, is significant for development of teacher identity and differs between individuals.

Expertise in content knowledge seems to be linked with the credibility of a teacher. According to Beijaard et al. (2000), teachers derive their professional identity from how they see themselves as experts in various knowledge areas. In their sudy, teachers who perceived themselves as subject matter experts thought that it was not possible to be an authority for their students and a believable professional without solid content knowledge. Burn (2007) has considered the teacher's relationship with content knowledge from the viewpoint of certainty in acting as a teacher. Student teachers face a challenge to their sense of being a subject specialist and knowledge about the subject itself during teacher education. According to Burn (2007), uncertainty about one's existing understanding of content itself is especially problematic for those student teachers who regard themselves as subject specialists (cf. Merenluoto, 2003).

The role of mathematical knowledge in good teaching has been acknowledged and widely discussed in previous years (e.g., Leinhardt & Smith, 1985; Steele, 2005). Research on knowledge and beliefs about the content knowledge of secondary teachers and its impact on the teaching process have been of general interest, even though the connection is difficult to demonstrate (Gess-Newsome, 1999b; Kahan et al., 2003). For example, mathematical competence is seen as a capacity for implementing curricular coherence, i.e., teaching mathematics to coherent and significant mathematical curricular goals (Ferrini-Mundy, Burrill, & Schmidt, 2007). However, it seems to be difficult for teachers to combine good teaching and mathematical knowledge (Mosenthal & Ball, 1992). Grossman (1990) mentions that the dominance of content knowledge is

so strong for some teachers that being a good teacher is isomorphic with conceptions of knowledge in subject matter (see also D. Cohen, 2008). However, student teachers are compelled to rethink content knowledge from the pedagogical perspective after embarking on becoming a teacher. Mathematics in particular induces strong views of it and about it. Foss and Kleinsasser (1996) discussed how demanding it is to influence pre-service teachers' views of mathematical content knowledge as their personal history and beliefs are so strong. As Ball and Bass (2000) claim, practical experience is important in putting mathematical knowledge to use and for learning to use it in teaching.

In this research, expertise in both procedural and conceptual mathematical knowledge is essential to being a qualified professional mathematics teacher, and to emerging teacher identity (Beijaard et al., 2000; Smith, 2007). In Finnish teacher education, students should be able to build up a solid knowledge base in mathematics through courses that they take in university mathematics. Studies in university mathematics traditionally constitute a powerful influence on the developmental process as a teacher (cf. Beijaard et al., 2000). Mathematical education aims at basic procedural and conceptual knowledge in mathematics and, furthermore, boundaries between contents of school mathematics and university mathematics are not particularly addressed during mathematical studies. Here, the distinction between mathematical knowledge for teaching and for other needs is not particularly made, because from the viewpoint of emerging professional identity, the meaning of expertise in mathematical knowledge is individually defined.

Pedagogical content knowledge

Pedagogical content knowledge is regarded here as a special domain of teacher knowledge, based in the work of Shulman (1986, 1987) and of some researchers inspired by him (e.g., Berry et al., 2008; cf. Grossman, 1990). Shulman (1987) states that knowledge specifically associated with teaching and learning particular subject is called pedagogical content knowledge.

Gess-Newsome (1999a) finds that pedagogical content knowledge has many useful features. It has provided an analytical tool for examining teacher cognition, highlighted the meaning of content knowledge and its transformation for teaching, and provided a more integrated vision of teacher knowledge and classroom practice. However, it is neither an exact model nor without problems regarding heuristics. Gess-Newsome introduces two approaches for conceptualising teacher knowledge. First, pedagogical content knowledge is explained in the integrative model by the intersection of three other knowledge domains: content knowledge, pedagogy, and context. Thus, pedagogical content knowledge does not exist on its own (Hashweh, 2005; see also Bromme, 1995). Second, in the transformative model, pedagogical content knowledge is a unique form of knowledge that impacts teaching practice. Thus, PCK is a knowledge domain which synthesises all knowledge needed for teaching and learning (Grossman, 1990; McCaughtry, 2005; Nilsson, 2008).

Teacher cognition is not the only approach to pedagogical content knowledge. In his critical analysis of research on pedagogical content knowledge, Bromme (1995) extends the original Anglo-American approach to PCK by dividing it into two categories. Firstly, aiming at a descriptive reconstruction of successful classroom instruction is the main idea in classical research on teacher effectiveness. This kind of research focusing on the ‘wisdom of pratice’ is embedded in normative premises regarding the objectives of teaching. Secondly, research has been about reconstruction of the teacher competence that is seen as professional knowledge, including pedagogical means and tools as well as criteria for making decisions. Furthermore, Bromme (1995) assets that an explicit conceptual distinction should be made between the concepts of scientific disciplines, school subjects, and subject didactics.

Teachers should possess a solid professional knowledge base to be expert teachers, despite the way professional knowledge is defined (Gess-Newsome, 1999b). Furthermore, applying knowledge in practice is essential for the teaching profession (Bromme, 1995; Grossman, 1990; Hashweh, 2005; McCaughtry, 2005; D. Cohen, 2008), during pre-service teacher education (Nilsson, 2008). Grossman (1990) has examined how student teachers construct pedagogical content knowledge with the help of teacher education programmes, raising the question of whether students apply their knowledge in the classroom. McCaughtry (2005) also states that entering the classroom for the first time and confronting the meaning of social context and interaction is a critical factor in pedagogical content knowledge. The theoretical perspective has predominated before teaching experiences, but knowing students and thinking about teaching in practice make a difference (see also Hashweh, 2005; Smith, 2007). Contextualising the professional knowledge and the role of experience are important for PCK (Bromme, 1995). As Foss and Kleinsasser (1996) mention, decisions in social and practical situations are made based on conceptions of teaching and learning mathematics that are developed through experience.

Hashweh (2005) also underlines the meaning of knowledge integrated with practice, presenting a model of pedagogical content knowledge that is an outcome of continous processes of planning and teaching. He calls the knowledge domain ‘teacher pedagogical constructions’ (TPC) instead of pedagogical content knowledge. For him, pedagogical content knowledge is event-based and story-based constructions interconnected with practice and experiences, not a ready-made knowledge category (see also Gess-Newsome, 1999b; cf. Grossman, 1990). Hashweh (2005) defines TPC based on tradition of pedagogical content knowledge:

> PCK is the set or repertoire of private and personal content-specific general event-based as well as story-based pedagogical constructions that the experienced teacher has developed

> as result of repeated planning and teaching of, and reflection on the teaching of, the most regularly taught topics (p. 277).

Thus, pedagogical constructions are developed through teaching practice including continuous planning and teaching activities. Teacher pedagogical constructions (TPC) are based on seven assertions: (1) PCK represents personal and private knowledge that can be transformed into public knowledge and shared with others; (2) PCK is a collection of teacher pedagogical constructions: it is not well organised and hierarchically ordered like content knowledge, but is composed of a set of entities or smaller units; (3) TPC result mainly from planning and teaching activities; (4) TPC result from an inventive process that is influenced by the interaction between teacher knowledge and belief categories; (5) pedagogical constructions constitute both a generalised event-based and story-based kind of memory. In other words, teacher knowledge which is both semantic and event-based distinguishes separate components and disconnects events in order to be able to reattach them in new way. At the same time, we might recall things narratively in sequence, probably through analogies; (6) pedagogical constructions are topic specific; and (7) TPC should be labeled so as to be related to other categories of teacher knowledge and beliefs.

Similar to the content knowledge domain, pedagogical content knowledge is related to teacher identity formation. For example, Bohl and van Zoest (2002) have merged PCK and pedagogical knowledge together as one aspect of ‘self-in-mind’ to make up the cognitive portion of a person’s identity. Similarly, Smith (2007) focuses on how professional identities are developed from the viewpoint of building pedagogical content knowledge. He has examined specific experiences of learning and teaching science in relation to the narratives about themselves as becoming professionals. Content knowledge seemed to be extended during the programme, but in order to be able to develop pedagogical content knowledge in parallel, experience is needed to apply knowledge in practice (see also D. Cohen, 2008; Hashweh, 2005; Nilsson, 2008).

The role of a teacher in the classroom is seen in relation to teacher knowledge. For example, Goos (2005) has examined PCK from the perspective of development of teachers' pedagogical identities regarding technology use in mathematics teaching and learning. In the study by Beijaard et al. (2000), the 'teacher as a didactical expert' is one of the three expertise roles that teachers can identify themselves with. Similarly, Burn (2007) has examined how learning of certain skills and knowledge affects the image of teacher identity. She states that it is important to acknowledge existing understanding and expertise of student teachers as subject specialists, to test and evaluate critically but not to condemn the knowledge that students bring with them into teacher education. However, Burn (2007, p. 461) discusses the need for 'a sense of identity in which expertise is seen as residing not merely in their accumulative craft knowledge …but also in their capacity to generate new professional knowledge'. Likewise, Loughran, Mulhall, and Berry (2008) have approached development of PCK through the idea that PCK could be introduced explicitly, meaning that promoting student teachers' understanding of PCK as a construction reshapes their further development as teachers.

In this research on teacher identity formation, pedagogical content knowledge is meaningful for two reasons. Firstly, as Smith (2007) states, building and constructing a knowledge base is associated with development of teacher identity. Pedagogical content knowledge is considered as something that can be taught in teacher education but still has to be constructed and internalised by the individual (see Bromme, 1995; Hashweh, 2005; Loughran et al., 2008). In the Finnish teacher education programme, the structure of PCK is closer to the transformative than the integrative model (Gess-Newsome, 1999a). Students take courses in separate knowledge areas, such as mathematics and general education as well as in mathematics education to obtain special knowledge about teaching and learning mathematics. Secondly, pedagogical content knowledge

can be considered not only as teacher cognition based on separate knowledge domains but also as teaching competence (Bromme, 1995). A teacher has to be able to apply professional knowledge in practice and rationalise decision-making in the classroom. Pedagogical content knowledge is associated with a person's view of his or her own competence, and through that, with the image of self as a teacher in practice (Beijaard et al., 2000).

Pedagogical knowledge

The third category of teacher knowledge is pedagogical knowledge of education in general, for example, about learners and learning, the curriculum and instruction, and classroom management (Grossman, 1990). In Shulman's model of teacher knowledge (1987, p. 8), the category of general pedagogical knowledge is decribed as 'knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter'. However, Morine-Dershimer and Kent (1999) point out that the nature of pedagogical knowledge is complex. In their model, pedagogical knowledge is grounded on the knowledge of learners and learning as well as of goals and assessment. Furthermore, they emphasise that the latter together with content knowledge are the basis for curriculum knowledge as a separate category. The category of general educational context is connected to knowledge of specific contexts which is linked further with pedagogical content knowledge (see also Grossman, 1990).

The other approach to the teacher's pedagogical knowledge is to consider facets of knowledge regarding the forms of teacher knowledge, i.e., the dilemma of the way of knowing and the origin of teacher knowledge. Morine-Dershimer and Kent (1999) argue the particular importance of

> interplay between *general* pedagogical knowledge, which is derived from the research and scholarly literature, and *personal* pedagogical knowledge, which is fueled by personal beliefs and personal practical experience (p. 22).

In their review of educational research on this area, general pedagogical knowledge consists of (1) classroom management and organisation, (2) instructional models and strategies, and (3) classroom communication and discourse. Personal pedagogical knowledge is divided into two subcategories, personal beliefs and perceptions, and personal practical experience.

Likewise, Hiebert et al. (2002) separate professional knowledge from practical knowledge in reference to the origin of knowledge and features of knowledge based on its origin. The main idea of considering the facets of teacher knowledge is to address the needs of teachers and student teachers; i.e., to present research knowledge in a form in which teachers could adapt its ideas in practice and as a part of their professional knowledge. (see also D. Cohen, 2008) The challenge is in translating research knowledge into the teacher's reality, into school practice. This kind of knowledge is seen as an essential element of teacher's professional knowledge. However, as Morine-Dershimer and Kent (1999) maintain, it has to be supplemented, applied, and strengthened by practical, personal pedagogical knowledge. After all, teachers are practitioners who develop practical knowledge in response to practical problems and notions in the classroom (Hiebert et al., 2002). Knowledge is not strictly limited to the category of general pedagogical knowledge, but in educational research, issues associated with it are typically related to pedagogy.

The gap between theory and practice is a special issue to be addressed with teacher's pedagogical knowledge. The pedagogical knowledge provided in educational courses is based on research knowledge which is accused of being theoretical. In addressing and understanding the needs of students and teachers, research has been done on the views of prospective and practising teachers on educational knowledge (e.g., Joram, 2007; Gore & Gitlin, 2004). Gore and Gitlin (2004) state that teachers dismiss academic research on the grounds that it is not practical, contextual, credible, or accessible. The transferability of research knowledge into the classroom environment seems to

be low. In addition, even those student teachers who valued research for its contribution to on-going professional growth questioned its use in practice. The supplementation and application of theoretical knowledge do not take place in practice (Morine- Dershimer and Kent, 1999).

Likewise, Joram (2007) has examined the significance of epistemological issues for educational knowledge and its the legitimacy. First, she states that it is known that educational research is problematic part of teacher education (see also Holligan, 1997; Korthagen, 2007). One way to rise to the challenge is to make pre-service teachers carry out their own action research projects during teacher education (Gore & Gitlin, 2004). However, Joram (2007) points out that understanding epistemologies underlying the beliefs about educational knowledge of pre-service and practising teachers as well as professors is another way to address the problem. From the viewpoint of student teachers, educational knowledge was non-generalizable because of a lack of opportunity to compare a particular method in two or more classroom contexts (cf. Gore & Gitlin, 2004). In addition, professors as academics and pre-service teachers encoded classroom situations differently, as professors found certain situations to be similar in particular attributes but pre-service teachers did not. These findings recall the observations about differences in the knowledge of learners and teachers by D. Cohen (2008).

Experience seems to influence the stances of teachers on educational knowledge and its verification (Joram, 2007; Morine-Dershimer & Kent, 1999). An individual can falsify knowledge about teaching and learning, as Joram (2007) maintains; for example, knowledge about a particular teaching method, through personal experience of using it. However, she continues that even if a method is found to be effective, reasoning is limited to this particular situation of their experience. The gap between research and practice could be narrowed by building learning communities in which the focuses could be interconnected (Korthagen, 2007; see also Wenger,

1998). Joram (2007) also highlights the idea of being aware of the ‘culture of thinking’ by those who are involved with teacher education. General educational knowledge could be constructed by integrative discussions about field experiences.

Pedagogical knowledge and expertise in that particular knowledge domain is related to teacher identity (Beijaard et al., 2000 and 2004; Bohl & van Zoest, 2002). However, just as definitions of pedagogical and educational knowledge differ, this particular knowledge domain is interconnected with professional identity in various ways. Bohl and van Zoest (2002) have combined general pedagogical knowledge with PCK and knowledge of learners into the domain called the ‘pedagogical dimension’. For them, the pedagogical dimension relates to the competencies required for arranging classroom activities to optimize student learning. Beijaard et al. (2000) take note of ethical and moral features that link the didactical and pedagogical sides of teaching with each other. For them, pedagogical expertise relates to teacher’s personal and professional role conception (see also Hodgen & Askew, 2007). They argue that teaching is not only about technical solutions leading to learning outcomes but about norms and values related to the teaching profession through interaction with students. Perceptions of the teacher’s role as a facilitator of learning have also affected how the teaching profession is seen in general.

The notion of professional development can highlight the significance of pedagogical knowledge for teacher identity. The study by Pendry and Husband (2000) concerned secondary student teachers who were expected to familiarise themselves with educational research. Students gave some reasons for educational research being useful for their professional development. First, it was practical in the sense that students found research knowledge helpful for classroom implementation. Second, they regarded it as valuable for prompting reflection and thinking as a teacher (cf. Holligan, 1997). Although only a minority of students identified research findings as

positive for their professional development, they did not universally reject such knowledge. Other sources of development, like teaching practice, were seen as more important, however. (Pendry & Husband, 2000) Holligan (1997) states that the role of theory as a tool in allowing the autonomous professional to adopt a critical stance is problematic, instead theory being used to confirm the views of practicalities and the intellectual scope that students already have.

In this research, pedagogical knowledge consists of two categories, general and personal, according to Morine-Dershimer and Kent (1999) (see also Hiebert et al., 2002). This division depends not only on the origin of knowledge but also content that is regarded as pedagogical. Pedagogical knowledge may be gained through research activities and reading literature as well as through experiences in the classroom, e.g., through social interaction with pupils. The idea of being able to apply and supplement general theoretical knowledge with personal knowledge based on practical experience is essential in the teacher education programme. All kinds of pedagogical skills are included in this category. Secondly, pedagogical knowledge is a special knowledge domain as knowledge building is partly based on practical experience. The issues of verification of knowledge are crucial to pedagogical knowledge. Thirdly, in addition to pedagogical content knowledge, pedagogical knowledge in particular orients students towards becoming a teacher. Knowledge about teaching and learning is clearly related to one's future profession, and hence has a special role in teacher identity formation.

Thinking skills

The fourth cognitive aspect of describing teacher identity formation is cognitive thinking skills. Firstly, as Beijaard et al. (2004) conceptualise professional identity, practical knowledge building according to what is seen as relevant for the teaching profession, from both an individual and collective perspective, is essential for teacher identity formation. When teacher knowledge is a basis for defining professionality as a teacher, i.e., the knowledge and skills that a teacher should

master, this also leads to the question of how to obtain and use this knowledge. Cognitive thinking skills are thus part of becoming a professional teacher. The second reason is associated with educational politics and the common conception of a good teacher in the Finnish educational system (Kosunen & Mikkola, 2002; Lavonen et al., 2007). A teacher is considered to be capable of thinking and using a personal knowledge base for making decisions about teaching and learning. Beside this, an ideal teacher is seen as a 'reflective practitioner', originally so described by Schön (1983), who intentionally reflects on and improves his or her own teaching and learning based on practical experience.

The teacher as a *consumer* and the teacher as a *producer* of knowledge represent two aspects of a teacher's cognitive skills and attitude towards knowledge (Gitlin, Barlow, Burbank, Kauchak, & Stevens, 1999; Pendry & Husband, 2000; cf. Reis-Jorge, 2005). A teacher should be able to be both a critical consumer of knowledge, and to build knowledge from practical experience. These two categories are related to the origin of knowledge that was discussed in more detail in the previous section about pedagogical knowledge. Knowledge was divided into the two subcategories of general and personal by Morine-Deshimer and Kent (1999) (see also Hiebert et al., 2002). The focus here is on the stance of a teacher towards all knowledge domains, including content knowledge, PCK, and pedagogical knowledge. However, pedagogical knowledge and pedagogical content knowledge, e.g., practicalities and methods used in the classroom, are most likely to be gained through personal practical experience as well as general theoretical sources. The main issue is to discuss the cognitive skills that a good (mathematics) teacher should have in the teaching profession. As D. Cohen (2008) argues, a teacher should gain a vast knowledge base of various domains related to the teaching profession, but applying or reformulating knowledge in order to promote the learner's processes is another story.

These cognitive skills relate to the research-based approach regarded as a basis for academic teacher education. However, no agreed view of the significance of research-based education or of the benefits of a research approach exists (Reis-Jorge, 2005). While research-based teacher education might mean only consuming research-based knowledge about education (Holligan, 1997; Pendry & Husband, 2000), over the previous thirty years in the Finnish teacher education tradition, student teachers have been to gain competence as critical consumers as well as producers of educational knowledge through research activities undertaken during their education (Kosunen & Mikkola, 2002; Lavonen et al., 2007; Westbury et al., 2005; see also Brinkman & Van Rens, 1999). The combination of two different approaches, an academic perspective including formal research procedures and professional development based on the idea of the reflective practitioner aiming at on-going self-development is problematic (Reis-Jorge, 2005; see also Beijaard et al., 2004). Similarly, Gitlin et al. (1999) state that teacher educators should be aware of how student teachers think about research, which could be introduced to them in a way that would facilitate combining it into their professional development.

Consumer of knowledge

In academic teacher education, student teachers become acquainted with research findings that they should be able to use for their professional growth (Gitlin et al., 1999; Pendry & Husband, 2000). In the study by Gitlin et al. (1999), both elementary and secondary school teachers regarded educational research especially as providing methods that can improve teaching in practice. Research was seen as helpful for becoming an effective teacher who knows what works best in the classroom. Holligan (1997) has however argued that practice in schools cannot be changed through theoretical ideas (see also Joram, 2007). According to him, students use the ideas that confirm their previous notions about practice and help them to understand their experiences.

Moreover, student teachers, who are usually practically rather than theoretically oriented, find that research literature is written in a way which is inaccessible to them (Hiebert et al., 2002; D. Cohen, 2008). The role of research and knowledge produced by academics is problematic, even in teacher education programmes with a strong research-based approach. As a way to make academic research knowledge more approachable, Gore and Gitlin (2004) suggest that teachers should be provided with more knowledge and skills for engaging confidently with research. Gore and Gitlin suggest that the complexity of research should be discussed, not just introduced as ready and simplified products during the university courses.

Practical experience, and professional development along with it, seems to be influential. Gitlin et al. (1999) state that despite the activities provided and its aims, teacher education has little influence on student teachers' thinking about the fundamental nature of research. However, according to Joram (2007), the attitudes of teachers toward educational knowledge as a source of being a good teacher seem to change with teaching experience. In her study, those who had more teaching experience considered becoming a good teacher was associated with thinking skills rather with a repertoire of specific teaching skills. D. Cohen (2008) discusses the dilemma of knowledge construction and valuation of finished knowledge. Teachers should acquire enough knowledge about learning and teaching as well as specific content to be able to support individual learning processes. The more experience they have, the more accomplished is their knowledge base. However, the finished knowledge that they try to offer learners is distant the processes and knowledge formulation of learners. He takes mathematics as an example of providing finished knowledge without the procedures required for learners to understand the basics.

It is a challenge to have an influence on classroom performance through research activities in teacher education. Decision-making is linked with practical knowledge and experience (Gitlin et

al., 1999). Both Carlsen (1999) as well as Steinberg, Empson, and Carpenter (2004) emphasise the meaning of the autonomy of a teacher in applying knowledge. On the one hand, an active role is essential if a teacher is to apply and verify knowledge in each dynamic teaching situation separately. Outside authority cannot be the basis for making decisions. (Carlsen, 1999) On the other hand, providing new instructional ideas and respecting the autonomous role of a professional is a challenge. The study by Steinberg et al. (2004) focuses on how teachers are able to use both practical and research-based knowledge for development of their own work in the classroom. The aim of the programme was to support teachers in getting to know children's mathematical thinking and use it to shift instruction towards practical inquiry. The potential to adapt the tools for reflecting on one's own teaching and the children's learning was greater when the ideas were parallel with practical personal knowledge and issues in the classroom (see also Joram, 2007).

Producer of knowledge

The teacher's stance on knowledge of how to modify and produce the knowledge needed in teaching and learning is critical. The research-based approach is not easy to implement in teacher education in such a way that the school reality of teaching and learning is taken into account. Kosunen and Mikkola (2002) claim that the role of research is limited to producing a formal educational thesis during teacher education but the opportunity to integrate smaller-scale inquiry activities with practice does not arise (see also Westbury et al., 2005).

An inquiry-based approach is one way to promote critical thinking and on-going learning in work (e.g., Schulz & Mandzuk, 2005; Steinberg et al., 2004). Schulz and Mandzuk (2005) sum up the recent research showing that inquiry-based approaches

> encourage resistance to thoughtless implementation of teaching practices, support disposition of critical thoughtfulness about teaching, and nurture the ongoing learning, professional growth and intellectual development of teacher candidates (p. 316).

According to Schultz and Mandzuk (2005), students link inquiry with teacher professionalism, as it is not only associated with classroom practicalities but also with broader context of the teaching profession. For them, inquiry is strongly contextualised, and both social and practical inquiry enhance practical knowledge. However, even if the basic idea of inquiry is internalised, Schulz and Mandzuk (2005) find it a challenge to address the positional differences that teachers experience in school after university.

Research activities have been regarded as one way to educate teachers who are critical thinkers and skilful in further development in their work. This necessitates an ability to conceptualise one's own knowledge and engage with the research approach. In a commentary article, Korthagen (2007) lists reasons for the gap between research and practice. A gap between professional cultures causes problems in relating research and school practice with each other. Besides, preconceptions and prior knowledge influence the way teachers consider research as a part of their work, and furthermore, practice cannot be understood simply from the cognitive viewpoint, as Atkinson (2004) states. The last reason for the gap, Korthagen (2007) claims, is the complexity of teaching. Research-based knowledge cannot be applied directly and unequivocally, while the notions of practice are various. Forms of knowledge cause a problem when practical knowledge encounters formal knowledge (see also D. Cohen, 2008; Hiebert et al., 2002).

A teacher as a reflective practitioner should be able to transform practical knowledge into professional knowledge in systematic development in his or her own work. Hiebert et al. (2002) analyse the nature of professional knowledge, especially the relationship between practical and formal knowledge (see also Carlsen, 1999; Reis-Jorge, 2005). Research knowledge is assumed to be the best basis for professional knowledge because of its generalizable and objective character. According to Hiebert et al. (2002), practitioner knowledge has three essential features for a

teacher. First, since practitioner knowledge is linked with practice because it develops in response to practical problems in the classroom, is grounded in the context, and addresses specific issues in the classroom. Second, practitioner knowledge is specific, detailed, and concrete, which might also be seen as problematic. Third, practitioner knowledge is integrated with and organised by particularities in practice. Compared with the knowledge of researcher, it is organised according to type of problem in practice rather than into distinctions among types of knowledge. Some additional requirements have to be addressed in transforming practitioner knowledge into professional knowledge. Hiebert et al. (2002) emphasise that professional knowledge has to be public, and has to be shared with others in order to meet such a requirement. Professional knowledge is then sharable and accumulative. As a last requirement, professional knowledge has to be accurate, verifiable, and continually improved.

Student teachers should take an active role in the classroom as professionals who consume the knowledge acquired in their studies critically and produce knowledge through practical experience. In particular, because of the structure of Finnish teacher education, students should integrate different knowledge areas into a coherent personal knowledge base and improve cognitive competence later in their teaching careers. From the viewpoint of teacher identity formation, skills in consuming and producing professional knowledge are embedded in the student's awareness not only of separate knowledge domains but also of the way to combine such skills with professional development and classroom activities (e.g., Beijaard et al., 2004; Smith, 2007). For example, teachers produce different kinds of knowledge of teaching and learning in the classroom, e.g., knowledge about pupils through formal and informal evaluation. Altogether, despite the origin of knowledge, the ideal in the Finnish educational system is that the teacher is is able to use knowledge in decision-making, e.g., in classroom implementation as well as curriculum work. Furthermore, the ability to develop further in the teaching profession is based on

thinking skills, and the ability to consume and produce different kinds of knowledge (e.g., Kosunen & Mikkola, 2002).

Affective aspects

The cognitive perspective associated with becoming and being a professional mathematics teacher is only one way to research identity formation (Beijaard et al., 2004). Emotions and subjectivity play an essential role in teaching and learning. Recent educational research has emphasised the role of the emotions intertwined with all aspects of teaching and learning (e.g., Beijaard et al., 2007; Hargreaves, 1998; Korthagen, 2007; Schutz & Lanehart, 2002). Learning is not a straightforward process that can be directed simply by its cognitive aspects (Boekaerts, 1999). The affective aspects, especially those associated with being a teacher are discussed here in particular relation to teacher identity. First, notions of the 'human factor' (after Korthagen, 2007) in teaching, including affective aspects of teaching and learning in general, are of interest. Affective aspects of teacher professional identity are discussed after the overview.

The meaning of emotions and willingness has been brought up in trying to promote teacher change (e.g., Boekaerts, 1999; Hargreaves, 1998). Teachers do not act simply according to logic or in a predictable way. Korthagen (2007, p.305) underlines the 'human factor' perspective because the cognitive stance is insufficient to understand teaching practice. Personal emotional reactions are part of being a teacher and, in his words, 'humans do not act on the basis of logic alone, and from an actor-perspective there are often significant personal reasons for not acting such a manner'. Likewise, Hargreaves (1998) stresses that being a good teacher takes more than just mastering the school subject and being effective. In his study, the emotional perspective is embedded in the political environment of educational reform. Emotional relationships with students are of special interest, and Hargreaves (1998, p. 835) describes teachers as 'emotional, passionate beings who connect with their students and fill their work and their classes with

pleasure, creativity, challenge, and joy'. The emotional reactions of teachers such as lack of willingness, have dragged on desired changes directed by policy-makers (Boekaerts, 1999).

The 'human factor' of the teaching profession can also be approached through characteristics associated with the quality of a teacher. Fajet et al. (2005) use the concept of the 'affective qualities' of a teacher, originally introduced by Weinstein (1989), alongside the cognitive category. In this category, they include personal characteristics by which the quality of a teacher, either good or bad, can be profiled, including confidence, inter-personal skills, and commitment. Similar to Younger, Brindley, Pedder, and Hagger (2004), Fajet et al. (2005) state that it is not only about particular attributes but also moralistic constructions and visions associated with being a good teacher. Affective qualities include personal characteristics, attitudes, and behaviour towards students as well as attitudes towards teaching in general.

The personal perspective, including a variety of affective aspects, also appears in research on teacher identity (e.g. Atkinson, 2004; Walkington, 2005). Eteläpelto and Vähäsantanen (2006) state that various competences are integrated into personal professionality through subjective meaning-making (see also Beijaard et al., 2004; Danielewicz, 2001). They highlight a need for the personal approach alongside the social construction of teacher identity, especially because of emotional reactions related to personal experiences throughout the process. Hodgen and Askew (2007) discuss the special role of mathematics in teacher identity. Since mathematics generates strong reactions, a need for attitude change exists. Teacher identity and emotion are connected in three ways according to Hodgen and Askew (2007):

> (1) Emotions are connected to the figured aspects of identity and to imagination and desire. Desire for an unattainable completeness is linked to identity.

> (2) The relationship between knowledge and emotions, the importance of personal relationship with mathematics being essential. This idea is founded on DeBellis and Goldin's (2006) analysis of knowledge and emotions. Associated with this, intimacy means a kind of vulnerability of one's identity.
>
> (3) emotions of positional identity relate to the development process and one's experiences. (pp. 474-475)

Alongside personal experiences, engagement in the teaching profession and values are part of subjectivity. Knowles (1992) uses the concept of 'strength of teacher role identity' in the sense of how strongly student teachers engage in the teaching profession and view themselves as teachers (see also Samuel & Stephens, 2000). There is a difference between playing a role as a teacher and truly identifying oneself as a teacher (Danielewicz, 2001; Walkington, 2005). Consequently, an individual has to adopt the teacher identity and to be able to relate core beliefs to the cognitive aspects of being a teacher (see also Korthagen, 2004; cf. Beijaard et al., 2000).

Emotions are interconnected with teacher identity at several levels in research, both in the long-term relationship with the teaching profession as well as feelings that arise during the developmental process (Hannula, 2004; Hoekstra et al., 2007). In this research, affective aspects associated with the teaching profession generally are distinguished from situational emotions that arise during the developmental process of becoming a teacher as well as in teaching situations. Like the cognitive aspects discussed in previous sections, the category of affective aspects is one way of profiling the individual state of teacher identity as well discussing what a good mathematics teacher is like in general. Taking this as a starting-point, affective aspects of teacher identity are regarded as 'traits' that are understood as something stable and fundamental to being a teacher. The category of motivation, discussed by Hannula (2004), is the basis, representing the subjective perspective. The category of 'affective aspect' comprises (1) motivation for and

commitment to the teaching profession, (2) values and attitudes toward the profession in general, and (3) personal characteristics associated with being a teacher, according to the understanding of Fajet et al. (2005). Especially at the early steps of teacher identity formation, the questions concerning motivation for becoming a teacher and appropriateness of one's own personal characteristics for teaching profession arise.

THE IMAGE OF AN IDEAL TEACHER DIRECTING DEVELOPMENT

The image of an ideal teacher, i.e., what a good teacher is or is not, is seen as fundamental to the process of individual development (Arnon and Reichel, 2007; cf. Sfard & Prusak, 2005). The image of an ideal teacher is developed through experiences and influential activities. Students have conceptions of good teaching and learning in mathematics based on experiences as learners of mathematics, especially of the ability and skills a mathematics teacher needs. Conceptions of an ideal teacher can be approached both collectively, as a socially shared image of a good teacher, and individually as the image that one has of being a good teacher. Everyone, despite the professional orientation, has their own image of a good or bad teacher at least to some extent. However, associating this image with teacher identity formation is not self-evident, even among student teachers (Arnon & Reichel, 2007).

The image of an ideal teacher, however, is approached through three notions. First, I discuss conceptions of a good teacher in general as well as the background to those conceptions. Second, I examine the image of an ideal teacher from a collective perspective. The image of an ideal teacher is a socially constructed and shared view of what is seen as essential and valuable in the teaching profession. Last, I approach the image of an ideal teacher from the individual perspective. The image of an ideal teacher directs personal goals that an individual sets. Tension between the present image and the image of an ideal teacher is seen as a force for change (Beijaard et al., 2004; cf. Sfard & Prusak, 2005; see also Richardson & Placier, 2001). From this point of view, becoming a teacher is a matter of active direction towards something; i.e., an individual aspires to be a better teacher in relation to various aspects of the profession.

Conceptions of a good teacher

The educational literature has considered the image of a good or bad teacher extensively. Fajet et al. (2005) describe the findings of numerous studies on the image of a good teacher under two categories, the 'professional competence' including mastering certain knowledge and skills, and the 'affective qualities' of a good teacher (see also Arnon & Reichel, 2007). These two categories relate to the personal characteristics of a good teacher. Arnon and Reichel (2007) consider these categories as inter-related, so that they are not dichotomous but complementary to each other.

In addition, some features of teaching performance are considered essential to being a good teacher, as in the research by Virta (2002, p. 691), who found that students described a good teacher as someone who 'makes the students think critically, have an enormous capital of information, and is willing to discuss and able to create a positive atmosphere in the classroom'. Related to classroom activities, classroom management skills and well prepared and taught lessons are also something related to being a good teacher (Younger et al., 2004).

Korthagen (2004) wants to broaden the discussion about a good teacher from the classical dichotomy that emphasises the difference between personal characteristics and competence as a teacher. While he considers it impossible to constitute a definite list of the features of a good teacher, various levels of essential qualities should be examined. Korthagen (2004) proposes a multi-level model in which levels are within and interconnected to each other. Two outer levels may be observed by others, (1) the environment, and (2) behaviour. A step towards the inner levels is (3) competence related to the teacher's behaviour. Korthagen underlines the distinction between the levels of behaviour and competence: competencies are conceived as an integrated body of knowledge, skills and attitudes representing potential for behaviour whereas behaviour is dependent on circumstances, and the environment in which competencies are put into practice. Korthagen locates (4) beliefs as the next level. Interestingly, he distinguishes general beliefs and

beliefs about oneself in the teaching profession. The fifth level is (5) identity that is defined as how a person sees his or her own (professional) identity. Last, the innermost level is about (6) mission, the psychological concept of becoming aware of the meaning of one's own existence within a larger whole. Korthagen (2004, p. 87) concludes that being a good teacher as well as teacher change takes place at different levels, stating that 'teacher's behaviour, competencies, beliefs, identity and mission together should form one coherent whole matching the environment'.

The reasons behind the conceptions of an ideal teacher have been of interest for improving teacher education and its influence. Younger et al. (2004) as well as Virta (2002) emphasise the significance of one's own schooling and memories of particular people who had made a difference (see also Brown, 2003). Students talked about their own teachers in terms of characteristics and good instruction. Virta (2002) mentions that student teachers accepted the old-fashion methods of their good teachers and, furthermore, were missing a strong schema of pupil-centred teaching. However, school memories were not the only thing the students mentioned as a reason, finding that teaching practice placement and especially experienced teachers influence their views (see also Richardson & Placier, 2001).

The image of an ideal teacher from a collective perspective

From the collective perspective, the image of an ideal teacher is seen as a socially constructed view of what is associated with being a good teacher. According to Sfard and Prusak (2005), both individuals and other people define what is desirable and worth aspiring to, especially within a particular community. In other words, 'designated identity', the concept used by Sfard and Prusak (2005), is not always a matter of free choice by an individual but also reflects socialisation within the context. Consequently, in this research, the image of an ideal teacher is seen as an interface between individual and collective perspectives on teacher identity, and thus the element, which can influence the formation of teacher identity. During teacher education, student teachers become

acquainted with socially shared conceptions of a good teacher and how to become one. Naturally, as Korthagen (2004) asseverates, it is impossible to engage with one normative, unanimous description of a good teacher. However, particular aspects and a common interest as well as practices associated with teaching profession are socially shared (Gee, 2000).

The formation of teacher identity can be interpreted as socialisation; first, in the community of teacher education, and, second, in the school context as a work community (Eteläpelto & Vähäsantanen, 2006; see also Wenger, 1998). The socialisation process has been researched by Walshaw (2004), who has examined the constitution of teacher identity within teaching practice. She claims that teaching experiences are not only a place for transforming identity through discourse and interaction but also a place for adopting norms and organisational teaching procedures (see also Brown, 2003). At the beginning of a teaching career especially, socialisation with existing norms is an important influential factor for a novice teacher and a way to become a 'real' teacher (Eteläpelto & Vähäsantanen, 2006).

Conceptions of a good teacher and what is seen as worth aspiring to might differ between an individual and a collective (Archer, 2008; J. Cohen, 2008; Walkington, 2005). Younger et al. (2004) highlight the challenge of addressing possible contradictions and tensions caused by idealism in becoming a good teacher. Similarly, Walkington (2005) emphasises the meaning of finding mutual understanding regarding the image of being a mathematics teacher in order to build trust between teacher educators and students. The core beliefs might differ, but mutual respect is the way to address the needs of students. According to Walkington (2005), teacher educators should continually encourage the formation of a teacher identity by facilitating activities that empower the students to build explicitly upon and challenge their beliefs.

Socially shared aspects of being a teacher also inform collaboration between teachers. In order to decrease tensions caused by different images of 'being a good professional', an individual might position him- or herself in the community by adopting shared values and seeking success by acting according to supposed norms (Archer, 2008). To be recognised by others and to be treated like a teacher is sought by acting according to certain norms. According to J. Cohen (2008), because individual teachers define and enact shared aspects of professional identity differently, formal structures to promote teacher engagement in collaboration with each other are not the same for all teachers. In her discursive study, teachers try to accomplish significances of the shared role identity as a teacher through identity talk.

Arnon and Reichel (2007, p. 462) highlight the meaning of breaking the cycle as 'if there is no development, growth and change in this primary image during the teacher education process, students will carry the same images that they arrived with back to their environments and to their pupils'. Various interventions based on research are suggested. Korthagen (2004) claims that it is important to take the concern of students as a starting-point because this is a driving force for development. In his model, since becoming and being a teacher is analysed through levels within each other, the types of intervention that might aid a student varies or has different effects. Besides, principles provided during teacher education should be embodied in action in order to have an impact (Danielewicz, 2001). However, even if generalisations about effective and expert teaching might be useful, these should not be presented as universal truth (Hagger & McIntyre, 2000). Altogether, if students are regarded as having an active role in teacher identity formation, confronting situations of disagreement and dissonance force them to evaluate and possibly reshape their views of an ideal mathematics teacher.

The ideal image orienting individual development

The image of an ideal teacher is meaningful for identity formation when it is related to personal goals and thus directs personal development (Arnon & Reichel, 2007; Virta, 2002). The starting-point is that individuals commit themselves to becoming teachers and are able to identify with the teaching profession (Danielewicz, 2001). The image of an ideal teacher is shaped in social interaction with others, e.g., during school time and in teacher education. An individual confronts the requirements of society and traditions through the social conceptions of a good teacher (see J. Cohen, 2008; Eteläpelto & Vähäsantanen, 2006). However, the image of an ideal teacher influences the personal developmental process only when it is particularly associated with this process.

Student teachers, as well as teachers later on in their career, have conceptions of the worthwhile features of the good teacher that they would like to become. As Korthagen (2007) puts it, prior knowledge and preconceptions play a powerful role in receiving and learning new knowledge and skills (see also Hagger & McIntyre, 2000; Knowles 1992; McCormack et al., 2006). However, the image of desired state as a teacher is seen to direct the developmental process through separate aspects associated with teaching profession rather than as a coherent entity. A person might have a clear picture of certain characteristics as a teacher that s/he personally finds valuable and desirable. The image of an ideal teacher might also be defined through some undesirable features that a person wants to avoid. Altogether, the image of an ideal is fragmentarily linked with personal goals through separate aspects.

Furthermore, the image of an ideal teacher is seen as dynamic and continuously in progress. It changes over time in social interaction with others and with personal experience (Arnon & Reichel, 2007; Danielewicz, 2001). For example, Arnon and Reichel (2007) have shown that the

significance of knowledge for a teacher changed with teaching experience. Teachers with professional experience attributed more importance to knowledge than inexperienced ones.

An individual has to be aware of his or her own needs in order to be able to to set personal goals embedded in the image of an ideal teacher. It is not simply about conceptualising the desirable characteristics of a good teacher but also reflecting one's present state as a teacher through personal experiences (Danielewicz, 2001). A person has to be able to form the image of oneself in the profession in interaction with others. Sfard and Prusak (2005) use the concept of the 'designated identity' of the desired state of being a teacher in their narrative approach to teacher identity, arguing that designated identities direct individual actions. Furthermore, they continue that the notion of two subsets, actual and designated identity, is essential in identity formation. For them, actual identity is about the existing state of affairs, answering the question 'Who am I as a teacher?' while designated identity defines the desired state of affairs, 'Who do I want to become?' (see also Beijaard et al., 2004). In other words, designated identity is manifested in commitment, desire, or even obligation to become something different from what is the case at a particular moment.

To conclude, formation of teacher identity is seen as a process of filling the gap between two states: existing being as a teacher, which I will call *the present image of teacher identity*, and desired state as a teacher, which I will call *the image of an ideal teacher* (Beijaard et al., 2004; cf. Sfard & Prusak, 2005). The dynamic nature of teacher identity regarding the internal processes of identity formation is embedded in this notion. First, an individual has to be aware of the present state of his or her own identity at a specific time and place. Recognition of this is situational, but some aspects remain more stable than others. The question is about trait kind of features that constitute an understanding of the state as a teacher. Second, a person should become aware of the

image of an ideal teacher underpinning personal developmental goals. Similarly, the ideal image as well as personal goals are dynamic and momentary but recognisable at certain times and places. The tension between the present and desired state of identity is a driving force for the on-going and dynamic process of identity formation. According to Sfard and Prusak (2005), an individual decreases this tension through learning (see also Wenger, 1998; Bohl & van Zoest, 2002).

It is a challenge for students to reflect on their own state as a teacher as well as to set personal goals on the basis of the image of an ideal teacher. Virta (2002) found connections between the image of what she called a good teacher and the goals that students set for their own development among a group of student teachers (see also Arnon & Reichel, 2007). Both Virta (2002) and Younger et al. (2004) have shown that students highlight the significance of personal characteristics in evaluating their individual strengths and developmental needs. Almost surprisingly, limited content knowledge as a specific knowledge domain was of concern rather than teaching skills. However, discussion on the significance of the ideal teacher is not automatically connected to the concept of teacher identity or self-regulated learning. For example, Arnon and Reichel (2007) state that

> the actual discussion of the image of the good teacher during teacher education is a method of raising consciousness and stimulating thought processes, enriching the image of the ideal and turning the theoretical discussion into an instrument of the process of preparing the student of education (p. 261).

For them, examination of the images of the ideal represented by students is a way to evaluate the effectiveness of the teacher education programme.

In this research, the concept of the '*present image of teacher identity*' stands for understanding of existing state as a teacher, in this case also understanding of emerging professionalism. The main

idea is accordance with the notion of actual identity used by Sfard and Prusak (2005), but wording 'present' describes better the notion of something that takes place as a part of teacher identity formation from the individual perspective. The individual can reflect on his/her state as a teacher, according to Beijaard et al. (2004), based on interpretation of personal experience (How am I as a teacher?), whereas others use observations, for example, in classroom situations (How is an individual as a teacher?) to build up their understanding of an individual as the basis for influential social interaction. The *image of an ideal teacher* includes the view what a good mathematics teacher is in general, collectively and individually (after Arnon & Reichel, 2007). Both images are regarded as dynamic and continuously progressive entities. Besides, such images can be described through separate characteristics related to the teaching profession, e.g., through knowledge and skills as well as the affective aspects that are associated with being a teacher.

However, the assumption is that the image of an ideal teacher directs personal development depending on how strongly the ideal image is linked to the personal goals that an individual sets, i.e. what kind of teacher would I like to become? According to Arnon and Reichel (2007), personal goals are in accordance with the image of an ideal teacher but do not necessarily cover the ideal image in all respects. Consequently, personal goals do not necessarily constitute a complete picture of an ideal teacher that a person identifies with. The image of an ideal teacher is more like a collection of desirable features than a coherent embodiment of the ideal teacher. Therefore, the concept 'designated identity' used by Sfard and Prusak (2005), despite the common idea behind the notion, is not used here: firstly, the image of an ideal teacher is not seen as an overall desired state, and, secondly, it does not necessarily direct the development. Furthermore, both notions, the present image and the image of an ideal teacher, are equally 'actual' for the person involved with the process.

TEACHER IDENTITY AS AN ON-GOING PROCESS

Professional identity is seen as constructed and continuously reshaped by the individual in interaction with others (Beijaard et al., 2004; Coldron & Smith, 1999; Danielewicz, 2001; see also Jenkins, 2004). Here, the model introduced by Côté and Levine (2002) is considered as a starting-point for describing the on-going process of the formation of emerging teacher identity in more detail (Figure 2). As in the model, processes are divided into two categories, *internal* and *external*, through which the mechanisms of teacher identity formation can be analysed.

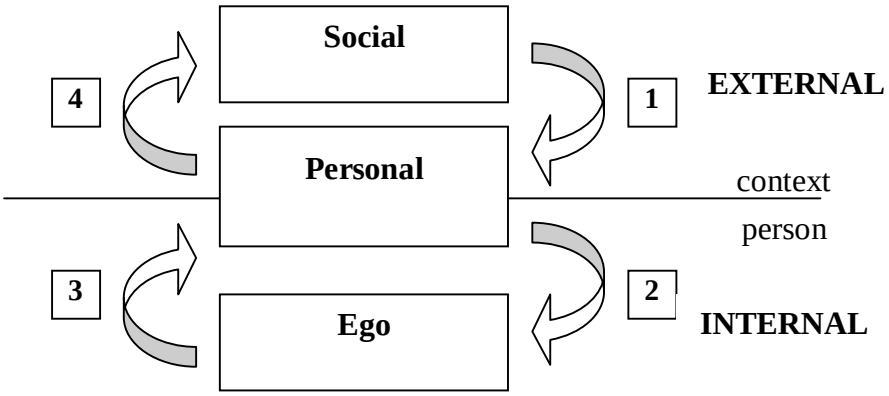


Figure 2. Teacher identity formation as an on-going process (Côté & Levine, 2002, p.134)

The relationship between personal and ego identity components represents *internal* processes of teacher identity formation. At the level of personal identity, an individual engages in interaction with others within a given context. First, the outcome of that influential interaction is internalised by an individual depending on meaningfulness and individual needs. In the case of teacher identity formation, a person has experiences with others, which influence the image of an ideal teacher and general perceptions of the teaching profession (see also Arnon & Reichel, 2007). However, a person internalises only some socially shared ideas related to the teaching profession as a part of a

personal image of an ideal teacher. A person filters influential ideas and constructs own understanding of being a teacher in general as well as perceptions of oneself as a teacher. Second, a person not only internalises the outcome of interaction but also constructs an understanding of him- or herself as a teacher in accordance with previous internalisations and inner understanding. Previous experiences through which an understanding has developed are important to the internal process (Nelson, 2008). In particular, teacher identity includes the idea of 'feeling as a teacher'; i.e., since a person engages with the idea of self as a teacher, taking a role as a teacher and a real internalised teacher identity are distinguished from each other. A person thus has an active and fundamental role in teacher identity formation, especially at the beginning of identity formation during teacher education.

The interaction between personal and social components represents the *external* processes of teacher identity formation. A person has contacts with other people in everyday life, an interaction through which individuals construct social reality and become aware of socially shared perceptions. In the case of teacher identity formation, socially shared ideas of the teaching profession and especially being a good teacher, i.e., the image of an ideal teacher, are essential for identity formation (e.g., Sfard & Prusak, 2005). Traditions, educational culture, and a socially accepted way of action represent those shared ideas implemented and reproduced by people. Teacher education is one of the institutions that intermediate socially shared ideas of being a good teacher and that socialises student teachers with existing values and norms. However, opportunities to participate in construction of shared understanding of the teaching profession are limited during teacher education. In this research, external processes of teacher identity formation and the relationship between personal and social identity levels are not the main concern. However, one cannot examine identity formation without considering the meaning of social interaction and the context in which a person acts.

The ongoing process of teacher identity formation includes the idea of change and development. Richardson and Placier (2001) summarise the nature of change by invoking four themes. First, they discuss how change is defined and by whom. Since teacher identity formation always involves a person (Beijaard et al., 2004), it is a subjective understanding of the formation process and possible changes in it. However, the idea of engagement in interaction with others and external processes of identity formation includes the idea that the process is sharable and can be partly recognised by others (Gee, 2000). Others such as teacher educators and peers can then also define the change. In this research, the change is defined in terms of development in cognitive and affective aspects of the teaching profession understood through both present and ideal images.

Second, the question of who has the power over change is crucial. In the case of teacher identity formation, even within teacher education, this is the students themselves. Of course, structural and cultural constraints as well as the established path for developmental direction influence the process of change as well. However, the students' role is collaborative and they make their own decisions regarding the personal process of emerging teacher identity they are involved in.

Third, the change entails the idea of direction towards something. Here, the image of an ideal teacher directs the change, since 'becoming a good teacher', can be regarded as an obvious aim of developmental process. However, the definition of a good teacher and aspects such as knowledge and skills needed as a teacher differ between persons.

Last, Richardson and Placier (2001) discuss difficulties in describing or identifying general stages of development. In general, the theoretical framework is based on Côté and Levine's social psychological model (2002). Identity formation is seen as a continuous process involving both

internal and external factors. From the individual perspective, the tension between the image of an ideal teacher and the present image of oneself as a teacher is a driving force for change. However, the basic assumptions about the individual active role and individual trajectories entail the idea that it is not possible to find developmental stages in teacher identity formation. The individual is the one who determines which experiences have an influence on individual development and how (Danielewicz, 2001; Sfard & Prusak, 2005; Wenger, 1998).

Internal processes of identity formation

According to Côté and Levine (2002), a person constructs an individual view of reality through internal processes and, in the case of teacher identity, a person constructs an understanding of becoming and being a teacher the same way. Internal processes are bidirectional. On the one hand, a person filters and internalises an influential outcome of interaction with others on the grounds of one's own needs, liking, core beliefs, and personal tendency (Walkington, 2005). Personal motives and student background pave the way for the internalisation process. Hodgen and Askew (2007) discuss the willingness to aspire for development as a teacher. In addition to the internalisation of external impacts, the aim of teacher identity formation is that one comes to 'feel that s/he is a teacher' and identify oneself with being a teacher, distinguishing between a role as a teacher and professional identity. On the other hand, a person constructs a self-presentation based on previous internalisations (after Côté & Levine, 2002), which is a suitable impression for others to recognise at the level of personal identity. A person constructs a personal understanding of being a teacher through lived experiences within a particular context.

Notions associated with teacher identity formation from the personal perspective will now be discussed. First, a person's background, including motives for and commitment to the teaching profession, are seen as essential to the process. Since the research is about the early steps in identity formation during pre-service teacher education, it emphasises the student teacher's

viewpoint. Second, the notion of 'becoming a teacher' is elaborated in more detail, since a person should be able to identify with being a teacher. Last, identity formation takes place through experiences with others, since different experiences are a core element in teacher identity formation, which a person undergoes in interaction.

Student teacher background

The student teachers' background embedded in both professional and personal life experiences is meaningful for the process of becoming a teacher, for the formation of teacher identity (Beijaard et al., 2000; Richardson & Placier, 2001). What an individual brings has an influence on conceptions of teaching and learning generally, the image of being a teacher, and the student teachers' motivation including motives for applying for the teacher education programme (e.g., Haritos, 2004; Merenluoto, 2003; Virta, 2002; Younger et al., 2004).

The reasons for becoming a teacher are many and, despite national differences, common themes can be seen internationally (Virta, 2002). One of the reasons for becoming a teacher and entering the programme is the value of the school subject itself. For those students, becoming a teacher means an opportunity to continue working within a subject area, like mathematics. The other reason is one's own school experiences or encouraging teaching experiences in school as an unqualified teacher. However, according to Virta (2002), the influence is not clear as some students give positive experiences as a reason, but others express critical attitudes towards their schooling because of frustration or negative experiences. Passion and emotional commitment to teaching, beside the desire to work with children, are also mentioned as reasons for embarking on a teaching career, according to Younger et al. (2004). Moreover, a majority of students see teaching as an opportunity to make a difference (O'Brien & Schillaci, 2002). However, not all students are so noble; pragmatism is a key factor for those who claim that being a teacher is a meal-ticket (Richardson & Watt, 2005). Secondary student teachers might also view teaching as a

stepping-stone to other careers. Besides, it is also a second choice for those who are not so successful in subject matter studies. (O' Brien & Schillaci, 2002) In all, the orientation towards teacher education differs among student teachers.

Student teachers have two kinds of role in learning to teach in the teacher education programme. Firstly, they are becoming teachers for schools in the future and one's image as a teacher is a central aspect of professional development (Malmberg, 2006). Secondly, student teachers are also learners guided by teacher educators. They have a particular orientation toward university course and experience the learning process as a student. The nature of motivation influences the way students study and learn in university studies (Nolen, 1996). In Finnish research on study orientations of university students, Mäkinen and Olkinuora (2004) noted that four groups differed from each other regarding general study orientations, applied learning strategies, and study success: performance-orientated, task orientated, socially-orientated students and avoiders. A need for study guidance is essential according to Rautopuro and Väisänen (2002), as students who are committed to studying and are aware of their motives achieve both more success and satisfaction. In the mathematical field, the general study orientation of students seems to vary greatly (Mäkinen & Olkinuora, 2002). They continue that one reason for avoiders is instrumental motives for studies; many students in mathematics and physics for example attend university studies as they want to improve their knowledge base in order to apply to medical school or technical studies (see also Virta, 2002; cf. Merenluoto, 2003).

The way student teachers engage in becoming a teacher, i.e., developing themselves as teachers, is essential for the formation of teacher identity (Beijaard et al., 2004; Danielewicz, 2001; Malmberg, 2006). Construction of a new professional identity is a challenging process, in which an individual confronts the need to question his or her own pre-conceptions (Kagan, 1992;

Trotman & Kerr, 2001; Fajet et al., 2005). Students should be able to imagine themselves as teachers and think about their own preconceptions and attitudes related to teaching and learning (see also Bohl & van Zoest, 2002). Furthermore, students should set personal goals in order to orient to individual development. Danielewicz (2001) highlights that there is not only one but many ways to develop identity. Since individual work on teacher identity formation is needed to make progress, supporting individual identity formation is a challenge because of different needs and backgrounds.

Younger et al. (2004) have divided student teachers' expectations of their studies into three sub-categories. First, learning in university courses is one way to learn to teach, especially a way to learn the content knowledge needed as a teacher. Second, the opportunity to observe experienced teachers in classroom contexts is also a way to learn as a teacher. Students need to have a model to identify with and to be able to see ideas of teaching and learning in practice (see also Haritos, 2004; Trotman & Kerr, 2001). The last category, unsurprisingly, was learning through doing. It is not only about an opportunity to take a role as teacher but also getting feedback from experienced teachers. At the same time, there are also findings that student teachers seem to assign great importance to their personal characteristics and less importance to education. Fajet et al. (2005) state that pre-service teachers consider teaching primarily as a task involving affective, interpersonal relationships rather than a profession requiring a skilled and knowledgeable practitioner (cf. Virta, 2002).

Becoming a teacher

The question of how teacher identity exists and especially what it means that an individual student teacher grows to be a teacher needs to be discussed. As mentioned before, research on (teacher) identity varies greatly and, consequently, the understanding of 'becoming and being a teacher' differs. Some research distinguishes a professional self from a personal self on the grounds of

intrapsychological processes, so that ‘becoming a teacher’ means a change in inner understanding (Korthagen, 2004). Some regard teacher identity as consisting of several sub-identities (Beijaard et al., 2004), while others regard identity as a unity that develops and appears differently at different times and places (Sfard & Prusak, 2005). The point of departure of this research is the model based on the three components of identity: ego, personal and social identity (Côté & Levine, 2002) and, according to the model, teacher identity coexists at all three levels. It is not possible to found teacher identity on only one of these three, even though it can be approached from each separately. Since, this research focuses on the early steps of emerging teacher identity during pre-service teacher education, ‘becoming a teacher’ is of special interest from the perspective of the person and internal processes.

In the model presented by Côté and Levine (2002), the focus is on the ego identity level, which involves internal processes not directly visible to others. Eteläpelto and Vähäsantanen (2006) highlight the significance of perceptions of oneself, one’s own role and commitment to the teaching profession for teacher identity. Similarly, Beijaard et al. (2000) have investigated teacher identity through individual perceptions of professionality and especially from the perspective of teacher knowledge domains. ‘Becoming a teacher’ means growing to be a teacher, i.e., how comprehensively one identifies oneself with being a teacher.

Moreover, there is a difference between acting as a teacher and being a teacher, i.e., genuinely adopting teacher identity (Danielewicz, 2001). The way teacher identity is recognised by oneself and others makes the difference (Gee, 2000). A person is only taking a role if s/he gives the impression of being a teacher, e.g., performing like a teacher in the classroom and school environment but, despite the real image that others recognise, not regarding him/herself as a real teacher. Walkington (2005) states, based on Mayer (1999), that

> a teaching role encapsulates the things the teacher does in performing the functions required of her/him as a teacher, whereas teaching identity is a more personal thing and indicates how one identifies with being a teacher and how one feels as a teacher (p. 54).

When merely taking a role as a teacher, others recognise a person as a teacher based on self-presentation that takes place at the personal identity level and indirectly at the social identity level (after Côté & Levine, 2002). However, at the ego identity level, being a teacher is not internalised by a person when taking a role.

The process of becoming a teacher is closely involved with interaction with others. According to research by Wenger (1998) and some based on Wenger's ideas (e.g., Bohl & van Zoest, 2002; Hodgen & Askew, 2007; Swennen, Volman, & van Essen, 2008), identity formation is seen as a result of learning within certain communities of practice. For example, Bohl and van Zoest (2002, p. 139) claim that 'our identities exist not only within ourselves, but are also strung across a continuum between ourselves and others'. Similarly, Samuel and Stephens (2000) discuss teacher role and identity from both the perspectives of the individual and the cultural environment. Compared with the model of Côté and Levine (2002), the focus is then on the ego and personal identity levels, at which self-presentation takes place. 'Becoming a teacher' has also been associated with having a position in the school community. McCormack et al. (2006) regard teacher identity as connected with position and recognition by others (see also Gee, 2000).

Social theories have been criticised for failing to deal with the subjectivity and internal processes that teacher identity development involves (e.g., Eteläpelto & Vähäsantanen, 2006). Volman and ten Dam (2007) claim that an individual is someone who has a dominant role in interplay between social and individual perspectives, maintaining that social identities structure the learning processes that a person engages with. However, the image of self, perceptions of oneself as a

teacher in this case, directs individual commitment and what is seen as worth aspiring to. Similarly, Côté and Levine (2002) talk about an individual who filters external influences in the continuous process. Because of the active role in directing and filtering influential interaction, an individual him/herself has to be motivated to become something and develop him/herself through learning (see also Danielewicz, 2001).

'Becoming a teacher' is associated with the idea that an individual grows up in some way and changes at the ego identity level (after Côté & Levine, 2002; see also Richardson & Placier, 2001). Promoting this change through new knowledge and skills provided in the pre-service teacher education courses is a challenge. Student teachers bring influential, distinctive perceptions about teaching and learning to teacher education, and this variety should be taken into consideration somehow (Hagger & McIntyre, 2000; Kagan, 1992). Smith (2007) discusses the need to consider what different knowledge areas, like mathematics, mean to professional identity. Subject matter studies influence the views of teaching and learning that student teachers have (see, e.g., Foss and Kleinsasser, 1996). Since the way of thinking in mathematical and natural sciences as disciplines is different from that in educational sciences, student teachers might have difficulty in understanding the idea of educational studies and pedagogical knowledge after studying for many years in a subject department (Brinkman & Van Rens, 1999; cf. Joram, 2007). In addition to subject matter studies, student teachers should become acquainted with educational research as a part of being a professional teacher (Gitlin et al., 1999; Gore & Gitlin, 2004; Reis-Jorge, 2005).

The question concerns not only what is seen as valuable knowledge and skills, but also how student teachers learn new things and change. Pre-service teachers tend to use their personal experiences as critical filters in adopting and integrating new content into their professionality (Malmberg, 2006; see also Volman & ten Dam, 2007). Student teachers should be able to reflect

upon their own preconceptions of pedagogical knowledge and should understand the meaning of the key concepts used in designing, organising, and evaluating learning and instruction (Haritos, 2004; Younger et al., 2004; see also Da Ponte, Oliveira & Varandas, 2002). Trotman and Kerr (2001) claim that two stages can be addressed through integrative activities. Firstly, student teachers become conscious of the values and beliefs that they have internalised as a consequence of previous activities and experiences (see also Foss and Kleinsasser, 1996; Kagan, 1992). Secondly, beside becoming aware of their own background, students should be given opportunities to reflect critically on and expand the understanding they derive from making the internal more external and explicitly understood. This may make the students' sense of themselves as a teacher richer, so that the desired transformation of perspective is easier to achieve (see also Danielewicz, 2001). However, as Trotman and Kerr (2001) and Senger (1999) state, changes in thinking do not necessarily lead to changes in action, here understood as a change at the personal identity level in Côté and Levine's model (2002). Promoting real transformation is a challenging task.

In this research, 'becoming a teacher' is associated with the process of change. As discussed in the previous section on the image of an ideal teacher, one's awareness of the present state of emerging teacher identity as well as awareness of the personal aims in relation to the image of an ideal teacher is fundamental to this process. In Côté and Levine's model (2002), 'becoming a teacher' takes place primarily at two levels, ego and personal identity. The state of teacher identity is to be recognised both individually and socially. Even though teacher identity is socially constructed in interaction with others and is recognised as situated and shared by others, an individual has a fundamental role in directing the change and in giving meaning to experiences. In other words, teacher identity cannot be discussed without considering the understanding of the individual, the one who 'feels' like a teacher and whose face is recognised by others. In academic teacher

education, integrating new knowledge into professionality is important for the process of 'becoming a teacher', i.e., learning and strengthening competence as a teacher is one way to grow to be an autonomous teacher. 'Becoming a teacher' means gradual changes in an individual through both adaption and through adopting something based on social influences. For changes to take place, a person needs confirmation and to be seen as a teacher in interaction at the personal identity level within the context.

Teacher identity constructed through experience

Experiences are essential to teacher identity formation (Beijaard et al., 2004; Nelson, 2008; Samuel & Stephens, 2000). In Côté and Levine's model (2002), the boundaries between a person and context are at the personal identity level, where others perceive the individual state of identity through self-presentation. The actions that a person engages in in everyday life are the basis for individual experience. However, the meaning of events depends on the person and his/her previous internalisations at the ego identity level. As Sfard and Prusak (2005) explain, our vision of our and others' experiences is essential for constituting identities, not experience as such.

For the individual, experiences form a continuum between past and future mediated by present experiences. In the Deweyan way of understanding experience, continuity is seen as a fundamental feature of experience (Nelson, 2008). A person intertwines previous and present experiences with each other. Dewey's understanding of experience (1938) is as a moving force grounded in situation, rooted in interaction, and related to the individual's life. First, experiences are always situated in a certain time and place, meaning that they cannot be separated from the context and time in which they occur. Second, interaction plays a central role for experience to occur at a particular time and place. Third, experience cannot be separated from the person having it. Experiences are always in continuity with personal life and actually defined as of a particular kind by the person concerned (Nelson, 2008). For Sfard and Prusak (2005), identity talk is seen as

a tool for copying with new situations in terms of past experiences and becoming able to plan for the future in their narrative approach.

In terms of Côté and Levine's multidimensional model (2002), past experiences are encapsulated in previous internalisations at the ego identity level and have an impact in identity formation through the inner processes of the person him/herself (Knowles, 1992). Samuel and Stephens (2000) associate experiences with professional identity, especially the image as a teacher arguing that not only questions about the present state and future designated image as a teacher should be addressed, but the past always brought by the individual should also be taken into consideration. In other words, the phenomenon should be examined based on three questions: Who am I? (present), What do I wish to become? (future), and What do I bring with me? (past).

'Becoming a teacher' means a change towards something. For example, Da Ponte et al. (2002) state that professional knowledge is not enough without internalising and adopting new ideas as a part of personal views and, in order to promote changes, reflection upon experiences is needed to stimulate thinking. Through experiences, a person gains new knowledge about teaching and learning. Kagan (1992) states that student teachers need to experience what works and why it works in the classroom as they engage in technical rationality. Similarly, Gore and Gitlin (2004) have noted that teachers choose to rely on the experiences of trusted colleagues as a basis of knowledge instead of research knowledge produced by academics.

Active reflection on experience should take place to promote development as a teacher., Students have traditionally been directed to reflect on their cognitive processes in academic teacher education. Morine-Dershimer and Kent (1999) underline the meaning of reflection in promoting the interplay between general and personal pedagogical knowledge. While personal knowledge

formed by practical experiences is broadened and made more objective, conceptions and principles of pedagogy explicated by research are contextualised. Some research distinguishes reflectivity and reflexivity from each other. Danielewicz (2001) considers reflexivity as the act of self-conscious consideration that is an instrumental and intentional means to an end, whereas reflection is directed towards something that has already happened (see also Côté & Levine, 2002). Walkington (2005) finds it challenging for teacher educators to mentor student teachers toward reflective activities instead of supervising performance as a teacher, functional competence in the classroom.

Experiences are also important for the affective aspects of teacher identity formation (Walkington, 2005). Atkinson (2004) criticises the view that stresses the cognitive viewpoints of becoming and being a teacher. He underlines the role of non-rational aspects in understanding the meaning of experiences, and through that, their influence on the formation of professional identity. An individual needs to construct fantasy through narratives, which allows understanding of all aspects of experience in a meaningful way. In fact, Atkinson states that formation of teacher identity is not only about reflective actions on practical experiences, which are based on rationality and thinking skills. He claims that reality is constructed partly in imagination, through which the notions of reality are completed and made meaningful for an individual (see also Sfard & Prusak, 2005).

Emotions that an individual experiences in different situations are particularly bound up with identity formation (Schutz & DeCuir, 2002, see also Hannula, 2004). When a person engages in interaction at the personal identity level, emotions and feelings play an important role in various situations. A subjective stance towards becoming and being a teacher subsists. Korthagen (2007, p. 305) states that ‘the problem of promoting fundamental professional change is first of all a problem of dealing with natural emotional reactions of human beings to the threat of losing

certainty, predictability, or stability'. Similarly, Danielewicz (2001) notes the need for students to build confidence and have a feeling of efficacy and empowerment. Hodgen and Askew (2007) associate emotions with teacher identity formation through positioning in a particular context. Emotions are seen as a way for a person to find out who they are, what they value, and what matters in specific classroom contexts where identity is reshaped (after Op't Eynde, De Corte, & Verschaffel, 2006). Although a person can recognise his or her own state regarding feelings as a teacher, it is problematic to build it externally in interaction. As Korthagen (2007) asserts, human change can take many forms (see also Nelson, 2008). Besides, longer lasting change is not necessarily as expected or immediately visible to others or the individual him/herself.

Côté and Levine (2002) claim that previous experiences and internalisations influence the self-presentation that a person provides to others (see also Beijaard et al., 2004). In other words, when an individual engages in interaction with others at the personal identity level, s/he relies on previous experiences and understanding in defining situations and reshaping the performance visible to others. All students have plenty of life experience before entering teacher education and making a decision about a future professional career. Once committed to the process of becoming a teacher, a person interprets past experiences in a new way and possibly associates them with the future profession. In the case of mathematics student teachers, mathematics as a discipline and mathematical learning experiences have a strong influence on emerging professional identity. Hodgen and Askew (2007) highlight mathematical intimacy and mathematical integrity (after DeBellis & Goldin, 2006) as essential for learning in terms of identity construction. DeBellis and Goldin (2006, pp. 137-138) define mathematical integrity as the 'individual's affective psychological posture in relation to when mathematics is 'right,' when a problem solution is satisfactory, when the learner's understanding suffices, or when mathematical achievement deserves respect or commendation'. By mathematical intimacy, they mean deeply-rooted

emotional engagement, vulnerability and the building of mathematical meaning and purpose for the learner. These aspects of the teacher's own previous learning process in mathematics influence identity formation.

Students start to see themselves differently with teaching experience in the classroom. They begin to notice the differences between the image of an ideal teacher and their present state as a teacher (Arnon & Reichel, 2007). Students traditionally expect that teaching experience will teach how to teach (Grossman, 1990). For identity formation, it is essential that one has the opportunity to experience oneself as a teacher and build up an understanding of oneself as a teacher based on feedback, and to face uncertainty and self-doubt (Settlage et al., 2009; Burn, 2007). Côté and Levine (2002) discuss the conscious impression conveyed to others and the constructed self-presentation through which a person engages in interaction. In teacher education, teaching practice provides an opportunity for social interaction and engagement in the school context (Walshaw, 2004).

External processes of identity formation

Since the process of teacher identity formation is situated and embedded in social interaction, an overview of the framework of social perspective needs to be included here; e.g., discussing the meaning of social interaction and the context in which a person acts (Bohl & van Zoest, 2002; Eteläpelto & Vähäsantanen, 2006). The purpose is not to cover the social perspective comprehensively but to frame the aspects that allow talk about teacher identity as a situated and shared phenomenon. Some particular themes regarding identity formation that emerge during the early steps of the formation process are discussed.

Côté and Levine's model (2002) was introduced earlier in this chapter. External processes operate when a person engages in interaction with others in a specific context. Côté and Levine (2002)

talk about the interplay between the levels of personal and social identity components that involve others beside the individual. In practice, a person interacts with others and participates in communication through everyday life. While individuals build their social understanding of what it means to be a teacher by constructing social reality collectively and possibly challenging the existing constructions (Côté & Levine, 2002), an individual becomes aware of the existing social understanding of what it means to be and become a teacher through traditions and shared understanding of being a good teacher in a particular community.

Teacher education represents an institution that intermediates these socially shared ideas and through which student teachers become involved in socialisation processes. The aim of teacher education is to support the process whereby students become professional teachers, or at least construct a basis for professional development later in work. From the perspective of external processes, a person uncovers his or her state as a teacher through self-presentation and thus makes the individual state of identity recognisable to others at a particular time and place (Gee, 2000). Danielewicz (2001) calls this *going public*. Other people recognise the state of identity not only on the basis of physical characteristics but in reference to the context. An individual self defines the state of teacher identity through feedback and experiences in different situations, including comparisons with others (see also Beijaard et al., 2004).

This research discusses the aspects associated with social understanding of teacher identity utilizing three themes that emerge from the literature review. Firstly, a brief discussion of identity as a socially constructed entity is given. Identity formation is then seen to take place through learning and shared experiences (e.g., Wenger, 1998; Volman & ten Dam, 2007). Wenger's theory about learning and communities of practice (1998) is introduced because it is widely used in research on mathematics education. Secondly, teacher identity is seen as a situated phenomenon

that exists in relation to contextual aspects, like traditions in the school environment. It is noteworthy that these two themes are neither fully satisfactory nor exclusive but rather provide one way to consider the social perspective of teacher identity. These aspects interact – one cannot examine contextual aspects, like the community in which inidividuals act without thinking about social interaction with others, and vice versa.

Identity as socially constructed

Social theories of learning are one starting-point for research on teacher identity and its formation. One approach is to consider identity in relation to positioning in a particular context as well as regarding power issues in developmental process, as Gee (2000) states. Gee (2000, p. 99) defines identity, the general sense of 'being recognised as a certain kind of person' in a given context. In his analysis of identity, the central question is how and by whom a particular identity is to be recognised. According to Gee (2000), identity can be perceived from four points of view: (1) a state of existence that is given by nature and is not under the control of an individual or an institution, (2) an institutional position by which identity is recognised (e.g., a teacher in school), (3) individuality, as an individual trait that is constructed through discourse and interaction with others but determined by an individual, not by external forces (see also Danielewicz, 2001), and lastly, (4) identity based on being a member of an affinity group that shares common interests and practices (e.g., those who are interested in ice-swimming are members of a ice-swimming club). In the case of becoming a teacher, all three latter aspects could provide insight into the process. However, individuality describes the phenomenon in a good way, especially within pre-service teacher education, better than those involved with belonging to some affinity group or having a position in the community.

In research on mathematics education, Wenger's model of community of practice (1998) is widely used as a basis for a social perspective on identity (e.g., Bohl & van Zoest, 2002; Garcia, Sánchez,

& Llinares, 2006; Hodgen & Askew, 2007; Walshaw, 2004). Here, the outline and theoretical notion of community of practice are discussed in order to have an idea of the social approach to learning and identity formation. However, as the focus of the research is on individual internal processes and the boundaries of internal and external processes, the introduction is kept to a general level.

Wenger (1998) states that identity is developed through learning as a member of a community of practice. The meaning of social communities is essential to the process from the viewpoint of the social theory of learning. In Wenger's model, identity, meaning, practice, and community are all defined and related to each other through learning. Wenger (1998, p. 4) underlines the meaning of participation for constructing identities, as he claims that 'such participation shapes not only what we do, but also who we are and how we interpret what we do'. The social theory of learning points up *identity* as a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities. Wenger (1998, p. 145) claims that 'building an identity consists of negotiating the meanings of our experience of membership in social communities'. Thus when the definition of individuality is something that is part of the practices of specific communities, identity is seen as the interplay between individual and collective rather than a distinction between these two dimensions (see also Eteläpelto & Vähäsantanen, 2006; Swennen et al., 2008).

Wenger (1998, 148) extends the picture of identity through five notions: (1) identity in practice, (2) identities of participation and non-participation, (3) modes of belonging, (4) identification and negotiability, and (5) learning communities. The parallel between practice and identity yields a perspective on identity that is rich and complex because of its relations with practice. As is essential for this process, he examines different modes of belonging to and participation in a

community of practice (see also Danielewicz, 2001). Wenger (1998, p. 164) claims that ‘we not only produce our identities through the practices we engage in, but we also define ourselves through practices we do not engage in’ (see also Reid, Dahlgren, Petocz, & Dahlgren, 2008). Non-participation is also meaningful for identity formation as a source. He separates three different modes of belonging in a community. Firstly, he starts with engagement in practice that involves actions and interaction as well as shared reality and the negotiated meanings of experiences. Wenger talks about the physical limits of time and space in order to distinguish engagement from other modes of belonging. Secondly, imagination is an important component for the creative process of producing new ‘images’ and generating new relations. He underlines that imagination is not only an individual process but is also related to social interactions and shared experiences. In addition, although imagination can involve stereotypes and something that is not true, it is necessary for creating something new and projecting our experiences (cf. Atkinson, 2004). Thirdly, alignment, like imagination, is not based on mutual engagement. Alignment requires that perspectives and actions be directed toward common purposes, and individuals become a part of something larger through discourse and acting according to particular styles.

Similarly, Danielewicz (2001, pp. 114-123) elaborates the affiliation and collaboration associated with social interaction in identity formation. She situates her notions about affiliation in the teacher education programme and teaching practice in the school, claiming that affiliation is a species of socialisation which takes place through several functions, such as identification, differentiation, and institutional actions upon identity. Danielewicz states that identity is manifested individually, but exists in social categories. In this sense, becoming as well as being a teacher involves developing both an individual and collective identity, and these should be fostered simultaneously.

Similar to Wenger's ideas, the relation between identity and learning new knowledge and skills is seen as essential for identity development (see, e.g., Boaler & Greeno, 2000; Burn, 2007; Smith, 2007; Volman & ten Dam, 2007; Beijaard et al., 2004). In a socio-cultural framework, as Wenger (1998) mentions, learning as a form of participation in communities of practice is not only about learning new skills and knowledge but also involves identity development (see also Lave & Wenger, 1991). In the study by Volman and ten Dam (2007), since learning is seen as being able to participate increasingly more adequately in social and cultural practices, it is linked to identity development (see also Swennen et al., 2008). Knowledge and skills to be learned should have a social connotation that students can identify with, because otherwise they will not be integrated into identity. Volman and ten Dam (2007) argue that learning and identity are related in two ways. First, identities are developed through the learning process when students acquire new knowledge and skills, and thus enhance their participation in social practices. Second, identification with particular positions in social practices either enhances or inhibits students' learning. Similarly, Garcia et al. (2006) associate learning with participation in the community. In their study about teacher educators' development and practice in the mathematics community, learning is seen as the growing use of conceptual tools, which are concerned with participating in the community, including negotiation of meanings.

The social perspective of identity needs consideration. Firstly, identity is elaborated as a general concept in social theories, e.g., by Wenger (1998) and Volman and ten Dam (2007). Being a social being is seen as fundamental to learning and, furthermore, as Wenger (1998, 145) states, building identity is associated with negotiating the meanings of experiences as a member of social communities. However, there is a difference between identity in general and identity associated with a particular profession, like being a teacher. The concept of 'identity' needs to be elaborated in more detail in applying it to 'becoming a teacher'. Experiences and communities of practice

like teacher education and school communitites are of special interest (e.g., Coldron & Smith, 1999). Besides, the learning process as well as belonging to a community is directed towards a particular outcome, 'becoming a teacher', and the special knowledge and skills needed as a mathematics teacher.

Secondly, the basic perspective in social theories is collective. An individual develops through learning in the community and what the individual engages with in interaction with others. Experiences and the meaning of contextual issues depend on each individual; for example, through choices and the strength of engagement (Côté & Levine, 2002; Danielewicz, 2001). In this research, the special interest is student teachers who go through their developmental process in teacher education with special features.

Thirdly, modes of belonging are crucial for development as a teacher, the notion being that a community of practice can become a learning environment only if those three modes of belonging are combined effectively (Wenger, 1998). The context of teacher education can be seen as one of the communities that student teachers are engaged in and within which the process of becoming a mathematics teacher operates. A student participates in various communities of practice, teacher education being one. The ideal case is that teacher education as a community of practice would be a learning environment in which the ideal image of a mathematics teacher offered in the study programme as well as actions and interaction fits into the personal trajectory for identity formation. Becoming a member of a school community is also fundamental to the process of 'becoming and being a teacher' (Danielewicz, 2001, pp. 111-130). However, in teacher education, students are more members of a community of teacher education than of a 'real' school community. School as a community of practice has a minor part in this phase of the process because of the limited amount of teaching practice.

Contextual influences

A contextual perspective is one way to approach professional identity, focusing on constructions of professional identity in academic communities (Archer, 2008), the teaching profession within social traditions (Coldron & Smith, 1999), development of teacher identity in a changing educational environment especially related to cultural issues (Samuel & Stephens, 2000), and the significance of contextual forces (Assaf, 2008; see also Goos, 2005). Research on identities situated in contextual framework has concentrated on both sociological and political issues as well as special features of the environment in which individuals participate (Collinson et al., 2009; see also Settlage et al., 2009). The present focus is on the significance of contextual issues such as traditions and environmental influences for professional identity development.

Identity formation can be regarded as socialisation into the teaching profession. From the collective viewpoint, the focus is on the influence that tradition and shared conceptions have on individual development. An individual has to be able to handle various educational traditions and to adapt within contextual influences. In Côté and Levine's model (2002), the relationship between social and personal identity level deals with socialisation processes (see Figure 2). Coldron and Smith (1999) list four larger social traditions that form the social space in which the individual makes craft, moral, artistic, and scientific choices, traditions which illuminate different aspects of being a professional teacher. Coldron and Smith claim that a narrow view of 'good teaching' should be avoided, and that teachers should be aware of a plurality of approaches to teaching, beside being able to think critically. Assaf (2008), who examines professional identity from the socio-cultural perspective, thinks that contextual forces are essential for shaping teacher identity through interpreted experiences. Shifting professional identity is seen as a response to contextual forces in the school environment described under three main categories: professional beliefs, instructional practices, and the school context including the teacher's roles.

One should not see traditions simply as restrictive social structures, but as the way to socialise in becoming and being a teacher (J. Cohen, 2008). Traditions are important for understanding and modelling issues arising from practice. Coldron and Smith (1999) use the term 'active location' in their analysis of the construction of teacher identities in social space, which they define as the range of possible choices an individual must make. They approach the socialisation process by defining the relationship between agency and social forms (see also Freitas, 2008). Professional identity is located as a dynamic and not fixed phenomenon in the social environment, and 'being teacher is a matter of 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' (Coldron & Smith, 1999, p. 712; see also Gee, 2000). They engage MacLure's idea (1993) that identity is something that an individual uses in relations with other people. An individual's location, professional identity, is a socially given meaning for socialisation, and it is determined biographically through personal choices. Samuel and Stephens (2000) examine the socialisation process in changing educational environments, conceptualising changes through cultural, political, historical, and social significances. Identity is seen as a tool for coping with contextual factors and the possibly controversial demands that individuals face in the educational community. Samuel and Stephens emphasise the importance of cultural influences for the professional environment and the cultural context influencing teacher role identity.

In all, external demands and personal aspirations are both driving forces in the development of teacher identity (Brown, 2003; Walkington, 2005; Assaf, 2008). Both Brown (2003) and Freitas (2008) have examined changes that take place in student teachers' views of conceptualising mathematics and its teaching. Student teachers seem to be reluctant to change their views of teaching and learning mathematics despite activities provided to disrupt their preconceptions. Besides, Brown (2003) claims that social practices cannot be separated from personal engagement

which involves emotional reactions related to mathematics. The meaning of the teachers' own voices in participating in their own professional rationalities is essential. According to Brown, it is problematic when social practices force the individual to move strongly in a particular direction, and at the same time, individuals are obliged to produce their own teacher identity. Freitas (2008) highlights the importance of critical awareness of existing collective understanding of teaching and learning.

Some notions regarding contextual factors of school practice and teacher education emerge in the literature (e.g., Danielewicz, 2001). According to Davies and Ferguson (1997), teacher education fails to address the needs that emerge from the school reality, like dealing with behavioural problems and cooperation with parents. Both issues relate strongly to school reality and cultural changes in education. Goos (2005) has examined how personal and contextual factors in the classroom shape the pedagogical identity of a novice teacher in the sociocultural framework. In her work, pedagogical practices and beliefs that novice teachers have about integrating technologies into secondary mathematics education are of interest. Teacher actions in the classroom have been examined in the light of three zones based on Valsiner's model (1997): (1) the zone of proximal development associated with individual undeveloped but emerging skills (ZPD), (2) the zone of free movement that is related to environmental constraints and facilities (ZFM), and (3) the zone of promoted action which is about an expert's guidance and the opportunity to promote actions (ZPA). The idea is that the three zones have to be balanced in order to make development possible.

However, as Atkinson (2004) claims, offering the proper learning environment with stimulating activities for student teachers is not simple. Teacher identity cannot be influenced directly nor can student teachers adopt all the knowledge and skills offered during the teacher education

programme. Korthagen (2004) suggests appropriate interventions to influence the various levels of presented in Bateson's model. Only the learning environment and behaviour of a teacher can be observed directly. In teacher education, the formation of identity may be influenced through outer levels in four ways: (1) by creating a suitable learning environment (environment), (2) by modelling and contingency management (behaviour), (3) through instruction, training and coaching (competencies), and (4) by conceptual-change approaches (beliefs). Attaining conceptual change is the most difficult. In order to do this, it is important to be aware of what students bring with them and to stimulate them to reflect on their personal beliefs and experiences (see also Walkington, 2005).

Boundaries between internal and external

In the review of the on-going process of identity formation, the process of 'becoming a teacher' has been approached separately from the internal and external perspectives. Both are needed for the elaboration of teacher identity formation (Beijaard et al., 2004). The boundaries between external and internal processes need to be examined here. In Côté and Levine's model (2002), it is the interactional level and engagement in activities of everyday life that intermediates external and internal processes.

The notion of 'going public' (after Danielewicz, 2001, p. 60), i.e., that an individual engages with interaction through self-presentation as a teacher, is essential. Danielewicz (2001) emphasises the meaning of public involvement and the role of an individual in making the process of 'becoming a teacher' visible to others. Once a person declares a desire to become and be a teacher, other people start to take this into account as well. Since an individual is considered to have an active role in identity formation, commitment to the developmental process and taking a role as a teacher in public is important, as Knowles (1992) states. The concept of 'going public' refers to conscious actions towards interaction, but as Gee (2000) points out, the process of engagement in interaction

with others and positioning oneself also has deliberate, conscious, active, or tacit dimensions. Interaction with others is conditional on uncovering the inner process to a certain extent by an individual.

Confronting the boundaries between individual and social levels of identity necessitates the idea of manifesting the state of identity to others through self-presentation (after Côté & Levine, 2002). In the case of student teachers, one way to manifest one's own state of teacher identity is to take a role as a mathematics teacher in the classroom. As well as being situated in the specific classroom context, it is a shared and lived experience in interaction with others above all (after Wenger, 1998). Practical experiences and the opportunity to see oneself as a teacher are regarded as essential for formation of emerging mathematics teacher identity during pre-service teacher education (e.g., Danielewicz, 2001; see also Kagan, 1992; Knowles, 1992). The authority associated with a role as a teacher is something that a teacher should have over students. According to Danielewicz (2001), it means the power required to educate effectively as a teacher manifested in classroom control.

Danielewicz (2001) uses the concepts of public self and private self to distinguish between internal and external processes (cf. ego and personal identity in the model by Côté and Levine, 2002). Student teachers need to be recognised as teachers by others and, in addition to this public image, should be able to combine both social and individual perspectives of identity without severe conflict. How well internal and external perspectives interconnect with each other is especially meaningful for the person who is engaged in the development process. As Samuel and Stephens (2000, p. 478) conclude, a teacher should develop a professional identity which 'sits comfortably with their sense of self and maintain a balance between satisfying the requirements of state and society and providing the source and impetus for change'. However, manifesting a state

of teacher identity is problematic for students if they are unaware of their being and needs as prospective teachers (Danielewicz, 2001; see also Arnon & Reichel, 2007).

Identity formation, or identity-making after Danielewicz (2001), is an iterative and recursive process. An individual reflects on his or her own being and the state of identity on the basis of feedback and the responses of others (e.g., Beijaard et al., 2004; Jenkins, 2004). Danielewicz (2001) describes the process as a series of try-outs including representations, seeing others' reactions, and receiving feedback, revising, and then re-representing. Danielewicz points out that interaction takes place through communication as well as other activities during teacher education (see also Gee, 2000). The notions of similarity and difference with others are at the heart of identity (Jenkins, 2004; see also Gee, 2000). Individuals shape and reshape their identities through identification as well as through distinction. Similarity and difference from others can be considered as an external force for reshaping identity as well as something that makes the state of identity recognisable. As Danielewicz (2001, p.10) discuss, we all form notions of others based on categorising, simply comparing similaritities and differences.

RESEARCH QUESTIONS

This chapter sets out the research questions, starting from the original research task formulated at the very beginning of the procedure. This qualitative educational research was originally designed to answer the question 'What is the process of teacher identity formation like in mathematics teacher education?' However, since only in the later phase of the research was the understanding of the researcher clear enough to formulate more specific research questions, the chapter defining the research questions is located here after reviewing the research literature.

Teacher identity manifests itself through the three levels presented in Côté and Levine's model (2002), in which the interplay between an individual and others in a particular context was seen as essential for identity formation. However, even if identity is both individual and social, an individual is the one to identify with and be identified with becoming and being a teacher. An individual has a leading role through constructing a professional identity and being the one who becomes a teacher through the processes that take place in a social environment (e.g., Beijaard et al., 2004; cf. Wenger, 1998). Consequently, the interplay between the context and the individual is related to how one attains teacher identity and constructs understanding of it. The present approach is conceptual (after Beijaard et al., 2004) meaning that it is possible to examine teacher identity through conceptualisation of one's own understanding. The original approach to teacher identity was based on Gee's idea (2000) that identity is something recognised by an individual self as well as by others at a particular time and place. An individual is seen as one who has primary access to the inner processes of identity formation. S/he is able to conceptualise an understanding of the state of teacher identity as well as what the understanding of others is. Furthermore, others indirectly influence the developmental process through social interaction, and similarly, the mediated social understanding of being a teacher may be attained through conceptualisation.

Teacher identity can be approach only through conceptualised understandings of the state as a teacher.

The research questions have been formulated based on comprehension of the nature of teacher identity formation, which has emerged from theoretical conceptualisation in the literature. In the theoretical part, teacher identity has been approached through three main perspectives: characterisation of teacher identity, the significance of the image of an ideal teacher directing the developmental process, and the notion of an on-going process of teacher identity formation. In fact, the overview of research literature has already addressed some of the need to understand the process of identity formation by constructing a theoretical conceptualisation for examination. Three main notions proved to be crucial to teacher identity formation on which the research questions are based. Both individual and social perspectives are revealed through these notions.

Characterisation of teacher identity

The first subset was characterisation of teacher identity that forms a basis for discussing what is associated with being a professional teacher in general and what is actually recognised by the individual and others. Characterisation makes it possible to discuss teacher identity, from both an individual and social perspective (see Beijaard et al., 2004; see also Fajet et al., 2005). Two subsets of characteristics associated with teacher identity, cognitive and affective, were defined based on research literature and the contextual features of the teacher education programme, within which identity formation is examined in this research. The state of teacher identity may be profiled through different aspects, i.e., considering the meaning of each characteristic as a part of the whole image. What is seen as desirable and valuable feature of a teacher is value-bounded in relation to the context. In this research, the context of Finnish teacher education and shared conceptions of being a good teacher have been influential. The first research question is

How is teacher identity profiled through its cognitive and affective aspects?

Approaching teacher identity through the present and ideal images

The significance of the image of an ideal teacher was the second theme used to approach teacher identity. The main idea in identity formation is the change towards something, here the intention to become a (good) teacher. On the one hand, an individual constructs an understanding of being a teacher by reflecting on the present state (ʻHow am I at the moment?') and the desired state of teacher identity (ʻHow would I like to be in future?') (Sfard & Prusak, 2005; see also Beijaard et al., 2004). The process of change is understood as closing the gap between these two states. From the individual perspective, the image of an ideal teacher, i.e., what is seen as desirable to aspire to, paves the way for individual development. However, the way the ideal image directs individual development is dependent on how strongly it is linked with personal goals that the individual sets. An individual has an active role in setting personal aims for further development. On the other hand, the ideal image is seen as a level at which individual and social aspects have an interface. Through social interaction, an individual becomes acquainted with socially shared conceptions of an ideal teacher and, furthermore, reshapes his or her own understanding by filtering social influences (Côté & Levine, 2002). From the social perspective, the focus of the research is on the image of an ideal teacher that is provided in teacher education. The second research question is thus

How do the present image of teacher identity and the image of an ideal teacher shape the process of teacher identity formation?

The on-going process of teacher identity formation

The third subset concerns teacher identity as an on-going process of change. Teacher identity is seen as a dynamic and continuously reshaped entity that is elaborated in the socio-psychological framework (Côté & Levine, 2002; see also Bohl & van Zoest, 2002). The formation of teacher identity can be examined through conceptualised understandings of the notions regarding

becoming and being a teacher. The on-going process involves both internal processes and external processes that function in social interaction with others. On the one hand, an individual constructs a subjective understanding of reality in terms of internal processes, filtering socially mediated influences and internalising them as a part of his or her own view. Previous internalisations, personal background as well as previous experiences are essential in this process (Nelson, 2008; Samuel & Stephens, 2000). The individual gives meaning to experiences through which the changes in understanding of teacher identity take place. On the other hand, identity formation is a socially embedded process, in this research, taking place in the teacher education programme. Contextual influences such as the meaning of traditions and socialisation processes have an important role. Boundaries between external and individual levels are of interest (Danielewicz, 2001). An individual engages with social interaction by manifesting his or her own state of teacher identity through everyday life, and is consequently able to reflect on this state as a teacher based on the feedback. In this research, the formation of teacher identity is understood as a serie of changes in understanding of the state of emerging teacher identity. The third research question is *What is the formation of emerging teacher identity like from the viewpoint of change?*

THE CASE STUDY APPROACH

I will now discuss the paradigmatic background of this research in order to articulate the underlying assumptions of this kind of educational research, qualitative case study. As Guba and Lincoln (2005) state, inquiry methodology is not simply a set of universally applicable rules or abstractions. They bring up the major issues confronting all paradigms clearly, which are the ontological, epistemological, and methodological bases (see also Denzin & Lincoln, 2000; Lincoln & Guba, 1985). These are the issues which need to be addressed in any underpinning research paradigm, including case study research that is not related to any particular research paradigm, as Luck, Jackson, and Usher (2006) suggest (see also Stevenson, 2004; VanWynsberghe & Khan, 2007). Luck et al. (2006, p. 108) in the context of nursing sciences argue that 'case study offers a flexible, pragmatic yet rigorous approach to research that is practical and suitable for nursing research'. The starting-point here can be considered to be educational practice.

Case study as an educational research approach is understood in various ways. According to Stake (2005), case study is a particular choice of what is to be studied. The case itself is the issue as well as what can be learned about it. Bassey (1999) argues that the educational case study approach is especially useful for developing educational theory that illuminates political and educational practices (cf. Patton, 1997). He identifies three subsets of case study: (1) theory-seeking and theory-testing case study, called instrumental by Stake (1995) (cf. Yin, 2003), (2) story-telling and picture drawing case study, called intrinsic by Stake (1995) and descriptive by Yin (2003), and (3) evaluative case study, which is regarded as a basis for the case study approach adopted by Patton (1997). My *instrumental* interest in the formation of teacher identity was the starting-point for constructing the study design and carrying out the research procedure. The focus of the case study is on the phenomenon itself, especially the formation of emerging teacher identity that takes place

during the programme, and the use of empirical cases is for understanding this contextualised process better. Patton (2002) calls this basic educational research.

The origin of this research was a practical interest in understanding the process of becoming a teacher within a particular teacher education programme. As Biesta and Burbules (2003) state, alluding to John Dewey, the point in doing educational research can be regarded as getting at knowing the practical phenomenon better as well as improving educational practices (see also Patton, 1997 and 2002). Even if this research neither aims at directly evaluating or improving educational practices, practice, for example, the particularities of the cases, has been the point of departure (see Stake, 2005). Furthermore, since characterisation of teacher identity and being professional is context bound, and therefore, it is possible to draw conclusions for improving the programme based on the findings, pragmatism is seen influential to the study.

The paradigmatic background of the research

Even if this research is not engaged with a particular paradigmatic background, pragmatism directed the way the research was originally conducted. Pragmatism can be seen as emerging primarily from writings of three American thinkers from the end of the 19th century and the first decades of 20th: C. S. Peirce, W. James, and J. Dewey. According to Biesta and Burbules (2003), Deweyan pragmatism proposes neither a specific procedure for conducting educational research, nor any specific research method. The pragmatist perspective is that the transactional framework allows us to understand knowledge as a function of and for human action, and human interaction and communication in thoroughly practical terms. Although pragmatism is not discussed here as a philosophical tradition in itself, the most important consequences of pragmatism for educational research and for designing case study research need to be considered. Firstly, according to Biesta and Burbules (2003), the relationship between action and knowledge appears in the attempt to refine and support day-to-day practice. Moreover, objects of knowledge are then instruments

appropriate in dealing with the everyday problems. This also leads to bypassing the questions related to reconciling 'scientific truth' with 'everyday life truths'. Secondly, the relationship between educational research and educational practice is not traditional. In other words, the question is not about applying theoretical information to practice but of cooperation and coordination (see also Stake, 2005). Thirdly, pragmatism provides a way of thinking about the objects of knowledge as instruments for action and, furthermore, different objects and different perceived worlds provide opportunities for action. Finally, intersubjectivity is the issue instead of objectivity and relativism.

The case study approach seemed to be appropriate for the research, the way to achieve understanding of teacher identity formation. According to Stake (2000), the power of the case study approach is capturing the case as a bounded system and exploring experiences in practice (cf. Yin, 2003). It provides an opportunity to extend our direct experiences. Reality is seen to consist of experiences and perceptions of all those, both teacher educators and students, involved in the study programme. This research is associated with an interpretive and naturalistic approach, sometimes called the constructivist approach, as the main idea is to understand unique individual experiences that take place in social interaction and are given meaning in social reality (Bassey, 1999; Stake, 1995). There is no single truth as all perspectives are meaningful and valued in the process of examining the case. Furthermore, there is no one ideal way to develop as a teacher. However, the case study approach enables one to see issues through a researcher's eyes and add theoretical construction to experiences (Donmoyer, 2000).

However, as Puolimatka (2002) suggests, pragmatism is problematic because of its basic idea of truth. Truth is based on utility and usefulness in practice, somehow combining 'scientific truth' with practical truth. Stake (1995) describes qualitative research of this kind as a non-determinist

and constructivist approach. Qualitative inquiry used as a research approach is subjective and intersubjective as well as rather open (cf. Patton, 1997). However, it is a challenge to conduct research in such a way and to manage to find truth in that sense. A criticism of case study research is the disadvantages of the kind of knowledge that is obtained. From a traditional perspective, generalisation has been a problematic issue to be confronted in research of this type (e.g., Flyvbjerg, 2006; Hammersley & Gomm, 2000). Case study is about capturing the particularities of the case, about understanding the bounded system itself. Controversy between the emergence of generalisation and the particular case is insuperable. By contrast, Lincoln and Guba (2000) discuss transferability and fittingness, which are defined as congruence between the context of the research and the context to which the results could be applied. Related to the possibility of achieving truth, Puolimatka (2002) also mentions that, despite the problematic issues related to reliability and the theory of truth, educational reality is accessible to some extent based on everyday experiences through qualitative research.

Methodological choices

A description of the issues related to study design and methodological decisions appears in what follows. As Hammersley and Gomm (2000) point out, there is no standard way to do case study. In this research, case study is seen as a method and a research strategy rather than a paradigm (Stake, 1995). In an instrumental case study like this (after Stake, 2005), the case is of secondary interest, playing a supportive role and facilitating our understanding of something else. However, the case is explored thoroughly and the context is elaborated to enhance our understanding. After defining the purpose of the research, the case(s) need to be defined and boundaries set for data collection (Stake, 1995). Students and teacher educators illuminate the process of teacher identity formation in two ways. Individual development is elaborated through the student perspective, those who become teachers. Each case as a whole has been considered in order to be able to understand the meanings of these contextualised experiences.

The case of teacher educators has been composed collectively to illustrate the social environment in which individual development is situated. The empirical part of the work is based on multiple cases.

First, depending on the purpose of the research, a case study might be either qualitative or quantitative in nature (Yin, 2003). In this research, the purpose has been influential for research design and qualitative strategy, meaning that naturalistic inquiry based on qualitative data and content analysis has been chosen in order to learn about identity development through individual experiences (Patton, 2002). Practical issues, not simply a need to understand developmental process have influenced the decision-making. Furthermore, as Hammersley, Gomm, and Foster (2000) remark, multiple case studies allow us an insight into causal relations and knowledge that could be generalised theoretically. In this research, multiple cases are examined to better understand the patterns of student teacher development and the role of the programme in supporting development.

Second, the inductive approach, where the researcher is interested in each participant's experiences without delimiting or pigeonholing, provides a point of departure. The research does include, however, elements of the deductive strategy, as examination of the phenomenon is outlined in terms of the theoretical framework of teacher identity formation which is augmented by practical notions. The aim is to merge the patterns related to teacher identity formation in the programme rather than impose some predetermined, deductively derived construction. As Stevenson (2004) points out, description of the case by using abstract concepts and a theoretical framework needs to be transparent enough to transform knowledge for others and to be obedient to the authencity of experience.

Third, the relation between partial and holistic approaches also appears in the case study approach (Patton, 1997). As Stake (2000) states, particularities of the case are of interest. Each student case here forms a bounded system with its own particularities. Description of the social perspective, however, is formed collectively and particularities make sense as part of the whole. A researcher needs both holistic and partial approaches at the same time.

Fourth, as it concentrates on identity formation and 'what is really happening', the research might be described as naturalistic by nature (Patton, 2002; see also Stevenson, 2004). However, it is not purely naturalistic because of the data-gathering process and the presence of the researcher, which might possibly have an effect on the student teachers. Intentional manipulations were avoided in order to have an opportunity to have a look at typical procedures within the programme, even if the study design can be seen as creative and practical. Furthermore, the view of change in this research is dynamic (Patton, 1997). The approach to identity formation was action orientated and aiming at revealing developmental outcomes in the formation process.

Last, Stake (1995) claims that interpretation is a major part of all research, especially in a case study. The researcher draws conclusions on the basis of the data gathered. Furthermore, he describes a good case study as reflective, patient, and willing to see another side of the research issue. Fundamentally, the researcher tries to preserve the multiple realities, the intersubjective world according to Biesta and Burbules (2003), sometimes even contradictory views. Thus, the researcher matters.

The role of the researcher in the research process

My own role as a researcher needs to be described in order to help readers to see my potential influence on the research process and to be able to evaluate the study (Stake, 1995; Tuomi & Sarajärvi, 2002). Some researchers regard this as the basis of confirmability of the research that

needs to be discussed as a part of its trustworthiness (Miles & Huberman, 1994). The role of the researcher intertwines with subjectivity and biases in research with an interview process both in the interview situation and in the analysis phase (Seidman, 1998; see also Kvale, 1996) Stake (1995) emphasises the various roles that a researcher might have in course of the process. The roles through which I clarify my stance relate to relationships between the phenomena, the participants, the researcher, and readers of the report.

Firstly, Stake (1995) identifies the case researcher *as a teacher* who tries to teach readers about the case and find the right words in order to comprehend. The researcher's role in informing others and in delivering knowledge gained through the research is essential. Here, the relationship between the researcher and members of both scientific community and teacher education is essential. I worked as a junior researcher in the Department of Applied Sciences of Education (the former Department of Teacher Education) starting in 2003. Beside research activities, I have also been responsible for teaching pre-service primary school teachers in mathematics education and supervision in a teaching practice school. However, I have not been involved with subject teacher education as a teacher educator but as a coordinator in co-operation between partners responsible for the teacher education programme (Lavonen et al., 2007). Therefore, testing draft ideas and preliminary findings with potential readers has taken place in seminars for developing the teacher education programme, for example.

Secondly, the case researcher might be seen as an *advocate*. In reporting the study, a researcher tries to convince readers of conclusions that have been drawn and the reasons for them. Some values underlying interpretation need to be declared. My basic education, which must have influenced my stance as a researcher, is in both educational sciences and university mathematics. I originally graduated as a primary school teacher, but I also have experience in studying university

level mathematics as a major subject and philosophy of life as a minor. Based on my own experience as a student, both teacher education and mathematical education are familiar and easy to identify with. However, I have not experienced the particular teacher education programme of this research through personal participation, either as a teacher educator or as a student. I regard my position as an outside member of the community of subject teacher education as helpful in understanding and interpreting the cases.

Thirdly, the case researcher can be seen as an *evaluator* (see Stake 1995). The role of a researcher in qualitative research is central when the emphasis is on the quality of activities and processes, portraying them in narrative description and conclusions based on interpreted evidence (e.g., Patton, 2002; Seidman, 1998). Knowing various aspects of the programme has been of help in the research as well as being acquainted with all the actors. In this matter, I have presented my ideas and preliminary study not only to make them more understandable but also to make sure that those responsible for implementation of the programme are aware of my project and have an opportunity to comment. The role as evaluator is particularly relevant in research on teacher identity formation and the phenomena that need to be recognised by the individual and by others (Gee, 2000).

Stake (1995) promotes the idea of the case researcher as *biographer* and *interpreter*, which concerns the interrelations between the participants and the researcher. The researcher is seen as an agent of new interpretation and new knowledge. My task has been to describe in detail the separate student cases, like story-telling, thus giving readers an opportunity to evaluate my research and interpretations. Each student case comprises a bounded system approached holistically. The basic interpretation and reporting the cases is grounded on gathered interview data but, in order to improve my interpretation, I have also taken a close look at additional data

and tried to picture each case based on informal knowledge and fleeting notions through interactional contacts with them. A researcher should guard against writing to fit a stereotype (Stake 1995; see also 2005). In describing the processes of each student, my intention was to take into consideration the meaning they gave and how they saw the process. My own experience and understanding of the contextual influences have helped in this process.

Altogether, firstly, experiences in mathematical education and educational sciences in the pre-service teacher education have surely influenced my understanding of the individual processes. However, the process that students get involved in during the teacher education programme is not so familiar as to prevent examining it openly. Secondly, my experience as a teacher educator has been of help in understanding and constructing the reality from the teacher educators' viewpoint. Thirdly, my role as a coordinator has been essential for the research project, especially my ability to interpret and make contacts with the research participants. These three roles combined together have been crucial to my ability to carry out the research in meaningful way.

Conclusions concerning the paradigmatic background

This chapter has dealt with the paradigmatic background of the research and the foundation of methodological choices in qualitative case study, starting with the idea that this instrumental case study is embedded in the framework of pragmatism. The meaning of three aspects related to epistemological and ontological views are essential according to Biesta and Burbules (2003). Firstly, the relationship between theory and practice needs to be discussed. Theoretical knowledge is intertwined with practice and one cannot discuss them separately – objects of knowledge can be seen as doing rather than knowing something. This interplay is reflected in the design of the present case study and, as Biesta and Burbules (2003) claim, through the research procedure. This occurs in transforming the particularities of the cases into systematic and conceptual form. Secondly, the relationship between knowledge and reality, the idea of objects of knowledge as

opportunities and possibilities for action, is specially addressed in methodological choices. Study design and defining the research question reflect the multiple perspectives of various participants, not only through selecting a different kind of research participant, like students and teacher educators, but also through resources and choices in the data analysis. My role as a researcher is to intermediate this intersubjectivity. Thirdly, the question about the nature of knowledge that is seen as intersubjective according to Biesta and Burbules (2003), is contextual and practical and, most importantly, always related to foundational aims and values (cf. Stake 1995; see also Patton 1997). In all, educational research is fundamentally for education, and educational knowledge should lead to more intelligent practice.

CONDUCT OF THE RESEARCH

This chapter describes the overall view of the research procedure, including the cases, data-gathering process, and analysis. First, the research context that influences the whole process, especially defining the cases in the study, is portrayed. The selection of cases is then discussed and the data-gathering as well as data handling and analysis processes are elaborated in detail. Lastly, a summary of the research procedure concludes the chapter.

Defining the research cases

This qualitative case study consists of multiple cases, those of student teachers as well as teacher eductors. The research context has to be well known to be able to design the data construction and before that, choose the cases to be examined (Stake, 1995). The reasons for sampling and making practical decisions have to be described clearly in order to explain the contribution that the participants make to the research particularly (Patton, 2002). According to Miles and Huberman (1994), defining the case(s) not only concerns people as research participants but situations and context to be examined. The context, here the teacher education programme at the University of Helsinki, and the research task are both influential in the selection of the cases and for the overall study design. The practice is an essential starting-point for a case study of this kind.

The data is based on insights provided by two kinds of participant: students who are actually becoming teachers and whose professional identity develops, and teacher educators, who are seen as purposeful informants on the contextual and social surroundings. Consequently, the selection of the cases differs. As Schofield (2000) states, the possibility of generalisation should be considered when selecting the cases, and in his opinion, something typical, ordinary and common should be investigated, and careful case selection should reveal something new from such typical cases (cf. Flyvbjerg, 2006). Thorough description of the case and the context clarifies how and why it is seen as typical (Patton, 2002). Only then is generalisation within the context possible (see also

Stake, 2005). However, systematic selection of typical cases is associated with the idea of being able to describe the whole body of possible cases and their typical features (Hammersley et al., 2000). Beside selecting the cases for their typicality, information-oriented selection is one possibility according to Flyvbjerg (2006). The cases are then selected on the basis of the potential to cover various perspectives of the research context.

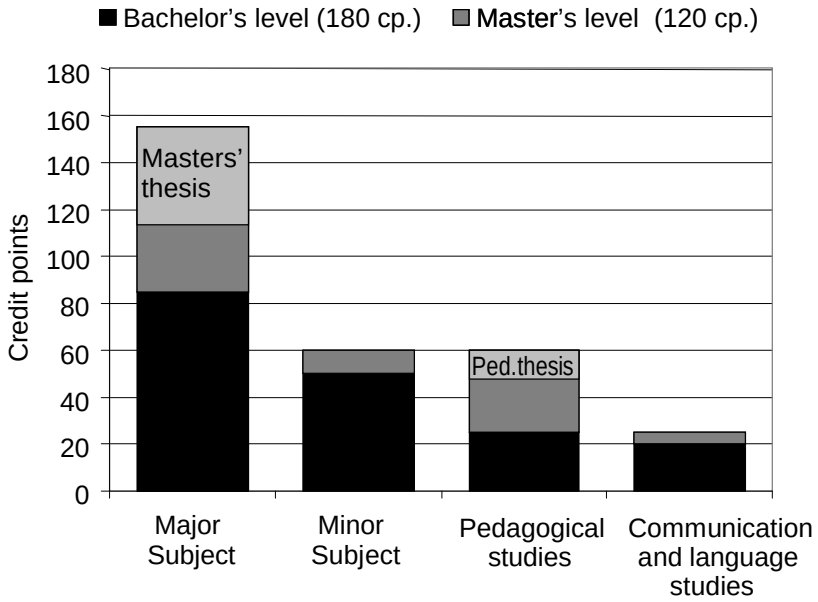
In this research, 'mainstream' students for whom the study programme is mainly designed were selected for the student cases. This kind of strategy suits well with the idea of testing and completing the theoretical framework (Flyvbjerg 2006; Yin, 2003). Multiple cases are needed to enhance researcher understanding of processes and phenomenon more generally (Miles & Huberman, 1994). The teacher educators, however, who gave an insight into the study programme, were deliberately selected with an information orientation (Patton, 2002). The teacher educators represent the various viewpoints on the context in which individual formation takes place. Since the point was to get a coherent view of the study programme, research participants were selected according to their positions in the programme. Each student case represents an individual case, through which development is examined, as in instrumental case study defined by Stake (1995). However, the teacher educators form a collective case study in which the shared understanding of teacher identity is the key issue.

Mathematics teacher education as a research context

The mathematics teacher education programme is outlined to provide an overall view of the research context. First, since the formation of teacher identity is examined focusing especially on the early steps in becoming a mathematics teacher, several courses and modules of the teacher education programme are described to establish the context within which student teachers act. Even though formation of professional identity is not merely influenced by teacher education or restricted to the official educational framework, elements and activities of the study programme

are considered to be essential for identity formation. Second, in addition to its influence on individual development, the research context has had an impact on the design of the research and on the usefulness of the findings.

The research is on mathematics student teachers who will be qualified to teach mathematics and another school subject, like chemistry or physics, in grades 7-9 in the lower secondary school (students of 12-16 years old) and grades 10-12 in upper secondary school (students of 16-19 years old). At the University of Helsinki as well as other Finnish universities, master's studies in university mathematics are the main component of the mathematics teacher education. The programme consists of a master's degree pre-service teacher education programme (300 cp[1]), which takes approximately five or six years to complete (see Figure 3). The programme consists of mathematical education, i.e., university mathematics as a major (150 cp), another school subject such as chemistry or physics (60 cp), and a year of education (60 cp) including supervised teaching practice modules (20 cp). In addition, the programme includes language and communication courses.



[1] 1 credit point (cp) means approximately 27 hours work.

Figure 3. The structure of the teacher education programme at the University of Helsinki

Some essential features of the programme are discussed in more detail because of its importance for the research. The Department of Mathematics and Statistics is responsible for mathematical education, which is the same for all bachelor's level mathematics students despite their intended specialisation. In master's courses, the aim is to deepen students' knowledge of real numbers and analysis in general. However, two special mathematical courses are provided for prospective teachers at master's level; one course on geometry (10 cp) and another for student teachers focusing on integrating university mathematics with school content (12 cp). Mathematical content knowledge courses are based on the same structure as other university programmes in mathematics as a discipline. The notions about the students' need for help in learning university level mathematics and in combining separate pieces of mathematical knowledge together has led to improvement in tutoring of all students (Oikkonen, 2009; see also Lavonen et al., 2007).

As illustrated in Table 1, the educational studies are divided into four sections: general educational courses (13 cp), mathematics education (17 cp), educational research (10 cp), and supervised teaching practice periods (20 cp). The main idea is to help students to combine educational theories with practice and their previous knowledge of mathematics. The need to combine theory with practice is to be addressed by combining different courses together through timing and contents. In addition, portfolio assessment work is also used to help students form a coherent view of what is provided during the courses. (Lavonen et. al, 2007)

Table 1. The structure of the educational courses in mathematics teacher education programme

Educational studies			
General courses in education, teaching	Mathematics Education 17 cp.	Educational research 10 cp.	Teaching practice 20 cp

and learning 13 cp.			
- Psychology of development and learning - Special needs education - Social, historical, and philosophical basis of education	- Psychological basis of teaching and learning mathematics - Curriculum development and planning of teaching - Evaluation of teaching and learning of mathematics	- Research methodology in education - The teacher as a researcher seminar - Minor thesis in education	- Supervised teaching practice (basic, applied and advanced) - Reflection supported by portfolio assessment work

Although students may apply for the teacher education programme at each phase of their studies in mathematics, the courses (60 cp) provided by Department of Applied Sciences of Education are usually completed after the 4th or 5th year because of the structure of the programme. The constraint is that students have to complete enough courses in mathematics and another school subject, like physics or chemistry, to ensure that they have sufficient expertise in content knowledge before entering the first teaching practice period at the end of the first half of the educational studies.

The main organising theme of the research-based teacher education is to promote the teacher's pedagogical thinking. In other words, being a professional is not only based on expertise in separate knowledge domains, like mathematical content knowledge and pedagogical knowledge, but also on being able to apply such knowledge and skills in practice (Kansanen et al., 2000; Lavonen et al., 2007). The teacher education programme can be described as a highly academic way to educate prospective teachers when cognitive knowledge and skills are critical to the research-based programme. Firstly, in practice, all mathematics student teachers complete both a master's thesis in their major subject (30 cp) and a minor educational thesis as a part of their courses in mathematics education within the educational studies (10 cp). The aim is to achieve

thinking skills both regarding subject matter and pedagogical issues as well as skills for continuous professional development in the future. Students not only deepen their understanding of central concepts and familiarize themselves with research literature and methods, but are given an opportunity to experience being a reflective practitioner, as a professional who may act as a researcher in future work (see also Westbury et al., 2005). Secondly, the teaching practice is included only in the educational study year, and students have responsibility for no more than approximately 30 hours of lessons.

Student teachers

The student participants were selected among those taking a major in mathematics and who had decided to become a teacher, i.e., those who wanted to specialise in teaching and learning mathematics through educational studies as their minor subject. In practice, student teachers participate in university mathematics courses at the Department of Mathematics and Statistics (subject department) among all other mathematics students, especially for the first three or four years. Moreover, only some mathematics students make a decision on future specialisation at the beginning of their university studies. The majority settle on teacher education after a couple of years at university. The student teachers who participated in the research were selected among so-called mainstream students in mathematics teacher education, whose needs the programme is primarily designed to address. There are also special groups of students who do educational studies after their master's degree in mathematics or engineering, for instance. However, because of differentiation in their educational backgrounds, which is not specifically considered in the programme, concentrating on mainstream students was a conscious choice.

First, all mathematics students able to particpate in the research, i.e. those students taking a major in mathematics and who participated in most educational courses during the academic year 2005-2006 had to be found. The students also had to be willing to participate in the research. In practice,

because of the structure and timing of the programme, these students could be reached in early autumn just at the beginning of the educational studies. In order to contact all the possible participants, the researcher visited the first small-group meeting for portfolio assessment work by mathematics student teachers. The research project and the main idea were briefly introduced to the students. In this phase, the role of the researcher, the position as a staff member with no direct involvement, particularly with the secondary teacher education programme, was clarified. After the introduction, students were asked to write about themselves as a student (Appendix 1). Based on the information given, all possible voluntary students, 21 altogether, were contacted. Three dropped out of the educational course during the first semester, leaving 18 students as research participants altogether.

To ensure that there were enough participants by he end of the academic year, the data was gathered from all eighteen. It was already obvious that only a few cases could be included in the research report. The selection was based on the research task and contextual features. First, students with special status or an exceptional educational background, like a doctoral degree and university degree in engineering, were exluded in order to focus on so called ‘mainstream’ cases that the teacher education programme is primarily designed for. Then, as further selection was needed, two were chosen on the grounds of their background information and general familiarity with the possible cases. The idea was to capture two student cases through which teacher identity formation within the teacher education programme could be examined. In practice, the first two cases with sufficient conceptualisation of the developmental process were selected in order to assure the emergence of the phenomenon.

There are two reasons for this solution. First, by selecting two ‘mainstream’ student cases, the nature of teacher identity formation could be examined embedded in the context of teacher

education (Schofield, 2000). The case study approach is intended to uncover processes and patterns of individual cases, using the case description to make transforming the findings possible but not to generalise anything in a traditional way (Lincoln & Guba, 2000; Stake, 1995 and 2005). Furthermore, as Grossman (1990) has argued for her study design, since teacher development always involves an individual, expanding the number of cases would not meet the requirements of generalisation. On the other hand, the selection had to be made before thorough data analysis because of the practical constraints of time and other resources. Without specific and in depth understanding of all cases based on data analysis, the cases to be elaborated in detail were selected by chronological order.

Two cases, John and Mary, are presented in this research report. Even though the results are not based on comparisons between individual images of each student's teacher identity, some general notions about their backgrounds at the beginning of their educational studies can be of help in showing who the student research participants were (Table 2). First, at the beginning of the course, the research participants differed from each other because of their various motivational backgrounds. John was somewhat uncertain about his motives for applying for the teacher education programme. He had originally wondered what subject his personal interest would be. Mathematics became his major subject during his university studies. He pointed out that the meaningful learning experiences he had had in mathematics itself were the reason for his choice. Furthermore, becoming a teacher provided him with an opportunity to have a real occupation. The case of Mary is different, as she was motivated and stated that becoming a teacher was her first choice. The only decision she made was whether to become an elementary school teacher or a secondary school mathematics teacher. Second, neither of the students had work experience as a substitute teacher. This is understandable because of their ages; at the time of the research, John was 29 years old and Mary 25. Third, both were taking a mathematics major and, by chance,

physics as a minor subject to be taught in school. However, their backgrounds differed regarding previous studies in education. John had done some educational studies beforehand but Mary had not.

Table 2. Background of the student participants John and Mary

	John	Mary
Motivation for applying for the teacher education programme	John is a strongly self-regulated student who wants to study issues of his own interest. He regards himself as suitable for the teaching profession but it is only one possibility among others for him. One reason for becoming a teacher is pragmatic, as he discusses the opportunity to have a job in the future.	Mary has always wanted to become a teacher. She hesitated only between whether to apply for elementary or subject teacher education. According to Mary, she drifted into studying university mathematics after graduating from high school with good marks. She became inspired by mathematical education and decided to combine her desire to become a teacher with this particular subject.
Work experience as a teacher	John does not have teaching experience in school, only some experience in giving private mathematics lessons	Mary does not have teaching experience in school, only some experience in leisure activities with youngsters
Age	29, started university in 1997	25, started university in 2001
School subjects (major and minor subjects)	mathematics and physics	mathematics and physics
Previous studies in education	previous studies in general educational sciences (no specific teacher education courses)	no previous studies in education at all

The collective case of teacher educators

The other perspective for the process of teacher identity formation was based on conceptions of teacher educators, who were involved in the mathematics teacher education programme. The idea was to examine the overall view of becoming and being a mathematics teacher provided during

the study programme through aim setting and study implementation. Each teacher educator has conceptions of becoming and being a good (mathematics) teacher, relating both to an ideal image in general and study activities that should procedure individual development. However, since the individual teacher educator has a limited opportunity to influence and interact with students within the teacher education programme, the conceptions of teacher educators as a whole are of interest.

Information-oriented selection based on particular criteria, purposeful sampling according to Patton (2002), was used (see also Flyvbjerg, 2006). The mathematics teacher education programme is somewhat fragmented because of multiple subjects and rather small courses in different topics. As the idea of sampling was to select teacher educators so as to represent all sections of the programme, the structure of the programme and the different courses were the starting-point. Therefore, all educators responsible for teaching, mentoring or planning the programme were regarded as possible participants for the research, approximately 60 teacher educators altogether.

In practice, a teacher educator who would be a good informant in the research was the one with an opportunity to influence the programme implementation through teaching and planning. Each teacher educator in question was listed according to the various sections included in the programme. First, all sections of the programme, mathematical education in the Department of Mathematics and Statistics, teaching practice in university practice schools, and both mathematics education and general educational studies in the Department of Applied Sciences of Education were to be represented. Second, those teacher educators who had a central role in the programme implementation and had participated in co-operation in programme development were highlighted. Furthermore, the selection was not only based on the number of lesson hours or their official position in the programme but was also influenced by the role that individuals have in

developmental co-operation between university partners. An information letter was sent by e-mail to the key persons who were selected to be the participants (Appendix 2). The only challenge in selection was to find the key informants for mathematical education, because only a couple of courses are provided specially for mathematics student teachers and people in charge of the courses change almost every year. All educators included in the original selection agreed to participate in the research.

The collective case of teacher educators has been gleaned from interviews with 11 participants altogether. All sections of the programme, and by the same token, all partners involved in the programme, were represented: mathematical education relating to studies in university mathematics (2), general educational studies (4), mathematics education (2), and teaching practice (3) included in the section of educational studies. As one can see, the selection of the research participants is not based on the amount of study according to credit points but on the idea to gather data that would reveal influences on teacher identity during teacher education as richly as possible (Patton, 2002). Next, a brief overview of each participant is given to show what kind of key informant the collective case is based on (Table 3).

Table 3. The background of the teacher educators

Teacher educator	**Role in the teacher education programme**	**Department represented**
TE1	responsible for the course in special needs education	Department of Applied Sciences of Education
TE2	responsible for the course in general education	Department of Applied Sciences of Education
TE3	responsible for the course in analysis	Department of Mathematics and

		Statistics
TE4	responsible for the advanced course for student teachers	Department of Mathematics and Statistics
TE5	teaching practice supervisor	University teaching practice school
TE6	teaching practice supervisor	University teaching practice school
TE7	teaching practice supervisor	Teaching practice school
TE8	responsible for the course in developmental and learning psychology	Department of Applied Sciences of Education
TE9	responsible for the courses in mathematics education	Department of Applied Sciences of Education
TE10	responsible for the course in the philosophical, sociological, and historical basis of education	Department of Applied Sciences of Education
TE11	responsible for the courses in mathematics education	Department of Applied Sciences of Education

Teacher educator 1 (TE1) was responsible for the course in special needs education as a part of subject teacher education for the first time. According to him, the topic of the course was his speciality through previous teaching experience as a university lecturer and research activities, but the context of subject teachers was something new. Despite the experience as a teacher educator and research-based knowledge about the topic, TE1 felt that the framework of the course was too broad and a challenge for a single person. Consequently, TE1 had a real need for co-operation with other educators in planning the course content and for discovering the coherence conception of the study programme. Framing the course specially for prospective subject teachers seemed to

be a challenge for him. Besides, he claimed that it was essential to take into consideration the background of subject student teachers, e.g., work experience and study history.

Teacher educator 2 (TE2) was responsible for a course in general education. He had wide experience as a teacher educator in all pre-service teacher education courses as a professor of general education. TE2 emphasised his essential role in implementation and further development of general education as a part of teacher education. TE2 was worried about the marginal role of general educational issues in the teacher education programme for secondary school teachers. TE2 did not find co-operation with other teacher educators essential, the reason being the busy schedule and, more importantly, that there is no special need for co-operation because of the clear framework for different courses and division of responsibilities in programme implementation.

Teacher educator 3 (TE3), who represented the Department of Mathematics and Statistics, had long experience as a mathematician and researcher as well as university teaching experience in mathematics. Mathematics is his main motive for involvement in teacher education, but he has become interested lately in development of teacher education and teaching mathematics. In fact, it is not obvious whether TE3 should call himself a teacher educator or not. Courses on bachelor level mathematics are for all mathematics students despite their intended specialisation. To be a teacher educator is more likely to involve administration like marking and supervising master's theses. However, TE3 finds cooperation with other teacher educators relevant, even if he thinks the individual teacher educator has a minor role and limited opportunity to exert influence.

Teacher educator 4 (TE4) also represented the Department of Mathematics and Statistics. For TE4, teaching and being a teacher educator was as important as research on mathematics. Furthermore, TE4 had taken a degree in pedagogy for higher education as a part of his university

work. However, as was the case with TE3, T4 did not categorise himself necessarily as a teacher educator in being responsible for courses in university mathematics for all students. He has been one of the active participants in cooperation to develop teacher education representing the mathematics department, but he still stated that cooperation with other teacher educators had no central role in his work, which is more about educating all mathematics students in general and teacher education is only marginal.

Teacher educator 5 (TE5) was a supervisor at a university teaching practice school, both in lower and upper secondary school mathematics. He emphasised a strong commitment to his work and willingness for further development as a mentor, beside being a mathematics teacher. TE5 had a couple of years' experience as a mentor. He described his role as an educator as divided: while he felt like a mentor during teaching practice periods, he felt more like an ordinary teacher at other times. Personal needs, which should be addressed if possible, should be the basis in mentoring the students. TE5 found cooperation within the teacher education programme valuable, especially with other mentors in university practice schools.

Teacher educator 6 (TE6) was an experienced teacher educator with a long career at a university practice school. He was also responsible for teaching upper and lower secondary school mathematics, beside being a mentor for student teachers. He prioritised his role as a mathematics teacher over being a teacher educator. In practice, pupils in the classroom always come before the needs of teaching practice as part of teacher education. In general, TE6 described his role as a teacher who also does his share in the teacher education programme. He valued cooperation with other teacher educators. He claimed that more detailed and clear standards for mentoring and evaluating students would be of particular help. TE6 seemed to regard his role as a teacher educator as personally meaningful.

Teacher educator 7 (TE7) represented the so-called ordinary field school, in which teaching practice periods, especially the second practicum called applied teaching practice, takes place. He worked as a mathematics teacher in secondary school for a couple years after graduation before taking a role as a mentor. TE7 stated that it is easy for him to identify with the role of the mathematics student teacher. Taking a role as a teacher educator was also an opportunity for him to reflect on his own activities in the classroom but, first and foremost, he highlighted the importance of teaching practice periods for individual development of students. He also saw cooperation with other teachers as a resource.

Teacher educator 8 (TE8) was responsible for the course in developmental and learning psychology in the subject teacher education programme. Beside the general course for all student teachers, he had also a role as an educator for psychology student teachers. He had been involved in teacher education for approximately for the last ten years in all. In his opinion, his expertise is especially about issues related to interaction and about how to educate students' skills for social interaction. TE8 discussed the lack of time for doing research because of teaching obligations. Cooperation with other teacher educators has occurred, especially with others responsible for the developmental and learning psychology course.

Teacher educator 9 (TE9) represented the Department of Applied Sciences of Education, especially the courses in mathematics education. She was one of the educators responsible for the studies in mathematics education including portfolio assessment work, the educational minor thesis, and courses in mathematics education and methods. She had long and extensive experience in teaching mathematics both at school and university. Beside practical experience, she was also active in the educational research community, which was one of her reasons for becoming a

teacher educator. It was also an opportunity for self-development. Cooperation with other teacher educators was one part of her role as an educator. Interaction with teaching practice mentors was of particular significance.

Teacher educator 10 (TE10) was responsible for the course in the philosophical, sociological and historical basis of education in all teacher education programmes at the Department of Applied Sciences of Education. This experienced teacher educator originally transferred to work at the university because of his desire to complete his doctoral dissertation in history education. The development of the course in question has been his responsibility for several years. According to the interview, TE10 has taken the implementation of the course as a challenge because of the large number of students and the extensive framework of the course content. However, his role as a teacher educator has been meaningful as TE10 is able to teach in his research field. Collaboration with other educators was restricted to those who are responsible for the group activities of the course.

Teacher educator 11 (TE11) represented the modules of mathematics education. TE11 was an experienced teacher educator in mathematics education with a mathematical background and long experience in pre-service teacher education. In practice, TE11 was responsible for the course in the educational minor thesis and lectures in mathematics education in the programme. TE11 is intimately engaged with research activities, and regards it as possible to really know something only through research. Educational research, especially on mathematics education, was seen as strength for him as a teacher educator. Co-operation with other teacher educators takes place mainly within his own research group. However, TE11 reflected on the need for more general discussion on values and the principles underpinning the teacher education programme.

The data-gathering process

As Stevenson (2004) states, pre-structured cases including pre-designed data collection procedures are needed to ensure that investigation is focused expediently (see also Bassey, 1999; Huberman & Miles, 1994). The data that the cases are based on was compiled during the 2005-2006 academic year. Some decisions had to be made about research procedure, especially the nature of data required and the timetable for the data-gathering process. Firstly, the empirical part of the research comprises two kinds of cases, student cases and the collective case of teacher educators. Semi-structured interviews were considered to be the appropriate approach (see Kvale, 1996). According to Seidman (1998, p. 7), the interview is 'a powerful way to gain insight into educational issues through understanding the experience of the individuals whose lives constitute education' (see also Kvale, 1996; Tierney & Dilley, 2002). Furthermore, the interview data was augmented with written documents to improve interpretation. This data revealed the conceptualisation and reasoning of participants and facilitated seeking data triangulation (e.g., Bassey, 1999; Seidman, 1998; Stake, 2005).

Secondly, data-gathering was completed during one academic year, 2005-2006, during the educational studies that student teachers participated in. Two reasons justify this decision. First, the courses lasting two semesters are practically the only ones targeted specifically at the teaching occupation. Only a few courses in university mathematics are specialized for student teachers, and in practice the process of 'becoming a teacher' is considered mainly in the educational studies. Second, the one-year timetable for data-gathering was a practical choice. Because of the structure of the university courses, particularly when specialisation in teaching usually takes place during the last two years, contacting student teachers would have been practically impossible before they took their educational studies. For many student teachers, the process of becoming a teacher starts only then.

Interviews

The procedure for interviews with student teachers and teacher educators is described separately. The way interviews were designed and what was discussed is particularly significant for understanding the cases, and thus, for understanding teacher identity formation (e.g., Seidman, 1998). Kvale (1996) points out that there are no special rules, procedures or techniques to be followed (see also Keats, 2000). It is about making decisions on the reflective level, based on knowledge of the field, particularly in accordance with the research purpose (Stake, 1995).

Interviews with the student teachers

Student teachers participated in three semi-structured interviews during the 2005-2006 academic year, similar to the setting of the study by Settlage et al. (2009). The idea of making student teachers reflect on their conceptions and experiences of becoming and being a teacher remained the same in all three interviews. The structure of the interviews, especially the first, was designed on the basis of experiences that the researcher had had in a preliminary study in autumn 2004 as well as research literature about teacher development, as Seidman (1998) suggests. The preliminary research was on student teachers' views on the teacher education programme, especially educational studies as part of the programme (Krzywacki & Juuti, 2005). The data was gathered through semi-structured interviews with ten student teachers. In designing the structure and situational arrangements of the interviews, it was useful to have experience in interview situations and in forming questions beforehand. Carrying out the semi-structured interviews without leading the interviewees was particularly considered.

Before the first interview, all participants were given a brief information letter about the research (Appendix 1). In addition, the first interview was settled on the phone and some discussion took place depending on what the participants wanted to know more about. The role of the researcher and the confidentiality of interviews were explained to the participants. The second and the third

interviews were rather similar, the first one dealing with the main issues and arrangements for the interview situations. The student teachers were thus able to build up a schema of the interview situations and the procedure beforehand based on the first interview. In practice, all interview meetings were carried out at the Department of Applied Sciences of Education, the idea being to make participation in the research as easy as possible. Students were able to integrate the interview meetings with their study activities and no extra effort was needed in this sense. Even more importantly, the aim was to establish an atmosphere in which the participants could feel free to talk about their experiences (Kvale, 1996).

The first interview with the student teachers was based on four themes related to being a good mathematics teacher and becoming a teacher during the programme (Appendix 4). The reason for carrying out the first interview right at the beginning of the educational studies was to elicit conceptions of becoming and being a teacher before the influence of the courses, particularly the teaching practice periods, in which all students teachunder supervision. First, the motivational background for applying to the teacher education programme was of interest (Appendix 3). Students were made to reflect on their reasons for becoming a teacher as well as to talk about their educational history. Second, expectations and personal aims for the courses were discussed in the two phases of the interview. Third, discussion on the conceptions on teaching and learning mathematics started with a question related to school memories, and experiences in school mathematics. Even if that was not the particular topic of the research, it was a good phase to start further discussion of being a good mathematics teacher and, more importantly, for questions related to the kind of mathematics teacher the interviewee wanted to become. Specific skills and knowledge were discussed as being related to conceptions of a good mathematics teacher. Last, students were asked to reflect on their view of the best way to evolve into a good mathematics teacher.

At the second interview, which was carried out just before the Christmas break in December 2005, expectations and the main issues of the previous interview connected to the programme were summed up with the student in order to enable discussion of the courses so far in terms of preliminary expectations (Appendix 5). The idea of a good mathematics teacher as well as the features of a good teacher generally was discussed again. In addition to general reflections, students were asked to reflect on themselves as a teacher through their strengths and issues of further development. Students also talked about personal goals in their upcoming studies and in school work. Since the second interview was conducted after five months of their course, it was natural to evaluate the work done so far in respect of their own experiences as a student teacher.

The third interview took place at the end of the educational studies in the spring of 2006. The exact time of the last meeting depended on the final teaching practice period. The last teaching practice lesson(s) of each student teacher were observed before carrying out the last interview. The lessons were recorded, not for use as research data but to share the experience with the participants before the last interview. The students got the video recording of their lessons for their own use at the last meeting. The themes of the semi-structured interview were basically the same as in the two previous ones. Three main themes were under discussion: the notion of a good mathematics teacher, evaluation of the programme, and reflections on the student's own development as a prospective teacher (Appendix 6). Plans for a career were also of interest.

The student interviews, which took place three times during the academic year, constituted the core of the data for the student cases. First, it is important that interaction between interviewer and interviewee be based on trust and confidentiality (Kvale, 1996; Seidman, 1998). Spontaneous interaction was promoted as the research participants and the researcher came to know each other through several meetings during the study year and visiting one of the teaching lessons during the

advanced teaching practice period. Second, the main themes were discussed in all three interviews. While the students had an opportunity to return to these themes and change as well as stability of views can be seen in the data, the previous interviews and discussions about the same topics had provoked the students' thinking. Being conscious of one's own thinking was needed when the data was based on the student teacher's ability to conceptualise personal development and general conceptions of teaching and learning mathematics, especially being a good teacher (Beijaard et al., 2004). In this sense, one cannot regard the continuous procedure of the research as harmful for the validity of the data. Moreover, the times between each interview, approximately three and five months, were long enough for students to forget the details of the previous interview. Only the main themes recurred to them. Last, the interviews were carried out with the idea that students were mostly to make the running, the input as well as the comments by the researcher being minimised (see Seidman, 1998). This worked out well, especially with multiple interviews.

Interviews with the teacher educators

The main theme of the interviews with teacher educators was about conceptions of becoming and being a good teacher. The special interest was their role as a teacher educator, how the aims and implementation of the programme supports individual development of mathematics student teachers during teacher education. The semi-structured interviews took place in April and May 2006 before the end of the semester. All participants were informed about the topic of the research project in general (Appendix 2). However, no further information or specific questions were brought up beforehand. The idea was to elicit the personal theory and basic conceptions of all teacher educators. Interviews based on questions and tasks given beforehand would have produced different data. Replication of the written official curriculum and documentation of statements that teacher educators would have regarded as 'the right answers' was to be avoided.

The interview was initially structured around the themes discussed with the student participants. The main discussions concerned theory derived from educational literature, just as in the student interviews. Furthermore, although the teacher educators' stance on the process of identity formation differs from the student perspective, no specific theoretical concepts related to the formation of teacher identity were used in the interviews. Consequently, the way teacher educators talked about their role in the programme as well as about becoming a good teacher was not provoked by the conceptualisation of the researcher and, at least to some extent, the idea of juxtaposing reflections of teacher educators with those of student teachers was already considered while gathering the data.

A few principles were adopted to address the different roles and background of teacher educators in the interviews. First, the structure had to allow slight modification according to the interview situation and the issues that might emerge individually (Warren, 2002). Only the main themes were the subject of specific questions and further information was brought up when needed. The roles of teacher educators and the significance of single courses varied. For example, the role of a professor of educational science was significantly different from an ordinary mathematics teacher involved in mentoring during teaching practice periods. Second, the design of the interview was slightly modified based on the preliminary interview with an experienced science teacher educator. The four original themes remained the same, but some questions were modified and themes on the role and the background as a teacher educator were marked out for separate discussion.

The semi-structured interview was originally based on four main themes (Appendix 7). First, the interviewee's background as an educator was one of the interview themes, and then the role in the teacher education programme. Some warming up was needed at the beginning of the interview,

and the background and the role of each informant was needed for understanding each teacher educator's perspective. Second, conceptions of teaching and learning in general were discussed. The perspective of the individual teacher was preferred to describing teaching and learning situations. Discussion about being a good teacher differed according to the teacher educators' position in the programme and whether mathematics as a discipline had an important role or not. However, the special interest in mathematics teachers was brought up at least at a general level. Third, the relevance and the main idea of subject teacher education were discussed through reflections on goals, implementation and evaluation of the courses. The idea of the third section was especially to elicit intentions which an individual teacher educator had for guidance during teacher education. The courses and views of the whole programme were discussed separately. The fourth theme was evaluation of the programme and ideas for further development.

In practice, the semi-structured interviews were mainly the same with all educators but the order of the themes and the number of follow-up questions differed according to interaction and the interview situation. The follow-up questions were needed only if an interviewee did not offer further reasoning on that theme (Warren, 2002). The role of the researcher in relation to the status of the interviewee was either collegial or hierarchical. In practice, the social situation of each interview was formed from pre-existing dealings with participants, and the situations turned out to be relaxed enough for such interviews.

Supplementary material

Supplementary material was also used in order to obtain various viewpoints and to confirm interpretations of the interview data (Stake, 1995; cf. Yin, 2003). In the student cases, written products like portfolio assessment work were used to augment the overall picture. The interviews with teacher educators were juxtaposed with the written curriculum for the teacher education.

The cases of student teachers

The supplementary data about the processes of the students during their educational studies included portfolio self-assessment work, an essay about school experiences in mathematics, and feedback questionnaires completed twice during the academic year. The self-assessment portfolios and some other written products were initially supposed to have the more essential role in giving an insight into individual development as a teacher. However, it became clear during the research that written material could only be used as additional source because of the nature of the products as part of the course.

First, in practice, the most essential source of supplementary material was portfolio assessment work. Reflections related to teaching practice periods were useful, especially about personal teaching practice aims when taking a role as a teacher in the classroom and self-evaluation as a teacher afterwards. Second, one way to gain an overall picture of evaluation of the programme by the students and to interpret their attitudes toward their personal development was to look at the feedback questionnaires about their courses. The questionnaire was the same for all students who took the educational studies during the 2005-2006 academic year. The main idea of the structured questionnaire was to assess study arrangements and the overall implementation of the programme. Third, the essay about school experiences as a mathematics student was written at the beginning of the course in mathematics education. The task was to consider school memories in order to become aware of the significance of previous experiences and to understand how one's school background might influence thinking. The most important thing was to extend the picture of an individual student and to have an opportunity to read more about school experiences, especially when this was explicitly brought up by the students.

The teacher educators' perspective

In addition to the data from interviews, the written curriculum for the secondary teacher education programme at the University of Helsinki was used as a complementary source on the conceptions of teacher educators. The main principles of the teacher education programme are documented in the curriculum. Even if the research was not primarily about the context of the teacher education programme itself but about formation of teacher identity within it, the official curriculum provided another perspective on the central aims and the image of an ideal teacher provided by the teacher educators. All teacher educators involved with the programme implementation have done their share in planning and writing the official curriculum which, including the official aims and the description of the intended outcome, can also be regarded as a link between teacher educators and student teachers.

Data handling and analysis

The aim of data handling and analysis in case study research is to achieve data reduction in order make it comprehensible (Huberman & Miles, 1994; see also Tuomi & Sarajärvi, 2002). A researcher has to make decisions about the data presentation, i.e. how the cases and results appear, and what kind of role the theoretical framework has in the analysis and presentation of the results. In practice, the presentation of the data is related to the whole process of empirical study, from the data-gathering phase to the final conclusions and verification of the findings.

The role of theory and some practical circumstances have particularly affected the way data analysis has been carried out and presented. Firstly, data analysis was conducted only partly simultaneously with data-gathering, and some practical challenges did not arise during the analysis. In describing intrinsic case study, Stake (1995) brings up problematic issues of carrying out the data analysis alongside the research process and challenges in making decisions about the procedure parallel with the field work. However, in an instrumental case study (the concept used by Stake, 1995) like this, the design of the research procedure is not so much open-ended as pre-

determined regarding, for example, the cases of interest, timing of interviews, structure of the interviews, and data presentations based on the theoretical background. Besides, separating interviewing and analysis minimises imposing something that emerged in previous interviews on the interview process, as Seidman (1998) remarks. In the first place, the research task was not about responsing to immediate practical situations but understanding the 'teacher identity' phenomenon through several cases. In practice, the analysis took place gradually from January of 2007 to April of 2008. The first interview data on the student teachers was examined in November and December 2005 simply in order to be able discuss the initial expectations of the students in the second interview.

Secondly, content analysis was chosen for the written and verbal data. Content analysis can be used for quantitative or qualitative data, either in a deductive or inductive way (Elo & Kyngäs, 2007; see also Hammersley & Gomm, 2000). Here, the analysis has both deductive and inductive elements. The way content analysis was carried out can be described as a modified version of analytic induction, in which the original theory-derived categories are modified through the analysis of separate cases (Hammersley et al., 2000; Huberman & Miles, 1994; Tuomi & Sarajärvi, 2002; see also Patton, 2002; cf. Elo & Kyngäs, 2007). The basis of data-handling and analysis was theoretical conceptualisation. In practice, understanding teacher identity and its formation was originally extended through the review on research literature. The themes of semi-structured interviews were formed on that basis and used as initial categories in the analysis phase. The original categorisation of the data was therefore established on the conceptualisation fixed beforehand. The initial categorisation was reshaped gradually from case to case by systematic procedure and researcher's intuition alongwith the analysis. Theory and empirical notions have thus been intertwined and influenced each other in both directions.

Thirdly, the data is composed of two different kinds of cases, student cases approached and presented individually and the case of teacher educators, approached collectively. The aim should be, as Miles and Huberman (1994) discuss, to describe and explain the cases as well as to find some kind of causality. The conceptualisation based on the theoretical framework was used as the ground for presenting the case descriptions. Nevertheless, the aim was not to find generalisability or particular patterns in the process of becoming a teacher as would be the idea originally in analytic induction (Miles & Huberman, 1994; see also Robinson, 2000). The cases themselves were of interest, but the case descriptions rely on common conceptualisation. In other words, all individuals have their unique developmental process but this can be displayed through the common features of teacher identity.

The data analysis, qualitative content analysis procedure is presented here step by step. As there were two kinds of data, interviews and supplementary written documents, the description of data handling and analysis is presented in two parts.

Interview data

The data handling and analysis of the interview data of both teacher educators and students are discussed here side by side. There were only a few differences in the analysis processes arising from the dissimilar roles of the participants. In the student data analysis, the notion of change and the basic assumption of an on-going developmental process was relevant, whereas teacher educators gave an insight into contextual influences and the currently desirable image of a mathematics teacher from a social perspective. However, the basic idea in content analysis was the same for both sources.

The data based on recorded semi-structured interviews was initially transcribed as a whole. An outsider carried out this phase of the data handling. Naturally, it was the researcher's

responsibility to make sure that the transcriptions represented the original recordings. All transcriptions were checked by listening to the tapes alongwith the transliteration, and the researcher started to immerse herself in the data at the same time (Seidman, 1998; Kvale, 1996). Only a few mistakes and indistinct spots were corrected, and the first impression of the whole dataset was gained through this revision. In practice, it was arranged that all indistinct expressions were specifically marked in the transliteration in order to assist correction.

The second phase of the analysis was to divide the transliterations into units of analysis (Elo & Kyngäs, 2007; Miles & Huberman, 1994; Tuomi & Sarajärvi, 2002). In order to be able to address the original research task, the appropriate units of analysis needed to be defined, in this case units of flexible length and larger than just separate sentences (see Patton, 2002). Fragmentation was to be avoided, and the connection with the context was important for understanding the reflections of the participants. The overall view of the context was retained by using a unit of meaning which consisted of one or more clauses as the analysis unit. In practice, the original transliteration was read through the second time and was divided into units of meaning. The following is an example on the original interview data of student Mary (S2).

127 H (H = interviewer) well how has it… was the teaching practice?

128 S2 that I have enjoyed practice very much, well I have been to *** high school, which is pretty easy to do your practical training in cos there's no problem with discipline, they [the pupils] are real motivated, motivated to study… so, in that sense it's been pretty easy to teach. But I think that it has been definitely the best thing, teaching practice in the educational [studies]…

129 H ok, why do you think that? S2 well… I just like teaching so much and it's been real good to take lessons there, and without a doubt it plays a huge part that the school is nice as well as the pupils, so, it has made me enjoy it … I think that the chance to

> experience practice and to act as a teacher, do what you are supposed to do, makes it more real and feels that this is really my thing, that it is not just about reading stuff from books…

Some decisions regarding the units were made. All questions and comments by the researcher which led to a new subject or brought something significantly new to the interview situation were placed in separate units. This made it technically possible to examine the structure of the interviews, and later the validity of the data; e.g., how the researcher prompted the interview situations (Kvale, 1996; Warren, 2002). Follow-up questions, which were asked in order to reveal reasons or to get more detailed information about something under discussion, were situated in the same unit as the interviewee's ideas. The distinction was whether the researcher's address was the initiative for the interview process or not. Each unit was then numbered before transferring the data from a word document onto an excel-sheet, in which the analysis was carried out. The numbering made it easy to find the original data when needed.

The third phase of the analysis was to formulate reduced expressions for each unit. All student cases were reduced before continuing with the analysis process. The idea of reduced expressions was to transform spoken expressions into more readable form; e.g., to leave out expressions and mannerisms with no special significance for the content. Along with producing reduced expressions and reading the data for the third time, some notions and working themes were written down. The original categorisation derived from the interview themes was then in mind, but was used more systematically only at the next phase of the analysis. As one can see in the sample of the data units (Table 4), the original expression was situated alongside the reduced expression as well as with further categorising in order to make it easy to backtrack to original phrases when needed.

Table 4. An example of organising the data and reduced expressions

N:o	Original expression	Reduced expression	Preliminary notions and themes
127	H (H = interviewer) well how has it… was the teaching practice?	How has the teaching practice been?	
128	S2 that I have enjoyed practice very much, well I have been to *** high school, which is pretty easy to do your practical training in cos there's no problem with discipline, they [the pupils] are real motivated, motivated to study… so, in that sense it's been pretty easy to teach. But I think that it has been definitely the best thing, teaching practice in the educational [studies]…	I have enjoyed it very much, I was *** and it was an easy school because there are no disciplinary problems and the pupils are motivated to study. It has been easy to teach. Teaching practice has definitely been the best thing in the educational studies.	teaching practice positive experience in practice The teaching practice experience the best thing in the course
129	H ok, why do you think like that? S2 well… I just like teaching so much and it's been real good to take lessons there, and without a doubt it plays a huge part that the school is nice as well as the pupils, so, it has made me enjoy it … I think that the chance to experience practice and to act as a teacher, do what you are supposed to do, it makes it more real and feels that this is really my thing, that it is not just about reading stuff from books…	I like teaching a lot and it has been nice to take lessons. Undoubtedly, the pleasant school environment and nice pupils have helped me to enjoy it. An opportunity to act in practice. It is more real and you feel you are doing your own thing for real, that it is not just reading something in books.	teaching practice pleasant school environment enjoyment acting as a teacher and real school experiences are meaningful

The fourth phase of the analysis of student data was about categorising the data according to the original categories and notions formulated in the previous round. There were originally five main categories in the student interviews: (1) a starting-point and the background of a student teacher; (2) conceptions of good teaching and being a mathematics teacher (the ideal image of mathematics teacher); (3) identification as a teacher; (4) expectations and aims for the course, and (5) evaluation of the course in relation to personal development as a teacher. At this phase, since it was clear that one analysis unit might be categorised in more than one subset, the categorisation was not exclusive either in the student cases or that of the teacher educators. The original categorisation was reshaped by sub-categories (see Appendix 8). In the first version of the categorisation, the main structure remained after the first round of analysis. However, the image of the ideal teacher and the individual developmental process were still separate categories. The conceptions of good mathematics teaching and learning were clarified by different subsets, i.e., knowledge, skills and affective aspects associated with teaching and learning (*Features of a teacher*), but identification with being a teacher was approached at a more general level (*View of self as a teacher*).

Next, after examination of the next two student cases, some modification took place in the categorisation system (Appendix 9). Firstly, separate knowledge and skills as well as affective aspects were grouped into two subsets, the cognitive and affective aspects of becoming and being a mathematics teacher. The cognitive aspects were divided into four sub-categories, three related to teacher knowledge domains and one to thinking skills needed as a teacher. The affective aspect was about personal features and attitude towards teaching and professional development. Secondly, sub-categories related to the teacher education programme were clarified and re-grouped. The issues related to the learning process were brought up alongside various study modules. Thirdly, the structure based on the ideal and present images of being a teacher was

brought into the categorisation. Besides, cognitive and affective aspects were further divided into two sub-categories, general views of being a teacher and views of oneself as a teacher.

In the next phase, the sub-categories regarding the context of teacher education and evaluation of the course were modified (categories starting from 400, see Appendix 10). However, given the research focus, the evaluation of the teacher education was not of interest and is not reported here in more detail. On completing categorisation of the cases, three main subsets were formed: conceptions of teaching and learning mathematics, the personal process of becoming a teacher, and the teacher education programme supporting the individual process (see Appendix 11).

Table 5. The final version of main categories and higher order headings

Sub-categories	**The main category**
General view of teaching and learning A teacher and teacher competences (a teacher as a person)	Conceptions of teaching and learning mathematics
Starting-point as a prospective teacher Individual developmental process	Personal process of identifying with being a teacher
Meaningfulness of and attitude towards the course Content and implementation of the course The overall view of the course	Teacher education programme supporting the individual process

In the final version of categorisation, the overall developmental process related to personal identification with the teaching occupation and the approach to being a teacher through separate aspects were distinguished. In the former category, the basis of grouping was in the overall process that a person goes through when becoming a teacher and in those aspects that were associated with the personal process generally. In the latter, the teaching occupation is seen as separate competences, which define being a professional teacher. Two examples are given to clarify the difference (Table 6). It is worth noting that when categorisation of the units is not exclusive, the same unit may belong to one or more subsets.

Table 6. Examples of categorisation of analysis units

John (spring, 314)

Original expression	**Reduced expression**	**Sub-category(s)**
H well… how would you evaluate yourself as a prospective mathematics teacher and also, already being one… what are your strengths? S1 well… probably that… that well… that I have pretty well established a grasp of mathematical content knowledge that I… that I understand what it is about. I regard it as rather important, well, maybe the most important virtue.	*Evaluate yourself as a prospective mathematics teacher, what are your strengths?* I have pretty well established content knowledge; I understand the issues. That is probably the most important.	Mathematical content knowledge: one's own starting-point as a teacher (111)

Mary (spring, 284)

Original expression	**Reduced expression**	**Sub-category(s)**
H did this emerge in practice somehow? S2 well… as a matter of fact I heard that there are some people, already graduated, who like keeping a diary after every lesson, write down some notes in the margin, that 'this was a particularly difficult topic' and then, the next time when taking a lesson on the same topic, it is possible to backtrack to the previous session and see the issues that were difficult and think over how to do it this time… I think that it's something I'd like to do as well, it is a clever thing to do and it is worth	I heard that one already qualified teacher makes notes, like keeping a diary, in the margin of lesson plans, about whether something was difficult. When you teach the same topic next time, you will remember how to do it. I regarded that as wise thing to do in order to have a feeling… and I would	pedagogical content knowledge (120) commitment to development of oneself as a teacher (230)

doing … that I could have the feeling... I could remember next year when teaching the same topic what was particularly difficult about it,	remember next year when the same topic comes up again.	

All cases were eventually categorised using the same system. However, this was only the basis for further examination of individual cases. Since the underlying assumption was that teacher identity and its formation is an individual phenomenon, the analysis was continued by focusing on each student case separately. From an individual perspective, the on-going process that is essential for teacher identity was examined using the three separate interviews side-by-side through various categories, the idea of change being paramount (Beijaard et al, 2004; see also Richardson & Placier, 2001). The notion of change needed to be defined for the data analysis. The students themselves identified the change through self-reflection and their own conscious statements about it. However, since it is not always so conscious or structured that individuals can reflect on it, individual change was also defined by the researcher by examining the possible changes within categories. Similarly, the relationship between the present image and the ideal image of being a mathematics teacher which informs different aspects of the teaching profession was of special interest. In the end, the two student cases are described through the categorisation. Furthermore, as the developmental process was of interest, the main category 'the teacher education programme supporting the individual process' is not reported here in more detail.

The data-handling and analysis procedure of the teacher educator interviews were basically the same as with the student interview data. Because of their different role in the research, the original interview themes were arranged differently. The basis of the data analysis was the four main interview themes: (1) role as a teacher educator; (2) conceptions of teaching and learning mathematics; (3) one's own course(s) as part of the study programme; and (4) the overall view of the study programme. In the first phase, after preliminary analysis of two first cases, only some

minor modification of the categorisation was done (Appendix 12). Two main categories emerged at this phase of the analysis, the starting-point as a teacher educator and implementation of the study programme (Table 7). In the first main category, subsets related to the teacher educator's background comprised the first higher-order setting. In the second, implementation of the course(s) that the teacher educator was responsible for was discussed separately from the overall view of the teacher education programme, the main idea being to identify issues to which teacher educators could contribute or could not. Furthermore, the general conceptions of a good (mathematics) teacher and the particular aims for student teachers attending the courses were distinguished at this stage. These two subsets naturally overlapped, but the idea was to distinguish between personal views that teacher educators had and those that teacher educators wanted to mediate through their courses.

Table 7. The final version of main categories and higher-order headings

Subsets	**The main category**
Role as a teacher educator Conceptions of good teaching and learning (in mathematics)	Starting-point as a teacher educator
Ones' own course(s) as part of the programme The overall view of the study programme	Implementation of the teacher education programme

The division of sub-categories comprising the higher-order settings was clarified in the second phase, after analysis of four cases (Appendix 13). Firstly, the relationship with students was removed to the subset of one's own teaching, and the sub-category related to student selection was created. Furthermore, a need to highlight the role of student teachers among all other students emerged. The role as a teacher educator and visibility of student teachers varied depending on the position that the teacher educator had in the educational system.

In the end, the original categorisation was revised only slightly, and the final version was not significantly different from the original one (Appendix 14). The way the cases were finally to be presented influenced the process to some extent. Firstly, the idea was to create a categorisation system through which all cases of teacher educators, despite their positions in the educational system and their role in relation to the students, could be described and analysed. Teacher educators were treated as separate cases to begin with. The shared categorisation was needed to facilitate conclusions about the various cases as one entity. Secondly, the categorisation of the data on teacher educators has features in common with categorisation of the students. In the

original interviews with both participants, conceptions of good teaching and learning as well as contextual features of the study programme had been discussed. These commonalities made it possible to juxtapose the cases and then discuss them side-by-side.

In the next phase, each teacher educator was studied separately using the categorisation, and case descriptions were created separately from each other as a bounded system. The collective view of the teacher educators was then constructed on the basis of these cases. In the collective case, the main issue was related to implementation of the teacher education programme itself, whereas the individual characteristics of the teacher educators, for example, their overall conceptions of good teaching and learning, were used to help in interpretation. After all, the research was not about the overall conceptions of teacher educators and their personalities as educators but contextual and social influences in the teacher education mediated by them.

Member checking was used as all participants were asked to review the case descriptions for accuracy and palatability (Stake, 1995; 2000; see also Patton, 2002). Since no changes were made to the case descriptions, member checking was more likely to assure mutual understanding and to inform the participants about the outcome. Besides, the participants could only comment on their overall impressions of whether the transcript reflected their personal views or not.

Supplementary material

Material supplementing the interview data was examined in terms of the categorisation systems created for the interview data. The supplementary data was originally structural and expressions were polished more carefully than in interview data, Which meant that the analysis through categorical aggregation was suitable and there was no need to produce reduced expressions as with the interviews (see Stake, 1995). The analysis of this material focused on extending the understanding of the cases and on strengthening interpretation of the interview data.

Supplementary material was thus used only in the second phase of data analysis while producing the case presentations.

In practice, supplementary material such as portfolio assessment work and feedback questionnaires of the student cases was read through several times, and essential information highlighted by categorisation. Supplementary data provided insight into the developmental process that all students were engaged with. However, a critical approach was essential because students had produced the written documents as course requirements according to special guidelines. The written documents were based on their self-reflections but their production was to be evaluated by the teacher educators. According to the students, discussions in the portfolio assessment work were mostly about their genuine reflections, but these were to some extent written to meet the expectations of the educators. Critical viewpoints about the programme and especially doubts about their development or motives for becoming a teacher were not elaborated openly. The issues of validity were addressed through critical dissection. In practice, when the data on the interviews and the statements in portfolio assessment work were in conflict, discussions in the interview, especially direct comments about issues discussed in writing were always regarded as more reliable.

In the case of teacher educators, the written curriculum for the teacher education programme was used to confirm and to augment the understanding attained through the individual cases. Similarly, as in the student cases, the curriculum was analysed while producing the collective case description. The aims and descriptions of study implementation were of special interest in giving an alternative perspective on the contextual features. Descriptions of the data based on the interviews and the curriculum were juxtaposed and interpretation of the interview data was confirmed in this way.

Conclusion concerning the research procedure

The whole research process started with an interest that emerged from practical experience. Empirical notions helped to construct the overall view of the research literature. The qualitative case study approach was intended to address the need to understand the process of becoming a mathematics teacher in the teacher education context. However, at the outset, it was clear that the empirical and inductive approach would not be enough. Familiarisation with the research literature was also needed to clarify the framework of teacher education. This interplay between the theoretical and empirical perspectives influenced the entire research process. Since the empirical procedure took place alongside the theoretical construction, the research procedure cannot be categorised as either inductive or deductive (Patton, 2002; Tuomi & Sarajärvi, 2002; cf. Elo & Kyngäs, 2007).

Theoretical knowledge based on the review of teacher identity research literature influenced the procedure at various turns. First, selection of the cases, especially the need to cover both individual and contextual aspects of teacher identity formation (Côté & Levine, 2002), proceeded from theoretical understanding. The individual process could not been managed without considering the contextual features and socially shared conceptions of what a mathematics teacher should be. The research context is thus described in detail to justify the case selection and convey a sense of its features. Second, the empirical procedure, especially the semi-structured interviews, was carried out on the basic assumption that it is possible to investigate and interpret one's state of teacher identity through individual conceptualisations (Beijaard et al., 2004). Consequently, only manifest content was of interest in the analysis, not latent material (Elo & Kyngäs, 2007). Several interviews were required to examine possible changes and reveal the ongoing developmental process. Each student case was elaborated separately, as an individual bounded system, but the case displays are based on the shared conceptualisation.

The overall research process took approximately four years (see Table 8). By the time of the interviews with teacher educators, the first two rounds of interviews with student participants had already taken place. The interplay between empirical work and constructing the theoretical framework was especially significant for case displays and for the way multiple cases were analysed.

Table 8. The schedule of the research procedure

Time	**Research phase**
2004 *Autumn*	Preliminary study • Data-gathering (student interviews) • becoming acquainted with the context and research literature
2005 *Spring*	Analysing the preliminary study data
Summer	Preparation of the data-gathering (student interviews) Constructing the research framework
Autumn August-September	Data-gathering • selection of research participants • student interviews (1st round)
December	Data-gathering and handling (transcription of the 1st interview) • student interviews (2nd round)
2006 *Spring*	Preparation of the data-gathering (teacher educators) Constructing the theoretical framework
April-May May	Data-gathering and handling (transcription) • student interviews (3rd round)

	• teacher educator interviews
Summer	Reshaping the theoretical framework
Autumn	Data handling (transcription) and analysis
2007	
Spring - Summer	Reviewing the research literature continues Data analysis (the student cases)
Autumn	Data analysis (the cases of teacher educators) Writing the research report
2008	
Spring - Summer	Writing the descriptions of the case displays
Autumn	Writing the research report
2009	
Spring	Writing the research report

TEACHER IDENTITY FORMATION THROUGH THREE CASES

The process of teacher identity formation is examined here through two kinds of case: two individual student cases, John and Mary, and the collective case of teacher educators. First, the separate cases will be presented, and the three research questions will then be answered in the last section, which concludes the results.

Both student cases are treated as individual entities in order to highlight the individual nature of formation of emerging teacher identity, since it is a person who is involved with the process of becoming a teacher and who is actually growing up to be a teacher. The three main theoretical themes underpinning the research questions are profiling the state of teacher identity through characterisation, describing the interplay between the present image of teacher identity and the image of an ideal teacher, and approaching identity formation as an on-going process.

In practice, the first research question regarding characterisation of teacher identity is addressed through elaborating the developmental process of the cases through cognitive and affective aspects of teacher identity. Furthermore, emerging teacher identity is analysed through the subsets of the present and ideal images taking each aspect separately. Changes that may have occured during the process were of particular interest. Therefore, the second research question regarding the present image of teacher identity and the image of an ideal teacher is approached from the individual perspective. The third question regarding the on-going process of emerging teacher identity is addressed, in addition to the changes regarding the aspects on the present and ideal levels, through the overall description of the individual developmental process that is presented. The background of the students and an outline of their motivation as a prospective teacher are discussed first. Since the basic information on these cases is described more in detail in the

previous chapter, the focus now is on the features likely to have influenced the developmental process.

In addition to the individual perspective, the collective case of teacher educators is to give an insight into the social perspective of teacher identity formation and the contextual influences on the process of emerging teacher identity. The image of an ideal teacher provided in the teacher education is examined using the collective case display, which also addresses the research questions regarding the ideal image and characterisation of teacher identity. The collective view of the ideal mathematics teacher is seen in terms of the separate aspects of teacher identity.

Student 1: John

The first student case is John, who was the self-regulating student with motivation for developing as a teacher. John was able to conceptualise his own developmental process quite clearly, and had an equally clear picture of the developmental process that he was ready to engage with. He considered practical experience as essential for his development because of the opportunity to 'witness' oneself in the role of a mathematics teacher. His personal view of being a good mathematics teacher was revealed as in conflict with that provided by teacher education.

Am I going to be a teacher?

The basis of becoming a teacher can be portrayed through three themes that help to describe previous experiences and influential attitudes: a positive relationship with mathematics despite unpleasant school experiences, engagement with self-development, and a relatively clear vision of how to become a good mathematics teacher. First, especially at the beginning of the educational studies, John discussed the difficulty he had had in adjusting to the school system during his school career. It seemed that, at least to some extent, the personal aims that he set for himself during teacher education emerged from his own experiences. His attitude towards mathematics as a school subject had always been positive, despite his negative experiences. His positive

relationship with mathematics was not primarily based on being extremely good at it; he considered himself talented but outperfomance was not something that would have been paramount.

> It is mathematics that interests me and even if I did not always feel like studying it well, I took care that I did somehow (at the time, I was going to be an engineer with a university degree and I knew that mathematics was to be mastered in the entrance examination). (portfolio, autumn 2005)

Furthermore, those negative experiences in learning mathematics emerged from poor instruction. According to John, he was already able to distinguish in elementary school between inappropriate feedback that caused bad feelings and mathematics as a school subject. The first unpleasant experience was about following instructions and inequitable consequences.

> … The tasks were about algorithms and homework was to be done in the exercise book. Instructions for the homework were that you were supposed to leave two empty squares around every algorithm. The last task did not fit on the page, as outlined in the instructions; I should've left two empty squares around it, but had no space on the page to do so. So, I decided to save some space and I wrote the task in a smaller space, resulting in having to do it again although it was correct. I found this unreasonable, but fortunately I understood to focus my hate against the unfairness of the teacher instead of the subject [mathematics]. (portfolio autumn, 2005)

Experiences in the school environment were based on the student's own schooling. John had not been a school teacher before taking teacher education, and only had some experience in giving private lessons. Possibly, therefore, he built his own vision of good teaching and learning in mathematics based on his school experiences at the beginning of the course, throughout which the significance of having enough challenges as a learner and the learner's own active role were the key factors in good teaching and learning.

> … I think it's very motivating when kids can have a certain kind of existential experience in mathematics… for example, when you have an infinite unknown mathematical something, at least for me… those have been the kind of experiences I have thought about, not during my time in school, but later (spring, 313)

Second, John seemed to hesitate over future plans for his teaching career. After a brief experience in polytechnics and university physics as his major, he ended up studying mathematics. John had also taken educational course some years before out of curiosity. However, mathematics had always inspired him greatly, and mathematics mattered to him the most; the teaching profession was only one occupational option amongst others.

> H …well, could you say more in detail how you found your way into education, why you decided to become a teacher?
>
> S1 well I have several reasons; one is that I needed to make the decision about me graduating, and I had already excluded the possibility that I could become a researcher in mathematics, too old for it, and somehow it blew over… (autumn, 23)
>
> I'll act as a teacher as long as I keep learning what it is like to be a teacher and I can familiarise myself with the school world… but I want to be a translator as well… it provides some kind of certainty in my life that if this choice [of being a teacher] is wrong for me as a future career, then I also have another option… (autumn, 27)

Despite the uncertainty about this future occupation, John stated that he was willing and suited to become a good mathematics teacher because of his sociable personality and aptitude for working as a teacher.

> I think the most important reason for the choice of a career in teaching was that it felt natural. I frequently reflect on how to teach or explain something… I think it's important to disseminate knowledge that is of the essence in some way. I believe in the traditional ideal of civilisation and I regard natural science as a triumph of the Western culture… I think

> that I have a strong aptitude for being a teacher. I have many family members who are teachers and somehow I've grown up to become a teacher. A profession is sometimes handed down. (portfolio, autumn)

Thirdly, in general, John could be portrayed as an independent and self-directed student. He had a clear vision about being a good teacher as well as how to become such a teacher already by the beginning of the educational studies. He considered that there was not only one but multiple ways to act as a teacher depending on one's own personality. This principle paved the way for him to become a mathematics teacher during his studies.

> All teachers should teach in their own way, it is… you have to invent your own way of thinking… but like I do… I think differently about these matters from how they want us to think here [in teacher education], and how they teach us here… (spring, 300)

Like many other students, John regarded being active in the developmental process as meaningful. For him, the meaning of his own thinking and challenges in his studies were essential, including educational studies. Learning university mathematics had been such an experience for him. He was optimistic about teaching practice lessons because of the opportunity to take a role as a teacher and to learn practical knowledge and skills, e.g., with the help of video recording:

> … it's useful to see yourself on the video tape, then you notice if you have mannerisms, and it might broaden your mind to see yourself anyway. I think it was a good idea to reflect on posing the questions… I did it rather well, I think the implementation was alright… I also know whether I posed good questions or, for some reason, not in the classroom, but then I might also miss something and it is nice to notice… (December, 146)

The developmental process profiled through characterisation

In John's case, expertise in mathematical content knowledge was the foundation of being a good mathematics teacher. In addition to mathematical competence, he emphasised considering the student's individual learning process and the teacher's support for it.

Mathematical content knowledge

		Autumn 2005	December 2005	Spring 2006
Mathematical content knowledge	**ideal**	Mathematical knowledge and skills are seen as a solid base for being a good teacher. Pupils should be able to rely on the correctness of instruction.	Mathematical competence is the basis for acting as a good teacher, especially in handling dynamic classroom situations. The teacher is then able to focus on relevant issues in teaching mathematics. Besides, a teacher should be enthusiastic about mathematics and be capable of strengthening his own knowledge base.	The basic idea remains the same. Mathematical knowledge is needed for acting well in dynamic classroom situations. A good mathematics teacher is able to think like a mathematician.
	present	**John does not discuss his own mathematical competence explicitly, but he seems to be confident about it.**	**Still seems not to be worried about his own mathematical competence. He states that his strength is willingness to develop his mathematical competence further.**	**He feels that his own content knowledge provides a solid base for being a teacher.**

According to John, mathematical content knowledge is the basis for being a good mathematics teacher in that the ideal teacher should be able to think like a mathematician as well as possess expertise in mathematics. At the ideal image level, the view of what was seen as valuable as a good mathematics teacher neither changed substantially nor was widely reflected on. In general, mathematical competence seems to be self-evidently crucial to being a good mathematics teacher, who should be enthusiastic about mathematics and should strive to improve mathematical competence when required.

> … you should not teach something incorrectly… I haven't thought of bringing this up… of course you have to master the content in order to be able to teach it… I think it is an ethical obligation; for example, that when a teacher is aware of problems in mastering the subject that is to be taught, he should learn it first… (autumn, 123-126)

> One of the important aims [in mathematical studies] is to learn to think in a certain way, like a mathematician, so that when you have a mathematical problem you know how to attack it like you should… then there is calculus, it's good to know that as well, but the most important thing is to learn the mindset … (spring)

After experiences in taking a role as a teacher in the first teaching practice, John highlighted that a solid mathematical base is a tool for planning and implementing lessons, as well as an aid in handling dynamic classroom situations. Since pupils have a right to rely on correctness in teaching, the teacher's knowledge should be mathematically exact and true.

> … I think it's about being ready to answer the questions if the topic is clear in your mind, and essential issues you can decide on at the moment or… you can choose as well… I think that knowing the subject… that you don't get lost… the content knowledge is then needed for being able to, well, to respond to questions somehow and to come up with an answer… (December, 190-192)

> It is essential from the viewpoint of professional ethics that you do no teach incorrectly or insufficiently, even if teaching well is more work than teaching insufficiently (portfolio)

John did not reflect on his own mathematical competence in detail during the developmental process. According to the interviews and portfolio assessment work, he found his own initial abilities good enough give him confidence. John stated that his personal strength is his willingness to find out and to develop his own mathematical knowledge when needed.

> H …well, how would you evaluate yourself as a prospective mathematics teacher… what are your strengths?

> S1 …well, probably that… that I have pretty well established mathematical content knowledge, that I… that I understand what it's about. I regard it as rather important, well maybe the most important accomplishement. (spring, 314)

In John's case, the ideal and the present image of expertise in mathematical content knowledge seemed to be closely connected, which consequently showed a minimal gap between the ideal and his present state as a teacher. John therefore did not have a real need for development in this respect or for setting any further goals.

Pedagogical content knowledge

		Autumn 2005	December 2005	Spring 2006
Pedagogical content knowledge	**ideal**	Mathematics should be taught in a way that everybody can understand. Teaching mathematics is about learner-centred matter; differentiation and taking care of learning of all kinds of pupils.	Still, learners are seen to have a central role in teaching and learning mathematics. A teacher should help in this process through simplifying and bringing up central issues. Learning mathematics should be active, based on learners' existing skills.	A teacher should help students' to learn and encourage pleasure in mathematics. The main aims of teaching mathematics are to gain basic calculating skills, to develop mathematical thinking and to apply mathematical knowledge in the real world. A good teacher possesses an overall view of mathematics instruction.
	present	**John seems to lack practical skills for teaching mathematics in classroom. He emphasises the significance of finding a proper level of abstraction.**	**He thinks that the challenge is not with creativeness or lack of ideas. His practical skills in implementing lessons and considering students' abilities need to be developed further. He feels that he has found his own way of teaching mathematics.**	**The most challenging thing in teaching mathematics is to mediate mathematical thinking in the classroom and make pupils see the beauty of mathematics.**

Expertise in *pedagogical content knowledge* was combined with the skill of providing enjoyable and suitable learning opportunities in mathematics. According to John, learning mathematics takes place through one's own active thinking. Skills in posing mathematical tasks and mentoring pupils in their own learning processes are relevant. It is the teacher's responsibility to support this learning process by simplifying the central topics, and finding the appropriate level of abstraction. A good teacher considers the individual abilities of pupils carefully, is able to differentiate between pupils on this basis, and provide challenges for gifted pupils.

> You should be able to offer everyone some additional tasks for the good ones or something intelligent to read about the topic, for example, something different within mathematics that would develop skills or give them amazing insights… something from advanced mathematics… (autumn, 78)

> There are pupils, like, at different levels and I think the teacher owes those who are more skilful... they have to be given the opportunity to learn, even if there are others in the class who might miss something in the lesson...this would kind of take into account the heterogeneity within the class... (December, 187)

Furthermore, a teacher needs to master the field of teaching and learning mathematics in general and be able to highlight the most essential issues.

> … what is essential in teaching… why in particular this exact topic is taught, why this topic is included in the school course… if you do not master (the view of) mathematics then it soon descends into learning idiotic algorithms, and well… it means in percentage calculation many different kinds of formulas instead of reflecting the concept of the percentage and equations in mathematics books… (December, 200)

In terms of the ideal image level, John first reflected on issues regarding the viewpoint of the learner and the role of the teacher in the learning process. At the end of the studies, John also specified his view of a good mathematics education with three central aims: to gain basic

calculation skills, to develop mathematical thinking, and to apply mathematical knowledge in the real world. In portfolio assessment work, John discussed the meaning of learning objectives and essential values underlying the requirements for a good mathematics teacher:

> It's obvious that teaching objectives and ideals pave the way for the teaching methods being used and at least some methods are being excluded based on these objectives and ideals. If the aim is to guide a person towards self-regulated thinking, to direct them to apply knowledge and skills widely and to take others into consideration, you cannot use drills or any method of conditioning, it's not the best way to achieve the aim… I consider that it's important for them to have a positive view of mathematics as a useful and clarifying tool for thinking, that you don't need to be afraid of or hate the subject, but that it is helpful for you in life, study and at work. (portfolio, autumn)

John had doubts about his own competence in pedagogical content knowledge. He realised that he had no practical tools for implementing lessons in the way he would like to, e.g., in achieving a good level of abstract in instruction. It was challenging for him to make pupils see the beauty of mathematics or to create positive learning situations.

> I have wondered… that what kind of actual methods are there, and then I wondered how to evaluate and how to produce an exam and what kind of questions there should be… if I was made to take a role as a teacher in the classroom, I think those would be the issues that I'd hesitate the most to address… (autumn, 36)

After the first teaching practice, he was able to set more detailed personal aims. He considered creativity in planning the lessons as a special strength for him.

> I seem to come up with ideas very easily, that I have ideas for implementation and for methods and I can implement a lesson that has good content… and certainty for implementing the lesson, that I could carry it out the way I planned… (December)

In the end, despite the need for further development, John felt that he had found his own way of teaching mathematics and reflected on his view of mathematics teaching broadly.

> … there are two stories side by side, a mathematical story like this and then the story of calculus, which is necessary for understanding mathematics, to be able to proceed one has to learn calculus… applications are needed as well… maybe we have many stories side by side, which are followed. Calculus is needed for understanding the main story. (spring, 310)

Altogether, the image of an ideal teacher was reshaped gradually alongside the developmental process without any major changes. According to John, a teacher is the one who is responsible for facilitating the individual learning processes of different kinds of pupils. John reflected on his present state as a teacher in terms of the ideal image, finding that further development was needed in practical skills to be able to implement lessons as intended. He seemed to have a clear notion of good teaching and learning mathematics as well as of the skills required for implementing such teaching. In this matter, the ideal image seemed to pave the way to become a better mathematics teacher.

Pedagogical knowledge and skills

Pedagogical knowledge and skills		Autumn 2005	December 2005	Spring 2006
	ideal	Since a teacher is responsible for pupils' learning, one has to be able to create a positive atmosphere for studying and learning, to motivate and inspire as well as to differentiate. Knowledge and skills in ICT also are needed.	A good teacher has pedagogical knowledge and skills in general for classroom management. As learner-centeredness is the key point for him, skills in management, e.g., giving instructions and guiding pupils' work are important. A good teacher possesses general knowledge about human beings and learning.	A good teacher understands differences between people and their learning processes. From a practical viewpoint, a teacher needs to have routines and skills for implementing lessons in the way planned.
	present	**The willingness to understand and social interaction with pupils is his strength as a teacher. He has some doubts about own teacher authority due to being too pally with pupils. Practical classroom skills need to be improved.**	**John is surprised about the level at which teaching and learning should take place. He recognises that he has to develop his skills in instruction and understanding pupils' basic needs. A challenge is to implement lessons in the way planned, e.g., to keep to the timetable and give clear instructions.**	**Despite the progress in practical issues, he still needs to develop himself. John feels that he is able to understand pupils better in general. Still, it is difficult to evaluate own competence with no solid experience.**

According to John, a good teacher should master general knowledge about learners, learning, and teaching. Pupil-centeredness is the main theme in teaching and learning, meaning that, in practice,

a teacher has to consider the skills of the pupils carefully. Solid pedagogical knowledge and skills are the basis of being able to create a positive atmosphere in the classroom as well as for differentiation.

> If you consider these studies in education and how much you benefit from them… but one should have at least a basic understanding of human psychology, about the mechanisms of learning and memorising; there's been quite a lot of research on those topics, and there's also good contemporary literature in Finnish (December, 217)

At first, John did not explicitly mention the significance of practical skills. With experience in teaching practice, practical skills and routines in classroom management seemed to be more essential. He highlighted the importance of classroom management in general for guiding learning according to its goals.

> … well, the cognitive load should be focused on the topic that is being taught, meaning that the load is not on if it is too difficult to do; for example, if it's difficult to draw a table with four columns and fill the columns with something nice… if it's really difficult, then let's not draw it but let's use ready-made tables… well, somehow the effort should be focused on the right issue… (spring, 321)

Besides, John talked about the importance of real interaction with pupils. General pedagogical knowledge is also of help in this.

> Well, respect for all pupils, this should be the basis for… and a certain kind of honesty towards them and a willingness to meet them face to face, that I think is a good basis for good instruction… (December, 185)

> … it would be nice to have skills in human relations… to be able to manage the situation without the need for strict discipline, that you are able to create this kind of atmosphere in there [the classroom] (December, 226)

At the beginning of the educational studies, John has already realised his lack of skill in managing the classroom as he would like. He was somewhat uncertain about his authority in the eyes of the class, but judged his own skills in social interaction with pupils as fine.

> I could get started… well, I'm a bit scared of being in the classroom, as I have not taught a whole class, I don't think that any major problems will emerge but somehow… how am I going to manage the situations and be able to recognise the right things there, as all kind of things are going on all the time… (autumn, 91)

However, his view of his own competence changed slightly with practical experience. Practical issues like giving instructions and implementing lessons according to plan were better understood. He was aware of a need for further development in mastering classroom situations in general. Particular skills, like giving instructions, were emphasised but were associated particularly with the role of the teacher in the classroom – how he would be able to use all kinds of knowledge and skills in dynamic classroom situations.

> … I should have guided activities in a more effective way, more directly and given more precise instructions, to have concrete models… oral instructions are not enough… I was too optimistic about oral instructions… a valuable lesson for me (December, 152)

> It's really important to master routines as much as you can, for example, keep an eye on the time despite the activity of teaching … it is extremely difficult at first, well, at least I wasn't able to keep things within schedule every time, when something took extremely long by accident… (spring, 356)

The image of an ideal teacher regarding general pedagogical knowledge did not change much during the study year, but the overall picture was modified towards dealing with practical skills. His views of his own competence changed slightly. Before the first teaching experience, he could conceptualise his strengths and weaknesses as a teacher. In actual practice, skills in giving instructions and handling the classroom situations become issues. He found understanding the

pupils' thinking and learning in the classroom situations demanding. The gap between the present and the ideal image was in fact quite substantial. The themes of concern were the same, but because of a high level of abstraction, and especially the lack of solid practical experience, the ideal image of a teacher remained difficult of attainment and self-evaluation was not comprehensive.

Thinking skills and competence for self-development

		Autumn 2005	December 2005	Spring 2006
Thinking skills	ideal	A teacher has to be able to give reasons for his or her decision regarding teaching and learning in the classroom.	Development as a teacher is possible through acting as one and then analysing one's actions. A solid knowledge base is seen as a good basis for further development as a teacher.	As an autonomous professional, a teacher needs to be reflective and analytic about being a teacher.
	present	**John does not articulate this theme regarding his own competences as a teacher.**	**He considers himself reflective by nature.**	**He considers himself reflective by nature, but John criticizes the need to explicate his own development and become aware of it.**

According to John, a good teacher needs to be able to give reasons for decisions made regarding teaching and learning. The starting-point is that there are, as John maintained,

> …naturally, different kinds of good teachers, and it is of the essence that one is able to act as a teacher in a way that is compatible with one's own personality. (portfolio)

At the beginning, he reflected on the importance of being capable of reasoning in order to strengthen his authority as a teacher in the eyes of parents.

> To learn to give reasons for the choices somehow… if nothing else but to spice your own talk… for example, if an angry mother gets in touch … you could spice your talk by using terminology and you could calm her down that way [laugh]… a teacher needs to be able to reason in different situations, it would be good to be able to commit oneself among one's colleagues (autumn, 50)

After the first six months, thinking skills were associated with development as a teacher through analysing classroom actions. A teacher should have a solid knowledge base for further development and to learn new things. Besides, a teacher should be reflective by nature and capable of making pedagogical decisions within the wider context.

> To be a teacher who reflects on his own actions and then is willing to talk about his own teaching… what matters is the mindset, as there have always been good teachers, and the quality of a teacher is not necessarily based on educational sciences… it can be based on something else as well, but it's essential to find a way to think about the quality of a teacher this way, and only this promotes diversity, everyone has to come up with it by themselves after all (spring, 342)

John did not reflect on his own background in thinking skills at all. He considered himself reflective by nature and capable of analysing own actions. However, he did not understand the need for explicating his own thinking process. It seems that becoming aware of the developmental process was neither necessary nor helpful in his opinion. The ideal and present image related to thinking skills and the ability to develop oneself seemed to be removed from each other. Altogether, the image of an ideal teacher did not pave the way for him, even though he found the reflective stance meaningful in his chosen occupation.

> … a good teacher wants to do the job well by putting their own ideals into effect; this leads on to striving to develop personal competence and teaching and this way to observe how these features are implemented in teaching methods, and to develop them when needed. (portfolio)

Affective aspects

		Autumn 2005	December 2005	Spring 2006
Affective aspects	**ideal**	A good teacher is fair and equitable towards the pupils, interested in work and engaged in doing his best. Still, being a teacher should be according to personal characteristics.	A good teacher is willing to get to know the pupils and to interact with them. Besides, interest in their learning is the most important.	Discussion on this matter does not take place.
	present	**John discusses being able to master his feelings. Besides, it is natural for him to interact with other people.**	**John regards reflectiveness and willingness to develop himself as his strengths.**	**No particular statements about the matter.**

In addition to cognitive aspects, John reflected *affective aspects* associated with being a mathematics teacher. Teachers should find their own personal way to perform as a teacher, find a real interest in the teaching profession, and engage with doing their best through a reflective and analytical approach. John listed some features of a good teacher who is willing to do his best as a teacher.

> These constitute [all-round education and genuine willingness to perform well at work] constitute a solid basis for professional ethics, from which, in my opinion, ensue all essential distinguishing features of a good teacher, like objectivity, being stimulating,

> clarity, classroom management, receptiveness to criticism and so on. A good teacher wants to do the job well and according to ideals… (portfolio)

John also emphasised the ethical perspective associated with the teaching profession.

> H well, why is it so important for a teacher to want to make pupils learn?
>
> S1 It is about being genuine as well… a certain kind of getting to work and dedication are needed as a teacher, at least it makes it easier if you really want to… do you want to do your job well and be good for the class, who are the ones learning? This can be reasoned in many ways, but one should be willing to do the job well, and consequently should be willing to produce a good outcome (December, 196)

However, despite a relatively clear view of the ideal teacher, the affective aspect was not an essential part of his present image of himself as a teacher. John mentioned that he is reflective and willing to learn new things by nature. He did not usually identify the requirements of the ideal with his own developmental process as a teacher but rather with his role as a university student.

Identifying oneself with being a mathematics teacher

The overall view of the developmental process that John was involved in during his teacher education is described here through three separate themes. First, John emphasised the meaning of having practical experiences along with his studies, especially taking a role as a teacher. Second, he felt a particular conflict between his developmental process and the contextual features of the teacher education, especially regarding the ideal image provided during the course. However, in the end, he still acquired the will to be a teacher.

The significance of practical experience

The significance of taking a role as a teacher emerged as essential in John's developmental process. At first, he seemed to feel competent and confident enough to take a role as a teacher but,

because of his lack of teaching experience, picturing himself as a real teacher was not possible. According to John, practical experience leads to becoming a good teacher. One cannot learn how to teach through observing; only some critical points can be grasped by analysing other people's actions. It is not just acting as a teacher but also analysing and evaluating the actions afterwards, as teaching practice showed him.

> Everyone has to piece together their own picture, and it's mainly through teaching experiences and then through reflecting on actions during those experiences… it's been a really good thing (December, 167)

> I don't really know how I am as a teacher as I've been a teacher only for a very short time (spring, 316)

At the beginning of the educational studies, he wanted to know more about different methods and practical solutions and, even more essential, he was willing to try them out to find the best for his way of teaching. Since he felt that he had a lot to learn about practicalities in the classroom, he set particular aims for the first teaching practice and for taking a role as a teacher.

> The first aim is to conduct the lesson well enough. I wasn't thinking about trying anything new in the first lesson but to carry it out teacher controlled, concentrating on the topic itself. I'm planning to use inquiry as a method and try to get kids interested, but the main focus is on carrying out the lesson itself. I believe that having an uncomplicated lesson helps me best as an inexperienced teacher… (portfolio)

After practical experience, personal aims became more detailed and related to particular classroom situations for the succeeding teaching practice periods. John came to see the significance of practical skills use generally. Furthermore, his expectations of pupils' priorknowledge and skills became more realistic, but otherwise, no great changes took place.

> I've learned to be more realistic, for example, about what to expect in the classroom and what the reality really is; for example, that you should be prepared for unexpected, that

> some surprising issues can cause difficulty – this has been the most important lesson for me… that you can prepare yourself for what works in the classroom… (spring, 325)

At the end of his studies, he felt that he was about to find his way as a teacher and be able to choose methods suitable for his own teaching style. His preconceptions of teaching and learning mathematics had been strengthened and it became clearer to him what kind of teacher he would like to be in the future.

> Well, applied teaching practice was pretty good… it helped me to start finding my own style as a teacher, meaning how I'm going to act as a teacher, to be in the classroom…then it is about building up the unique style you find and improving it, and then about removing bad elements and replacing them with something that works… it pretty often did feel like I found my own way of doing it (spring, 358)

Conflict with the ideal provided in the course

Although personal aims and the vision of oneself as a mathematics teacher became clearer during the educational studies, John originally had a relatively comprehensive vision of an ideal mathematics teacher and of how to become such a teacher. Furthermore, he was motivated to develop himself. John found the vision provided in the teacher education courses in conflict with his own needs, so strongly that he wanted to avoid 'inconvenient influences'.

> S1 I have constantly kinda fought against achieving my aims, making the goals into reality… well, kinda deliberately [laugh]…
>
> H but has your thinking developed and have you found your own way?
>
> S1 I think it has become clearer what I want… yeah, I do think it has been clarified (spring, 343-344)

First, becoming a good teacher was in his opinion based on his own reflections and developing actions in the classroom. However, he did not consider reflection or being explicit about the

possible changes as a teacher helpful for own development. Only activities focused on his own actions as a teacher seemed productive.

> And I don't want to think about how my thinking has developed, for example… I don't see what purpose it serves, really… I have my way of thinking and it is important that I have my own kind of way of thinking and acting, it's enough, it's constantly tested when facing reality and it either helps me survive or is useless and then my way gets revised, it's at the centre of self-reflection… but writing about it as well? I don't see the point… (spring, 368)

Second, the main idea was to find his own way of being a teacher and a teaching style that was appropriate for him. However, because of his minimal teaching experience, seeking and refining his personal teaching style was still going on at the end of the course.

> Well, I think that all teachers create their own way to be a teacher, their own teaching style, however, in my opinion it is also important to be aware what is happening around you and in the world… that would be/is useful… (December, 212)

> …when you act as a teacher on the basis of your personal abilities, you have to make decisions and think… there's no sense in making people think in a way that doesn't work for them… having different kinds of teachers is an advantage (spring, 401)

In fact, he claimed that educational sciences were not the way for him to develop himself as a teacher but practice and reflecting on his own actions – becoming a teacher is something other than knowledge of educational theories. Furthermore, he found individual educational formulae useless because of the lack of a broader framework in mathematics education. Only those theories and formulae, which were related to his own development and interests as a teacher seemed useful.

> I don't want to underestimate educational research, it has clearly a point, but it can't be… fundamental to being a teacher, I think this kind of diversity should be accepted, cherished, actually… if you emphasise educational sciences, for example, then it leads those who

> don't find it their own thing to sort of falling flat, that you just have a job and you do it… it seems to be the only way, to act as a teacher who thinks like an educational scientist… (spring, 304)

Even if he did not consider himself as a fully competent teacher and he realised the need for further development, the course overall seemed irrelevant for his individual teacher identity formation. His rather strong preconceptions of being a good teacher and high expectations for the course was problematic. He needed to have time for his own reflections in order to internalise meaningful issues, and this was not addressed during the courses, in his experience.

> I would like to see how professor X produces an essay of five pages about a topic that is not familiar to him in advance which should be based on the literature and you have only five hours time; it can't work if you want the essay to be a good one… (December, 254)

The biggest problem was the conflict between his personal aims and the ideal provided in the programme. However, he certainly considered mathematical education at university meaningful.

> Everyone has their own individual way of teaching , then you also have to create your own way of thinking… but I seem to think differently about these issues from how they think here or at least how they want to teach us to think (spring, 300)

> …In my opinion, this highest possible instruction could be a little bit more open-minded, to see the world in a different way… it's also related to the whole issue of being a teacher, not simply about the educational sciences and their way of thinking (spring, 406)

In the future

At the end of the educational studies, almost at graduation, he said, 'there is no harm in being a qualified teacher besides other activities.' Despite his criticism of the course, he was willing to apply for a position as a teacher, especially at high school and to continue the developmental process through practical experience in a 'real' school environment.

> My viewpoint is that this teacher education cannot prevent me from becoming a teacher, well… I think it was like it didn't manage to spoil my willingness to become a teacher… (spring, 346)
>
> … I would like to be a teacher and develop a solid base of professional skills and to qualify whilst working and then after a while I could rethink whether to continue or change my career or… but I am going to work as a teacher… I think this is really… what I want to do but not necessarily for the rest of my life (spring, 420)

Student 2: Mary

The second case is Mary, who was a really motivated student and willing to develop herself as a teacher. However, she was not particularly aware what kind of mathematics teacher she was or would have liked to become. Mary took an open-minded stance on her educational studies, which was to address her needs as a prospective teacher. For Mary, teaching practice was the place to witness herself as a teacher for the first time. Mary highlighted the importance of the teacher's authority in the classroom, the ability to direct different kinds of pupils and to create a positive atmosphere. According to her, being a mathematics teacher was more about genuine interaction in the classroom than about the particular competences that a teacher should possess.

I am going to be a mathematics teacher

Mary's point of departure as a prospective teacher may be described through two themes, an affirmative stance towards schooling and commitment to a developmental process as a student teacher. In general, school had been something positive for her. She had adapted herself to the school system and to being a student without difficulty. Mary did not recall any bad experiences in studying and learning mathematics. It had always been pleasant but sufficiently challenging. One reason she gave was that since she was not too talented in mathematics, she had benefited from school instruction.

> It's been a proper challenge, there have been tasks that really needed some thinking over, how to solve this, just at the right level of difficulty, but not so that it became frustrating, not that I wouldn't get it at all or understand it at all… (autumn, 48)

> No bad experiences come to my mind while I studied mathematics… therefore, it provided me enough challenges, but did not overwhelm me. (portfolio)

Furthermore, she described mathematics lessons during her school days as rather traditional without any 'edutainment'. Later during her education course, she paid attention to different methods and study arrangements that she could use in teaching and learning mathematics.

> In general, I've always liked mathematics and enjoyed the classes despite the fact that my teachers had hardly used different teaching methods at all. Maybe my classmates who weren't so interested in mathematics would have expected to have more stimulating activities. I was happy to have a teacher who mastered the topic and who was truly enthusiastic about it. (essay about school memories, autumn)

The significance of authority as a teacher and relationship with pupils emerged in Mary's reflections. She discussed her teachers with respect and wondered how they managed to exercise authority over pupils and to create a positive atmosphere in the classroom at the same time. She wondered whether those teachers had a special secret. Despite the rather traditional mathematics instruction, Mary had positive experiences in having an active role as a learner while learning mathematics.

In general, Mary was motivated to become a mathematics teacher. Her own schooling also seemed to be influential later in her teacher education. She had no prior experience in school teaching but she had been involved with free-time activities with youngsters.

> I really feel that I want to be in the teaching profession. I want to inspire my pupils to become enthusiastic about what has inspired me. It is naturally quite naive to think that you

> could get the hopeless case in the classroom to be inspired and to experience the joy of being successful. However, that is what I would like to aspire to do as a teacher. (portfolio)

She originally took mathematics at university just because of good marks at high school. She had also considered the possibility of applying for the primary teacher education programme later after getting more additional points for the application from school experience. It took her a year to realise that her wish to become a teacher and her enjoyment of mathematics could be combined. Before that, mathematics had represented an enjoyable interest for her, whereas being a teacher was associated with having a real occupation.

> In elementary school, I liked mathematics already and also dreamt about being a teacher like many other girls. I just didn't understand that I could merge these two… I didn't think of mathematics as a possible profession; it was just a hobby and exercise to improve my thinking… However, during my first year I realised that the teaching profession combines a great hobby, which means mathematics, and a nice job, meaning being a teacher (portfolio)

At the beginning of her educational studies, Mary was excited about having a definite aim of becoming a teacher for the first time in her university studies. In general, she was willing to develop herself as a teacher. She was relatively receptive towards her studies, with an open mind, rather than expecting that particular issues would be addressed. Her personal aims were not so clear and in general she was willing to learn everything that was offered during the year. It seemed that she expected that the image of an ideal mathematics teacher would be clarified for her.

> I haven't really set any… but I try to soak up everything possible, well, like, a sort of an attitude that this isn't all that much, and you try and get as much out of it as possible, and you concentrate all the time and so on… (autumn, 42)

She had particular expectations for supervised teaching practice, which was her first opportunity to take a role as a teacher. Mary expected that, based on the feedback, her view of herself as a teacher could be further elaborated.

> I hope I can benefit from teaching practice as much as possible. Real teaching experience I don't have… I have a sort of a feeling for teaching but, in reality, I start from nothing. However, I want to get as much feedback as possible from my mentors, in order to know what things I do well and what needs to be improved. (porfolio)

As in discussion about school experiences, the idea of the teacher's authority and role in the classroom emerged in relation to personal aims. Mary considered her competence in handling all kinds of situations. She particularly discussed the need to be able to master problematic situations that might arise in the classroom.

> How to act in different situations, that kind of thing I'd like to learn, to discuss problematic situations and to go through how to handle certain situations… when I heard horror stories from my friends, like 'what would you do in this particular situation as a teacher, when…' …well, practical, different kinds of situations (autumn, 27)

Before the first teaching practice and taking a role as a teacher in the classroom, she emphasised her need to have a sense of herself as a teacher. It seemed that she was both insecure about herself as a teacher and not aware of her own image and competence in teaching at the beginning of her studies. Only then it was possible to develop herself further.

> Before the first teaching practice I have several thoughts about teaching and learning, but the main idea here is to get some feeling and confidence for teaching, as well as to gain some readiness for self-development and my own teaching. (portfolio)

The developmental process profiled through characterisation

For Mary, being a good mathematics teacher is founded on mathematical knowledge that is something desirable but not a sufficient condition. She highlighted the significance of pedagogical skills and ability in social interaction with pupils in order to create a positive and encouraging learning environment in the classroom.

Mathematical content knowledge

		Autumn 2005	December 2005	Spring 2006
Mathematical content knowledge	ideal	A teacher has to be enthusiastic about mathematics and know the subject well enough to teach clearly.	After the first teaching practice, she connects mathematical knowledge with the dynamic classroom situation and the teacher's ability to make pedagogical decisions in different situations. A clear picture of mathematics helps her to be logical and clear.	Mary does not particularly discuss mathematical content knowledge in detail.
	present	**Mary feels that her mathematical knowledge seems to be all right, at least according to her marks. Still, some doubts emerge about whether it is enough for being a mathematics teacher.**	**Mary regards her mathematical competence as good enough, at least in certain situations. The level of knowledge is enough for being a teacher, even if not the best possible compared to other students in mathematics.**	**She is satisfied with her pre-knowledge and skills in mathematics as a prospective teacher.**

In Mary's opinion, mathematical content knowledge is a start in being a good mathematics teacher but not something particularly essential. Before starting her first teaching practice, Mary discussed the significance of mathematical knowledge as a basis for clarity in teaching mathematics. Furthermore, an ideal mathematics teacher is interested in and enthusiastic about mathematics.

> … you have to be enthusiastic about it, and you also have to know the content well enough in order to be able to present it clearly and don't have to wonder how it is… in other words, you need to be skilful and enthusiastic (autumn, 68)

After taking a role as a teacher during the first teaching practice, Mary discussed mathematical competence in new way. It became a tool for use in the dynamic classroom situation and for making pedagogically good decisions in the classroom. She saw it as the basis for providing well-structured instruction.

> … if you think about the amount of mathematical education here, it's probably too much compared to what you will need as a teacher, but enough to understand the mathematical background as well… it also clarifies your own mathematical basis, and you know what's being taught and where it all comes from (December, 166)

Furthermore, Mary associated mathematical content knowledge with being confident as a teacher. For her, it was one way to strengthen authority by being able to answer unexpected questions. However, she was not sure whether all university mathematics courses were actually needed and how well university knowledge could be applied in school work.

> After going to a pretty deep level in mathematics, it's somehow really clear in my mind what is taught in upper secondary school, so then it must be quite useful, even if I had wanted to study more things related to teaching, not so much just 'hard' mathematics… maybe I'll gradually realise how useful it is (December, 195)

Before teaching practice, Mary found her own mathematical content knowledge sufficient, at least according to her test results in mathematics courses. Nevertheless, she had doubts about the

adequacy of her mathematical competence for teaching, especially at the upper secondary school level.

> …in upper secondary, if you happened to have somebody really intellectual, then you might be near your own limit, you have to memorise the topic exactly, but… I master the content required for lower secondary school, and some background, and I've managed to get good grades here in all mathematics courses… Well, I don't really know how well I remember it all, but I could recap... (autumn, 99)

> … subject matter knowledge seems to be, however… a little bit … I don't know about it… not sure how well I really know mathematics… (December, 183)

In teaching practice, mathematical competence was put to the test in the classroom. Mary saw mathematical content knowledge as a basis for her self-confidence as a teacher. At first, she seemed to be worried whether she was able to create credible authority, but later she concluded that her mathematical competence was enough, at least in particular situations during the teaching practice. She still seemed to suffer some lack of self-confidence. However, mathematical content knowledge was not something to be further developed in future.

> There might be some situations, especially in upper secondary school, that you might feel insecure about your expertise in the content… how it is and how to avoid teaching the topic incorrectly, that you familiarise yourself with the subject at hand before teaching, to ensure that you really master it, not just that you trust your own expertise (spring, 293)

> H What about your readiness as a teacher?
>
> S2 Well, especially in mathematics, well… I have a feeling for it, I think I have it under control… (spring, 373)

Altogether, mathematical content knowledge was not particularly essential for being a teacher. Mary did not reflect on it more generally, neither the ideal image nor the present image of a teacher. During her studies, Mary became aware of the importance of mathematical content

knowledge for classroom actions and her self-confidence was strengthened in this regard. However, the ideal image did not particularly pave the way for her development.

Pedagogical content knowledge

Pedagogical content knowledge		Autumn 2005	December 2005	Spring 2006
	ideal	A good teacher has to be aware of processes related to learning mathematics and the cumulative nature of the discipline. Motivation through various activities and the teacher's responsibility for presenting mathematics appropriately are emphasised.	A teacher has to be clear and logical, and make mathematics easy for the pupils. Still, it is the teacher's responsibility to make mathematics accessible to all pupils and to make them understand through various methods. Real life applications and motivation are central.	Mary still emphasises that a teacher needs to support the learning of her all pupils through presenting mathematics appropriately.
	present	**Mary does not reflect on this at all at the beginning of her studies.**	**After teaching practice, she recognises a need for development in clear presentation.**	**It is not easy to apply various methods in the classroom, especially in mathematics.**

The relationship with pupils, especially the role of the teacher, proved relevant to pedagogical content knowledge. Mary associated expertise in pedagogical content knowledge with being able to assist individual learning trajectories. She considered that a good teacher is aware of the nature of mathematics learning processes, meaning that the cumulative nature of learning mathematics

needs to be taken into consideration. A teacher should thus be able to follow the students' learning process closely.

> …to be the kind of teacher who could take into account how pupils really learn, so that there would not be total lack of understanding, so one should observe how it is going in the classroom, because mathematics is a bit like having to master the previous piece of information and knowledge before learning anything new… (autumn, 69)

Furthermore, different kinds of activities, like learning games and methods, are the way to inspire poorly performing pupils to learn mathematics. According to Mary, it is the teacher's responsibility to present mathematics appropriately, to be clear and logical enough.

> … for those pupils for whom it is not so easy, well if learning could take place through some sort of a play, well I can't think of any particular play at the moment, but one could create something a little bit different and stimulating that could be used in lessons… (autumn, 71)

> … well, learning could take place in my lessons, so that I could teach so well that pupils could understand it all and they would not need to wonder 'what did she mean by that'… (autumn, 79)

After the first teaching practice period, in addition to clarity of instruction, a good teacher has to have flexible teaching methods, which are the way to motivate and create variety in teaching, to help as many pupils as possible to learn and understand. Mary especially highlighted the importance of motivation and personal interest in studying and learning mathematics.

> … when questions arise, then you could… if you have someone who just does not understand/get it, you could create new ways to approach the topic, to be creative… I got one situation that was just like that… and I couldn't figure any other way to explain it… and for sure, there must be another way to approach it… (December, 181)

> … mathematics is like… in many schools, you need to motivate your class and so on… many pupils are not necessarily able to relate mathematics to everyday life… it is like ʻwhy do I need to study this… so much and this way?'… to know how to motivate, skills for that (December, 169)

At the end of her studies, she also discussed expertise in school content and a need for being aware of those issues related to specific learning tasks that might be problematic. It was not only variety of methods which she considered an answer for supporting pupils, emphasising the importance of the teacher's role in presenting mathematics in a way designed to make learning easier.

> H Do you regard something as particularly important [in teaching mathematics]?
> S2 to be aware of topics that are known to be diffcult to understand or to realise, how to represent the issues clearly, especially for those kids [with learning difficulties]… to be clear enough (spring, 283)

Mary reflected on her own competence related to pedagogical content knowledge only after her first experience in the classroom. In her opinion, she needed to improve her skills in delivery. Besides, at the end of the study year, she realised that knowing several teaching and learning methods was not enough. It was a challenge for her to implement different methods in the classroom.

> …well, I've noticed in myself that I've had to think it over, thoroughly, many times, how to express certain things; what is the order and which words to use when teaching a topic, the order of sentences in order to prevent a blurred flow of information, when you just hope that pupils pick up the essentials and understand it… how to concentrate on what and how to say things… when you have thought it over the night before, you have an idea of how to carry it all out… (December, 157-8)

In all, pedagogical content knowledge was not essential in her reflections on being a teacher. At the ideal level, Mary highlighted the role of the teacher in promoting learning. The ideal image was described in highly abstract terms, and when Mary had no clear view of herself and her needs as a prospective teacher in this phase of her career, the gap between these two levels was considerable.

Pedagogical knowledge and skills

Pedagogical knowledge and skills		Autumn 2005	December 2005	Spring 2006
	ideal	According to Mary, a good teacher is a rightful authority to the pupils. A good teacher handles different situations in the classroom and is able to create a positive and encouraging atmosphere. It is the teacher's responsibility to promote learning for all.	A good teacher is able to support everyone through a positive atmosphere in class and confidential interaction. Still, Mary emphasises the meaning of authority and the role of the teacher as facilitating learning.	Mary emphasises skills for authentic interaction and a need to foster all kinds of learners. A teacher is responsible for supporting learning through clear presentation and motivation.
	present	**Mary reflects on whether she has authority as a teacher naturally and whether she is able to handle classroom management.**	**Authority and relationship with pupils concerns her, especially regarding classroom management. Besides, she wants to develop her skills in delivery in the classroom.**	**She feels that she is able to construct authentic relationships with pupils, but building up a suitable authority is still an issue for her. Classroom management is something to which Mary wants to pay attention.**

Mary discussed the importance of pedagogical knowledge and skills to the role a teacher has in the classroom. She stressed that a good teacher should possess well-established authority in order to be able to provide a suitable and positive learning environment for all pupils. A teacher should handle classroom situations in such a way that an encouraging atmosphere and classroom management could be purposefully combined.

> Not too authoritarian, but to be someone who handles the situation overall, so that there isn't mayhem in the classroom or other problems with concentration or something else… to be able to say in such situation that 'hey, this is something that you should do…' I want to avoid being too commanding, but I also want to be able to sustain an interaction in the classroom all the time (December, 153)

After her experiences in the classroom, Mary also reflected on the importance of mutual trust in interaction with pupils. She discussed how a teacher is able to create confidential and unreserved interaction in classroom, which were essential in creating a positive learning environment.

> … to possess the skill of presenting topics in an understandable way, and also the skill of noticing poorly performing pupils who have not necessarily understood or are too afraid to ask, to be able to notice them… and for example, at the end of the lesson when doing tasks individually, you can ask about other unclear issues, then you don't unintentionally humiliate them in front of the classroom (December, 178)

At the end of her studies, however, Mary stated that teaching methods are subject specific, a key to success in enhancing learning. However, an ideal teacher thinks carefully about suitable methods and study arrangements with different groups, and tries to take special needs into account.

> I remember my teacher with fondness, he had the energy to invent new ideas… I heard him think out loud that he was going to have a lesson, which he had thought of implementing in a particular way, but that it wasn't suitable for the group… it makes me think that even if

> you teach the same topic but it's not appropriate for this particular group, then you conduct the lesson differently with another group… it's something that I want to hold on to… (spring, 304)

Mary, who did not have previous teaching experience, was anxious about her authority as a teacher and about her ability to handle the dynamic situation in the classroom at the beginning of her educational studies, when considering her present state as a teacher.

> … if I'm going to be a teacher in secondary school, for example in X [the name of area]… if I act there as a friend of the students, I'm worried about my authority in their eyes; do I have it at all? It was easy there [in teaching practice school] where everyone wanted to study, it was ok to be like a friend, but in the future, I need to work on this problem… (December, 151)

After her first teaching experience, she elaborated on the issues associated with teacher authority in more detail, paying attention to social interaction with pupils, seemingly concerned about her ability to create authentic relationships with them particularly. However, feedback in teaching practice confirmed her view of herself as friendly and approachable. Being a teacher is largely about one's role in the eyes of pupils and the way of being able to control interaction in the classroom.

> I particularly hope that I can create an atmosphere in the classroom in which pupils are happy and willing to learn. I think it's particularly important to have a relaxed but still motivated mood in the classroom… In teaching practice periods, my views have been confirmed… that I do well with youngsters and I earn their trust without problems. (portfolio)

By the end of her course, she was more convinced about her readiness and general skills for interaction with pupils, but still did not feel confident about own authority in front of the class. Besides, her skills in organising classroom situations so that all pupils could benefit much as

possible were of concern. She talked particularly about her ability to set limits on pupils' behaviour and giving signals about desirable actions.

> … quite good feedback [in teaching practice], my other mentor in physics especially gave me very detailed feedback, about little things, and one thing was about being like a mate to the pupils… someone was late and I had just said that it is all right, welcome… assertiveness was needed, it matters if someone is late and if you approve of it the pupils start coming in late, I think s/he was right about what s/he said (spring, 295)

The pedagogical content knowledge aspect of the ideal image did not change dramatically during her studies. Teacher authority and the teacher's role in facilitating learning for all was essential for Mary. After the first teaching practice, she talked about clear delivery and practical tools in the classroom. All in all, Mary reflected on her present state as a teacher regarding pedagogical content knowledge domain according to the themes in her ideal image. The ideal image seemed to guide the developmental process, even though the gap between the levels was considerable because of lack of practical experience.

Thinking skills and competence for self-development

		Autumn 2005	**December 2005**	**Spring 2006**
Thinking skills	**ideal**	Thinking skills are not seen as a relevant part of the image of an ideal mathematics teacher. It is possible to find one's own way of teaching through the systematic approach.		
	present	**Mary does not reflect on this at all during her educational studies.**		

In Mary's case, thinking skills and competence in developing onself as a teacher were not a relevant part of the process of becoming and being a mathematics teacher. She neither associated thinking skills with being a good mathematics teacher in terms of the ideal image nor related to her image of herself as a teacher in different phases of her education. Thinking skills were seen as helpful only when facing problems in schoolwork and when trying to find her own way of teaching as an inexperienced teacher.

> I guess there will be such situations in practical school work… I have noticed that I seem to reflect on situations afterwards; I think about how I should have acted in a particular situation and I think it will also be like that in teaching… first, it is about finding your own way of teaching and thinking like that, gradually you learn… (autumn, 81)

> When you teach something for the first time, it would be good to take notes about things that pupils found difficult. It would be useful to take some notes for yourself about lessons that you have given. How to explain something, how it was understood, what was particularly difficult, what was successful, what I can improve on for the next time, and so on. (portfolio)

Affective aspects

		Autumn 2005	December 2005	Spring 2006
Affective aspects	**ideal**	A good teacher makes contact with pupils easily and is approachable. Mary talked about being enthusiastic about teaching and developing one's work.	A good teacher should be excited about being a teacher and willing to develop new ideas for teaching and learning mathematics.	
	present	**Mary considers herself as approachable and friendly. Besides, she thinks that that her strength is willingness to do her tasks well and take responsibility as a teacher.**		**After the teaching practice periods, she reflects on whether she is able to delimit her duties as a teacher.**

Mary discussed affective aspects associated with being a good mathematics teacher in terms of being approachable and fascination with the teaching occupation. A good teacher can be described through personal characteristics like being approachable and skilful in social interaction with others. Mary clarified her views through memories of her own school experiences and feelings related to her own teachers.

> well, to be a teacher that the kids would like, like being a mate in some way, like being a big sister or someone who is approachable but… if I wanted them to listen to me, then they would listen to me… (autumn, 79)

> to be such an approachable person… and someone of whom pupils would not be afraid to ask something… (December, 148)

In addition to appropriate personal characteristics, an ideal teacher should be interested in being a teacher and willingness to find new ways to motivate pupils. She talked about willingness to make mathematics understandable and meaningful.

> I would like to be enthusiastic… to have the energy to further develop and reflect on all kinds of things that might be helpful to make pupils learn better… to inspire them (autumn, 21)

> To be enthusiastic about your job, firstly… and then to try to find some examples that relate mathematics to their [the pupils'] lives, to have examples from everyday life, which are easy to understand… mathematics is seen in everyday life, it also exists outside school and is really useful and needed (December, 177)

At the end of the course, Mary highlighted that it was important not to expect too much from oneself. No teacher is perfect, and this is good to remember when trying to do one's best as a teacher.

> Lastly, it's good to remember that you cannot be perfect now no matter how hard you try. You need to do your best but need to reserve yourself the right to have some bad days as well. A teacher can't blame herself for all learning or motivational difficulties that kids might have. Of course, you must try to do something about them but you shouldn't ask too much of yourself. You have to be lenient with yourself and you need to endure possible failures. (portfolio)

In the first half of her educational studies, Mary had doubts about her characteristics as a teacher. She reflected on her way of being a teacher, and whether her personality was approachable and natural. The overall view of herself and of her own authority as a teacher was discussed at length in all interviews. Being approachable was not only an attribute of a teacher with firm authority but also a premise for her in building her role as a teacher. By the end of her studies, she seemed happy about her way of acting as a teacher.

> H Talk about yourself as a prospective teacher, what are your strengths?
>
> S2 my strength, but weakness at the same time, is that I know how to be a mate, approachable … I have noticed that kids readily come and ask questions from me and stay in the classroom after lessons to talk… I think I am approachable (spring, 288)

Furthermore, Mary also regarded her attitude towards being a teacher and willingness to do her best as her strengths. She talked about taking responsibility as a teacher. However, by the end of her studies, she questioned her ability to limit her workload. In this sense, her view of teaching occupation had become somewhat more realistic.

> A challenge for me is not to stick my neck out too much… to avoid being awake all night thinking about the next day's lessons… you should be able to impose limits on that… (spring, 301)

Mary described the affective aspects associated with being a good teacher through some desirable features, like being approachable, as well as her willingness to do her best at work. Mary reflected on the affective aspects regarding both present and designated states as a teacher through similar ideas. It therefore seems that the gap between the two levels promoted individual development.

Identifying oneself with being a mathematics teacher

The overall view of the developmental process is approached through three themes that emerged from the data: clarifying the view of being a mathematics teacher during the studies, identifying with being a teacher through practical experiences and plans for the future as a mathematics teacher in lower secondary school.

Clarifying the view of being a mathematics teacher during the course

The Mary's incentive in attending educational studies was her willingness to develop herself as a mathematics teacher. She had neither a clear vision of a good mathematics teacher nor how to

become one. During her mathematical education, she had been missing a pedagogical viewpoint and, accordingly, support for her personal development as a teacher. She expected that her needs as a teacher were to be really addressed during the educational studies. For her, studying university mathematics has not particularly been about becoming a teacher.

> I've studied much more than I will ever need there [at school], but when you've gone very deeply into… then it's clear in your mind, including the topics that are taught in upper secondary school, I think it's useful… even if I feel that I would rather have studied something more about teaching than pure university mathematics, but eventually I'll see the benefit of it (December, 195)

With the educational studies, Mary seemed to build up her view both of herself as a teacher through practical experiences and of the ideal image of a mathematics teacher. According to the interviews and additional written data, it seems that Mary expected to have a ready-made agenda for further development during her studies, including setting general as well as personal aims. In general, Mary took an open-minded view of her studies with no high expectations.

> S2 Not really… nothing special, it was just to be open-minded to everything that's provided… I didn't know how to prepare myself, there were no high expectations… I cannot say anything particular
>
> H so, you have taken a receptive stance towards…
>
> S2 yes, well.. nothing especially surprising springs to my mind (December, 142-3)

Mary expected to obtain new ideas about being a teacher, especially mathematics.

> … well, I've been receptive… well, I think about the whole year, it's been somewhat of a surprise that there wasn't so much new knowledge or amazing ideas that I expected, it was more like something that you could figure out with common sense… well, it's been, well I did not expect it to be so, how to say, simple… (spring, 271)

In general, Mary seemed to be satisfied with the vision of teaching and learning mathematics provided. However, once the vision of being a mathematics teacher had been clarified in her mind during the studies, Mary talked about some controversial issues that emerged. Firstly, she had difficulty internalising models for teaching and learning mathematics which were not accordant with her conceptions of the ideal way of teaching. For example, she would have wanted to take different learning styles into consideration.

> … so to speak, it was different to what I would have done, it was ok but… I am more like a 'taking notes' person and you need to have your own hands-on activity; it's then possible to check something from your own notebook… to memorise how it was from there, rather than using the schoolbook… it [the notes] could be in a shorter way and the essential issues already underlined in your notes (spring 262)

Secondly, Mary found the idea of the 'teacher as researcher' in conflict with her own idea of being a teacher. For her, producing an educational minor thesis was not obviously necessary for a prospective teacher.

> H well, why you need to do a minor educational thesis?
>
> S2 I guess it's about examining or something like that, that is the purpose, but I think it's somewhat … that you are acknowledged in one particular topic, a clear picture of it, but if you have no intention of becoming a researcher it might be somewhat frustrating, especially if you happen to have a topic that is not so interesting… (spring, 363)

Thirdly, even if Mary did not have a clear picture of the best way to become a teacher, she found the portfolio assessment work uncongenial. At the end of her course, Mary associated the idea of a teacher who develops and changes during a teaching career with her image of an ideal teacher. However, the developmental process was not about systematic writing, and she did not understand the significance of writing down one's own reflections or of becoming aware of the process. For

Mary, the developmental process as a teacher was not something that should have been shared with others.

> Portfolio assessment work is a good tool for stressing yourself out. I would reflect on my lessons anyway because I want to become a good teacher. No doubt it makes your reflection clearer when you have to write it down. But why would anyone else need to know how I have developed and thought about issues? Teaching practice has been the best part, however. I feel that I have certainly developed as a teacher through that… (feedback questionnaire, autumn)

Taking a role as a teacher in practice

Mary had high expectations of the teaching practice periods, during which she was able to take a role as a mathematics teacher for the first time. For her, becoming a teacher was strongly related to the practical experience of acting as a teacher. At the beginning of her educational studies, Mary talked about being a teacher so as to identify herself with being a teacher in the future. However, she needed practical experience build up a clear image of herself as a teacher as well as a notion of what kind of teacher she would like to be.

Mary had expectations for supervision during the teaching practice periods. She was willing to have guidelines for establishing aims, and detailed feedback on her own performance as a teacher.

> …well, like we have in small group activities, everyone has own turn to be in front of the group and, of course, in teaching practice you have an opportunity to do it on your own and then you get feedback… I think that the feedback itself is really important; since you don't necessarily understand that you are doing something wrong or badly, it's good to have someone to tell you about it (autumn, 116)

The first teaching practice period made the biggest difference. First, she was able to describe her needs as a prospective teacher in more detail after it. For example, she started to talk about the

meaning of good classroom management, which she noticed only during practice. Taken together, Mary highlighted the role of pedagogical issues in teaching and learning mathematics alongside mathematical competence.

> I don't remember any more what I said in autumn… well, I think I had more like big thoughts in autumn, and now I might have more particular things, like how I can explain this issue in more detail… something like clear performance, or how to use the blackboard or how visible it's at the back row and you should have handwriting that's big enough, such little details… well, maybe because I had only a little teaching experience, then I've noticed issues that also need to be considered when you teach (December, 160)

Second, the significance of mathematical competence acquired through mathematical education had changed because of her practical experience. She claimed that mathematical education had not been supportive in becoming a teacher, and the previous developmental process had not really touched her personally. However, the need for mathematical knowledge was seen from a different perspective. Theoretical knowledge was also reflected in practice in a new way.

> … well, recommendation could be like, it would be useful to work as a substitute teacher before starting the educational studies… I realised in the spring term after having experiences in basic teaching practice that I had something with which the issues provided in lectures and small group meetings could be combined… I felt I benefit more from these courses [spring term] than was the case in autumn… (spring, 326)

Third, her view of the teaching profession expanded. She became aware of features of the school context and of other tasks related to the profession.

> well, I don't know… a change if you can call it that, that I have realised that there are so many other things, like supervision during school breaks, or if you have a pupil with special needs which needs some extra things to be done… like HOJKS [the personal study plan] in teaching practice in the field school… so largely abut those issues, keeping touch

> with parents and things that are not simply about teaching… quite a lot is something else… (spring, 307)

Mary originally had doubts about her readiness for dynamic classroom situations. She became gradually more assured as a teacher, especially in her social skills and mathematical competence as a secondary school teacher. Feedback from supervisors in teaching practice was positive, sometimes too positive, when compared with own view of herself.

> …yes, it was somewhat funny because I did not regard myself… I was unsure of myself when starting the first teaching practice, that I had no experience in teaching and I thought that I'm not likely to be able to give really good lessons without experience, then the feedback has been mainly positive… hmm, I don't regard myself as really a good teacher and I surely have many things to be improved, but maybe it's just lack of time for thorough discussion and then only the major things have been brought up, if you have not made a big mistake, then nothing about the details… (spring, 297)

In the future

Mary gained confidence in her willingness to become a teacher during the educational studies, at the end of which she talked about herself 'as a teacher'. School experiences had strengthened her image of herself as a teacher, and it seemed that she was sure of her career choice.

> H …have you developed your own teaching style?
>
> S2 yes, I have some kind of image of my style, I think it will develop further in real work when you are a teacher every day of the week, after many hours of lesson it will surely change, but I have a sort of vision of how I am as a teacher (spring, 342)

Furthermore, she was able to imagine herself working in a school. Mary brought up the need for implementing teaching in her own way, despite the traditions at school.

> Moving to a new work community of course needs readjustment, but it is important not to assimilate too much. I want to invent nice ideas for lessons, including mathematics lessons

> that are traditionally run according to the same format. Even if no other mathematics teacher in the school is interested in doing learning games or inventing something else that isn't according to the mould, I'll try anyway to bring something cheerful and hopefully inspiring and promote change in order to motivate (portfolio)

Mary stated that she wants to work at the lower secondary school level because there she is able to find potential for 'real' interaction with pupils. With younger pupils, education is not only about teaching and learning mathematics. She considered that being a teacher might be a demanding and laboursome profession but she did not regard this as a special problem.

> … well, I'm eager to start my work and especially to have those classes that I'll teach for a longer period… well, in lower secondary even longer than in upper secodary school, however, to have the same group at least during the whole course, you can create or hopefully you are able to create an atmosphere which is nice to be in and that you could pay attention to every kid… well, I'm glad to start working, I'm full of enthusiasm (spring, 348)

The image of an ideal teacher provided during the teacher education

I now turn to the case description of the socially shared image of an ideal mathematics teacher mediated in teacher education. The meaning of mathematical education as a starting-point for being a good mathematics teacher emerged in the preliminary analysis of the collective view of teacher educators (Krzywacki-Vainio, 2008). The case display is based on two sources, teacher educators' views of the ideal image provided during the teacher education programme and the written curriculum of the teacher education programme. The idea in the case display is neither to concentrate on each teacher educator nor separate sections of the programme individually but to construct an overall picture of the ideal mathematics teacher, towards which student teachers are guided. For the process of teacher identity formation, it is essential to understand the contextual features that may influence individuals during the teacher education programme.

The socially shared image of an ideal mathematics teacher is elaborated through two subsets: in general, and through characterisation of teacher identity. There are two reasons for this structure. First, the teacher education programme is mainly constructed in accordance with teacher knowledge domains. Only the subset of affective aspects associated with the teaching profession is additional to the sections of the programme. Second, it is possible to juxtapose the perspectives of individual students with the socially shared understanding of becoming and being a good mathematics teacher in elaborating the collective perspective through the same subsets.

The general vision of an ideal mathematics teacher

The description of the ideal teacher starts with the general vision of a good teacher mediated in the teacher education. Four common themes, which were highlighted both in interviews with teacher educators and in the official curriculum, emerged from the data. First, it was explicitly mentioned that a good teacher is an expert in different knowledge domains, both mathematical content

knowledge, and in pedagogical issues. For a mathematics secondary teacher, it is especially important to gain the ability to think pedagogically about teaching and learning mathematics. The basic domains of competence were thus explicated even though it is possible to be a good mathematics teacher in multiple ways.

> … in my opinion, the division into three sections is quite good, to possess good enough expertise in content knowledge that is the responsibility of the department of mathematics, to have enough knowledge about learning, teaching and education, methods and theories behind it that is on the responsibility of Sokla [the Department of Applied Sciences of Education], and practical feeling for the teaching profession is on the responsibility of the schools, in a nutshell… (TE5, 138)

In addition to expertise in various knowledge domains, the meaning of being an educator, a pedagogue, was highlighted.

> well… they would become teachers who are able to think, who master it. I think I'm repeating myself but what else it could be than being an expert in teaching one's own subject, and at the same time being educators, like this when simplified… (TE2, 52)

Second, however, it is not only a matter of expertise in different knowledge domains but also the ability to plan and implement instruction such that pupils can learn. This principle refers to the student's ability to apply knowledge in practice and to find the connection between theory and practice. In the written curriculum, it is called 'personal pedagogical theory that is applicable in practice'.

> During the teacher education programme, a student teacher integrates content knowledge, knoweldge about education and different kinds of learners, pedagogical content knowledge, i.e., knowledge about teaching, studying and learning a particular subject, and knowledge about school practices with each other as their own practical pedagogical theory. The purpose of the programme is to support the prospective teacher in becoming an

> expert in planning and implementing instruction, and in assessment and development. (curriculum)

Third, in addition to aspects of competence as a mathematics teacher, the main aim is for all students to construct their individual way to act as a teacher. The idea that there are multiple manifestations of a good teacher was discussed, especially in the interviews with teacher educators. All students should develop their own way of being a teacher based on their inclinations.

> …well, in being a teacher and learning to teach, it is really important that you find your own way to do it, it's essential… everyone can become an excellent teacher starting from personal characteristics, through different methods; I mean that a teacher can act individually but still be excellent, you don't need to imitate anyone, just be yourself… (TE1, 163-4)

Fourth, a good teacher possesses an inherent readiness for continuous professional development. During the pre-service teacher education, a student should build up basic skills in self-development. According to the teacher educators especially, the idea is not to assume that one can find a way of being a mathematics teacher immediately. It was more about formation of a basic position as a teacher, becoming competent enough to take a role as a teacher, and further development takes place in the future.

> well, a teacher, I mean student teacher, should possess basic knowledge that enables them to survive the first couple of years before they get more experience, it makes them feel somewhat more confident of being there, that a student is not afraid of going there… in front of the classroom and facing pupils… (TE10, 97)

> … well, to have a readiness which is a good basis for acting as a teacher, at least in some way, and then they could develop it in future, continuously… (TE6, 136)

The comparison between the views of teacher educators and the written curriculum reveals one main difference worth highlighting. Since the written curriculum sees the school system as a part of society, a teacher is seen as someone who should promote the idea of active citizenship, social equality, and understand multiculturalism.

> During teacher education, the emphasis is on active citizenship, societal equality, and mutual understanding between cultural values. (curriculum)

However, the teacher educators did not discuss issues of the societal perspective in general. Only the teacher educator who is responsible for the special course on societal and cultural issues addressed this issue.

The characterisation of an ideal mathematics teacher

The image of an ideal mathematics teacher mediated by the teacher educators is conceptualised through cognitive and affective aspects. Basically, although the separate theoretical courses during teacher education are to address the various competences that a good teacher should possess, affective aspects of the teaching profession emerge during various courses. The overall picture of a good teacher is complex and there are great strains on being a good teacher.

> [demands for a good teacher] … well, it is a really large area when we talk about pedagogical skills and of course, we have various courses for that, maybe too many courses, like 'pajatso'; one message in my lectures is that this is not something that a single person could really master, so many demands that need to be met, it is not possible for the individual (TE11, 42)

Mathematical content knowledge

Mathematical knowledge was regarded as the basis for being a mathematics teacher. A good teacher possesses solid knowledge in different mathematical topics. All teacher educators

unequivocally shared this view. However, defining the essence of mathematical knowledge was somewhat problematic and not possible to define in one way only.

> well, when talking about the knowledge that is needed, of course you have to have enough knowledge of mathematics, and that is attained during the courses… analysis, meaning differential and integral mathematics quite a lot, well then of course algebra, you really need to master that… geometry, the amount of that has decreased, but altogether… that is basically what we have included in basic bachelor level courses; those you need to master (TE4, 19 ja 24)

However, discrete pieces of mathematical knowledge are not enough. Expertise in mathematical knowledge is more than competence in its separate parts as it requires understanding the nature of mathematics as a discipline. A good teacher has constructed an overall view of mathematics, which is needed for providing the fundamentals at school.

> One has to construct a more coherent and accurate view of mathematics, defining the separate pieces. Teaching is localised, piece by piece, but a teacher should be able to integrate the pieces into a broader mathematical context. It's not always successful as integration should take place in the students' mind. It's a matter of learning, not teaching. (TE4, 36)

Furthermore, mathematical thinking and ability in mathematical argument were also included in the skills that a mathematics teacher should master.

Although only cognitive aspects are discussed in the written curriculum, affective aspects related to mathematics as a discipline were brought up by the teacher educators. A good teacher should be truly interested in mathematics as a discipline and feel that the school subject is something special personally.

> But as a secondary school teacher you also need to have a special relationship with and interest in your own subject, a kind of special enthusiasm about it (TE8, 12)

Pedagogical content knowledge

The significance of pedagogical content knowledge became apparent in various ways. However, some central themes emerged from the interviews and the written curriculum, despite the different approaches to teaching and learning this particular school subject. First, a good teacher was seen as a professional with ability in pedagogical thinking who is able for example to plan, implement, and assess teaching and learning in mathematics. Furthermore, a teacher should understand the special features of teaching and learning mathematics, like being aware of methods appropriate for this particular school subject.

> H Could you describe in more detail what you mean by ʻteaching skills [*didaktiset taidot*]'?
> TE8 well, these are mainly about methods used in practical teaching situations, but then also the ability to plan and assess particularly in one's own subject, special skills for that might differ from other subjects (TE8, 13)

Teacher educators mentioned the need to find a new approach to teaching and learning mathematics. A good teacher is able to implement this in different ways to those used during their own school time. Associated with this desirable change, a mathematics teacher is seen as someone who, for example, pays attention and is willing to promote the individual learning process through interaction with peers.

> … my aim is no more than I could say trying to provoke ʻdisturbance' in our students' thinking, in their heads, so that they would start to wonder how this mathematics should be taught, that it would not be simply in accordance with their own school experiences, how I was taught, and I think this ʻdisturbance' could be something like, as we said earlier, to think of other possible ways to teach, also using discussions in the classroom… (TE10, 57)

Furthermore, a good teacher finds the interface between university mathematics and what is included in school mathematics. The importance of mathematical education is related to the teacher's ability for pedagogical thinking, especially whether a teacher is able to apply mathematical content knowledge meaningfully in the classroom or not.

> Surprisingly, content knowledge is not good enough, no coherent view on mathematics… some students do not even master content which is taught in high school. It is not problematic for classroom management or acting as a teacher in front of the classroom but for finding the central idea. Content knowledge might be fragmented. (TE5, 130-132)

A good teacher is able to simplify the mathematical content so that pupils can understand the essentials. Therefore, a teacher should have an overall image of school mathematics in addition to mathematical content knowledge.

> … about dropping some learning material, it is something… you need to know mathematics well enough to understand that authors of school books put everything in the book that they know about the topic, to be able to understand what is not really essential (TE5, 51)

However, when presenting mathematical content in simplified format, a teacher needs to be careful to avoid inaccuracy and incorrect transformation. For example, a good teacher pays attention to the correctness of mathematical writing on the blackboard.

Only with the help of the overall picture is a teacher able to present mathematics appropriately. For this, a good teacher needs a solid mathematical and educational knowledge base. The role of a good teacher should be as a promoter instead of a lecturer in the classroom. Actually, most of the teacher educators emphasised the importance of understanding mathematics from the viewpoint of the pupils. Only then is a good teacher able to promote individual learning processes.

> …if a secondary school teacher is only interested in his or her own subject, it is not enough. Real interest in pupils is also needed, meaning that the other half of the truth is about the ability to interact socially with children and youngsters, to be interested in their lives, try to find the boundaries between one's school subject and presenting the subject… (TE11, 13)

A need to motivate pupils and recognise the affective aspects associated with mathematics emerges, especially in learning mathematics. According to the teacher educators, a good teacher is aware of potentially negative aspects of learning mathematics and, furthermore, tries to identify with pupils' learning problems.

> [a good teacher] motivates pupils to be active and think for themselves, doesn't try to make him/herself irreplaceable and somehow tries to make pupils like mathematics and work on mathematics, because basically the only way to learn it is to do it yourself; but to motivate and inspire… You can do it in many ways… the important thing is to do it. (TE5, 23)

Second, all secondary teachers should understand the unique characteristics of their subject, in this case mathematics. For example, it is necessary to understand the cumulative nature of mathematical knowledge and the consequences of this for teaching and learning.

> You need to create mathematical understanding on the basis of previous knowledge, you cannot start in the middle and start to build up something that is understandable… mathematics as a subject is so different [compared earlier with history], you can repair the wholes somehow, but you need to start again to build up an overall picture (TE10, 34)

Furthermore, mathematics was also seen as a special school subject because of its nature as an exact science and the need for accuracy in classroom teaching. The mathematical language used in instruction paves the way for pupils' learning processes.

> … a certain kind of logic and consistency in how teaching is carried out, maybe it is more important than in teaching languages… teaching mathematics is not only about learning

> algorithms, but also teaching how to think… in order to do this, teaching thinking as well as algorithms, you need to be meticulous and organised (TE5, 24)

Third, a good teacher is acquainted with the curriculum process at different levels and is able to share the responsibility for curriculum work in school. A teacher should thus understand the wider societal importance of mathematics as a school subject. However, this viewpoint was underlined in the written curriculum, not particularly emphasised by the teacher educators.

> A student gets to know the societal tasks of school instruction. A student gets to know curriculum work at different levels, to know the national framework curriculum, and planning by those responsible for teacher education… A student has the ability to make pedagogical decisions that are reasonable and conscious for curriculum work and cooperative planning at school and for the school subject. A student will attain readiness to using ICT in instruction in diverse ways… (curriculum)

Pedagogical knowledge and skills

Pedagogical knowledge was discussed through two thematic subsets, theoretical and practical knowledge. A good teacher was seen as someone, who is aware of different aspects of the teaching and learning process in general and who is capable of applying such knowledge in the classroom.

> All teachers should master the same, starting from trivial issues like those described in the Clarke's model, to master content knowledge, instruction skills, a wider eduactional view combined with teaching skills, and first of all, respect for pupils… not everyone can be a mathematician but each pupil is valuable and it is a teacher's responsibility to help them to gain the best possible outcome in the subject… to be educator-teacher-motivator in contrast to a scornful embarrasser (TE2, 15)

A good teacher fully understands the pedagogical issues. During the theoretical educational courses, basic knowledge is divided into four main fields, which a good teacher should master. A

good teacher is also acquainted with different kinds of learners and special needs in learning, especially in mathematics.

> The basis of teaching should not be going through learning materials but the learning of pupils; planning the instruction should start from their viewpoint, and from observations and theoretical knowledge that a teacher has… in order to make an improvement, this should be the ground… (TE5, 50)

First, a good teacher should possess knowledge about the learning process and the basis of developmental psychology. Only then is a teacher able to support the developmental process of both individuals and groups. The constructivist view of education for enhancing individual learning was widely mediated during the teacher education.

> Actually, issues related to education… about development and education, they were essential, well… particularly, to understand what kind of developmental phases there are, those were really needed and important… (TE7, 127)

Second, a teacher should possess knowledge about special education, for example, about learning and behavioural difficulties that might appear in the classroom. A good teacher should also know how to perceive learning and behavioural problems in teaching situations.

> If a teacher has no clue what kind of divergent individuals there are and how you could help and educate them, take them into account in instruction, then you get scared, meaning that teachers are scared of difficult pupils, really, and especially how to present mathematics… to make pupils understand is really heavy stuff (TE1, 22)

Furthermore, according to the teacher educator who was responsible for the course in special education, a good teacher is open-minded about special needs education in secondary school teaching, and in order to attain this aim, some students need to change their attitudes.

> well, it is really important in studying special education to change attitudes, probably the most important, only after that, distribution and receiving knowledge… (TE1, 122)

Third, an ideal mathematics teacher is acquainted with societal and institutional issues relating to the school system. In practice, this means that a teacher should be able to be analytic about education and be able to discuss it from historical, societal, and philosophical viewpoints. Furthermore, knowing the historical background of the existing school system makes it possible to understand the overall picture.

> In a nutshell, to show the existence of the historical structure of the school, controversial tendencies that test the system, behind the tendencies there are ideologies and values, and then to show the relationship between the society and school, how school has an effect on society in the long run, especially…and this double binding, meaning that at the same time school should convey cultural heritage and should pave the way for the future in continously changing circumstances… (TE11, 55)

The need to be acquainted with multiculturalism emerged only from the curriculum.

> A student should get to know the philosophical and institutional background of education and the educational system as well as essential educational policy issues… The challenges of a multicultural society and the role of the school in civil activity should be paid attention to. A student should have the ability to understand and analyse education and educational systems from the historical, societal, and cultural viewpoint as well as to handle multiculturalism. (curriculum)

Fourth, a good mathematics teacher is familiar with educational research, especially on mathematics education. This includes both research knowledge about teaching and learning mathematics as well as basic knowledge of research methodology.

In addition to knowing about basic educational issues, a good teacher is able to apply this to teaching, studying and learning process. In practice, for example, this means that a good teacher uses flexible teaching methods in suitable ways and practical work skills in the classroom.

Besides, a teacher is able to identify problematic situations and to handle them in an appropriate way.

> … there are no similar days or similar situations, one has a bad day and the other has a good one… one should have eye for observing the situations (TE10, 28)

Furthermore, a good teacher has skills in using information and communication technology in his or her teaching. However, this was particularly included among the essential qualities of a good teacher by the educators.

Last, a good teacher possesses skills in interaction, and furthermore, is aware of his or her own personal interactional features. This is not only related to interaction with the class but also willigness to cooperate in planning and decision-making regarding the curriculum work at school.

> I think it's one of the basic skills that a teacher should possess, not being a traditional teacher who shuts the door behind her and in the classroom, implements teaching freely autonomously… to cooperate with others… (TE10, 69)

Thinking skills and competence for self-development

A good teacher masters basic research skills and understands the main principles of educational research. Students traditionally produce a small-scale thesis on educational issues in their major subject. It may recently have also taken the form of a pedagogical project and reflections on it. Associated with this kind of work, a prospective teacher should become skilful in writing research with a solid structure.

> A student gets to know research on teaching and learning the subject, and produces independently either their own minor thesis or a pedagogical product designed for the learning situation. A student develops the willingness to be an expert who does research on and develops his or her own work. A student is ready for life-long learning and further studies in educational. (curriculum)

The main idea here is that a good teacher learns how to reflect on his or her own work systematically and generally is able to examine and develop it. The idea of a teacher as researcher is thus internalised as a part of being a teacher. For example, good teachers are able to strengthen their own expertise in various aspects when needed.

> … to give some skills for reflections about teaching and learning, before entering school work, also to provide skills in analysing one's own teaching and what kind of instruction promotes understanding and what does not, to get to know different ways to teach and learn, different options that one can try… (TE5, 66)

During teacher education, the aim is to extend competence in taking a role as an autonomous professional who is responsible for planning, implementation, and assessment of teaching and learning. The ability to reason in pedagogical decision-making is one of the main objectives in the teacher education programme.

> There is a lot of dicussion about the quality of Finnish teacher education; it means that a teacher should think independently, which is the reason why I do not want to provide knowledge as such… it needs to be reasoned and even then, I keep saying that there is no one to check you in the back of the classroom, you have to do what is the best in your opinion (TE9, 33)

One reason for the need to be an autonomous professional is the idea of developing a personal way as a teacher based on individual inclinations. Since there is no one kind of ideal teacher nor shared norms on how to implement teaching and learning in the classroom, a good teacher needs to be an independent professional.

> … it is a philosophical approach to bring up challenging underlying questions, without having ready-made answers… well, everyone needs to find the answers, whether this way or that way, there is no… you cannot decide only one way, those are questions of values, almost everything in school (TE11, 86)

During teacher education, in addition to educational research activities, critical reflection on societal and philosophical issues related to education are seen as essential for a professional teacher. Furthermore, portfolio assessment work also aims at skills in personal reflection and the ability to conceptualise the developmental process. According to the curriculum text, portfolio assessment work should be a tool for combining different knowledge domains with practical experience and for reflecting on one's personal educational philosophy.

> A student sets personal aims and reflects on his or her own actions critically. S/he reflects on strengths and weaknesses based on experiences and received feedback. Portfolio assessment work helps a student to integrate pedagogical content knowledge and practical experiences gained through teaching practice together. Portfolio work promotes building up a personal educational philosophy… (curriculum)

Affective aspects

Affective aspects associated with the image of an ideal teacher fall into two categories, the personal characteristics of a good mathematics teacher and attitudes towards the teaching profession. This viewpoint cannot normally be derived from the official written curriculum. However, in the interviews with teacher educators, several conceptions of the desirable characteristics of a good teacher were shared. The affective aspects were especially discussed by supervisors at the university schools.

Personal features of an ideal teacher

In the interviews with teacher educators, various issues regarding the appropriate characteristics of a teacher arose. The message seemed to be that a teacher should be suited to the teaching profession but this may involve different characteristics. For example, a good teacher should be emphatic and capable of taking professionl responsibility.

> … of course, a good teacher is… rather emphatic than cold-hearted, rather responsible than careless; a teacher is unique and sufficiently creative, the other pole is being mechanical, like a stereotype… (TE2, 79)

Furthermore, a teacher who is well organised is able to handle practical situations. However, this is something that people can learn.

> … of course, you need to be organised in order to handle your own life as well as your role as a teacher … maybe people become teachers who can do this, you can also improve in such issues if needed… it is not necessarily so important in all occupations (TE4, 52)

According to some teacher educators, it is easier to list undesirable personal traits than the image of a desirable personality. No teacher should have psychological problems. The entrance examination seemed to be important in reducing so-called undesirable personalities.

> I would say that it's not possible for everyone to become a teacher; of course, a person with normal intelligence can build up a knoweldge base, but a teacher needs to have a strong psyche… if you happen to have mental problems… (TE1, 141)

Actually, it is not possible for just anyone to become a good teacher.

> … those might pass the entrance examination, even if we interview in order to have only motivated individuals… those who are not suited to teaching, it's rather like leave those who are obviously not suitable and direct them somewhere else… (TE8, 68)

> … there are some personal features that you cannot gain by sitting in school, you can probably improve some features but there are others that you either have or not (TE4, 20)

The teacher's role in the classroom was also discussed. A good teacher is one who takes the role as an educator and paves the way for the pupils to learn. This is possible with good social skills, which are needed both in the classroom as well as in parental and collegial cooperation. It is not only about social interaction and constructing authority with pupils but also about taking a role as a professional in the eyes of other adults.

> well, I think that a good teacher is the one who says what to do, after all, well… we can discuss authority or something else, but it has to be the teacher who has it in the classroom and who has to create this atmosphere in the classroom… (TE10, 29)

A good teacher is encouraging and fair to all pupils. Neither gender issues nor success in mathematics should influence the relationships between the teacher and the pupils.

> Especially in comprehensive school, to be equal and fair, not to discriminate or play favourites… those are skills that we discussed with student teachers, what are the problems in using discrimination based on gender, girls and boys, in the class. It is not necessarily always bad, but what kind of dangerous values remain hidden… (TE5, 49)

Furthermore, a good teacher is self-confident in his or her own teaching ability. Mathematical competence can be a solid base for developing the authority needed in the classroom. However, knowledge and skills are valuable only when combined with sufficient self-confidence as a teacher.

> Content knowledge and skills are not the main point but self-confidence, trusting oneself. If one is self-confident overwhelming content knowledge and skills are not needed. However, expertise in subject matter may enhance self-confidence. (TE11, 16)

Attitudes towards being a teacher

In addition to certain personal characteristics, the teacher educators shared the idea of engagement with the teaching profession. First, a good mathematics teacher is well-motivated and committed to being a teacher in general.

> If students are motivated to become teachers… It's not about external motives but willingness to develop as a teacher and then it is possible to direct the process during teacher education. (TE7, 154)

> It's personality that is the starting-point for everything, and this field is not for a person with no fervour, you need to have a real fervour (TE6, 153)

Furthermore, a good teacher values the teaching profession in general.

> … basic skills in teaching, how to plan and face pupils and so on, and then to create a positive attitude towards the meaning of the teaching occupation (TE2, 53)

One of the main ideas in the teacher education programme is to promote the teacher's willingness for self-development. A good teacher seeks new approaches and pedagogical ideas that s/he could apply in the classroom.

> But you can develop – I notice that myself as well, that I have developed, meaning that there are opportunities to do things differently and you can always improve your expertise in content knowledge, there are no limits… technical solutions, using different methods,

> teaching methods, new technology has also appeared… great potential if you are willing, but you need to have the willingness… to be enthusiastic (TE11, 52)

The state of a good teacher is continuously reshaped. In the interviews as well as in the written curriculum, the vision of a good teacher includes the idea of a professional who is willing to take a critical stance towards his or her own teaching and the educational system in order to develop it further. There is always another way to do things.

> … well, teachers should be innovative and should also be… critical of one's work, …not afraid to renew your way of teaching and to try different solutions… well, promoting this attitude in prospective teachers is rather important… (TE1, 162)

The willingness for self-development includes the idea that a good teacher is capable of becoming aware of the limitations of his or her own competence.

> … a teacher who thinks he or she knows the topic under discussion and is not willing to go through it again, is a fool… (TE7, 29)

Conclusions concerning the cases

The process of teacher identity formation was approached through the two kinds of case described in the previous sections. The overall view and summary of these cases is given according to the three research questions based on the underlying theoretical themes originally outlined.

Instrumental case study like this concentrates primarily on the phenomenon itself, the overall process of teacher identity formation rather than separate cases as bounded systems (Stake, 1995 and 2005). However, the developmental process may be examined only through individuals and their understanding. The starting-point in this research has been that identity is an individualised entity, meaning that there is a person to identify with being a teacher (see Korthagen, 2004). The process of identity formation was thus approached through two separate student cases, those of Mary and John. In addition to these, the collective case based on the views of teacher educators was used to understand the contextual influences and the social reality in which individual development takes place (e.g., Assaf, 2008; Goos, 2005; see also Wenger, 1998). The summing up follows the themes of the research questions, both by viewing the cases separately and, in Miles and Huberman's terms (1994), by comparison between the cases in order to extrapolate the results to a more general level. The idea is not only to juxtapose the student cases, for example, focusing on the profile of the developmental process, but also to contrast the individual cases with the collective view of the ideal image of being a mathematics teacher.

Characterisation of teacher identity

The first research question was related to characterisation of teacher professional identity, i.e., *how is teacher identity profiled through its cognitive and affective aspects*. In general, characterisation makes it possible to see teacher identity both in individual and social terms. The nature of the individual identity of a mathematics teacher may be seen through a range of cognitive and affective characteristics, as with John and Mary. Furthermore, it is possible to

examine the interplay between an individual and the context according to particular features associated with being a professional mathematics teacher (Arnon & Reichel, 2007).

In John's case, mathematical knowledge and skills formed a solid base for acting as a professional mathematics teacher. It was self-evident to him that being a good mathematics teacher requires mathematical competence. John seemed to have a cognitive approach. He highlighted the need for understanding and supporting the learning process of individual pupils, for which a teacher should possess expertise in pedagogical content knowledge as well as general pedagogical knowledge and skills. For him, mathematics was something that needs to be presented to pupils in an appropriate way, for example, by highlighting its special features as a discipline. Furthermore, a teacher should take responsibility for making learning accessible to all. John associated thinking skills with being a teacher because of the need for further development. The developmental process conceptualised by John was strongly profiled through the cognitive aspects of actions as a teacher in the classroom.

In Mary's case, social skills and affective aspects were important in the teacher identity profile. According to her, a teacher needs mathematical knowledge and skills to be able to act professionally. Mathematics should be presented in a suitable way, and a good mathematics teacher needs to be able to motivate and use various teaching methods. Mary did not associate thinking skills with being a mathematics teacher. However, she regarded reflective activities as a way of envisioning her own way of being a teacher during her studies. Mary paid great attention to the relationship between teacher and pupils, for example, the teacher's authority in the classroom. In Mary's case, individual teacher identity was associated with an educator who takes responsibility for the overall learning process, and who is able to create an appropriate atmosphere

in the classroom. Mary highlighted the significance of personal characteristics like being approachable.

John and Mary reveal how characteristics associated with being a mathematics teacher enable one to profile individual development and teacher identity in particular, highlighting different characteristics as essential to teacher identity. For example, mathematical content knowledge seemed to be basic to being a mathematics teacher for both of them, but they put different stress on this. John highlighted this expertise as fundamental, whereas Mary considered it as desirable. For Mary, affective aspects and skills in social interaction were crucial. In addition to differing emphasis on particular characteristics, the range of features associated with teacher identity might differ as well. In the cases of Mary and John, subsets of thinking skills and affective aspects were not automatically included in the profile as a professional teacher. Expertise in educational research and the idea of 'teacher as researcher' especially was associated with teacher identity by neither.

Similar to the characterisation of individual teacher identity, the socially shared idea of a good mathematics teacher and societal positioning may be approached through a range of cognitive and affective characteristics. The case of the teacher educators represents the collective view of a good mathematics teacher that is mediated during teacher education. In terms of the image of an ideal teacher, conceptualisation of different features makes juxtaposing of individual and social views possible, which is elaborated in more detail in the following section.

Approaching teacher identity through the present and ideal image

The second research question was about exploring the teacher identity formation through *the present image of teacher identity and the image of an ideal teacher*. From the individual perspective, identification with being a mathematics teacher takes place on two levels, through the

image of one's present state as a teacher and through the image of the ideal teacher, which is considered as a range of desirable and valuable characteristics as a mathematics teacher (Arnon & Reichel, 2007; see also Sfard & Prusak, 2005). The case displays of John and Mary have been described within this framework. First, the individual image of an ideal mathematics teacher is gradually reshaped by experience. At the beginning of his course, John had a relatively clear vision of being a mathematics teacher. Nonetheless, some changes took place during his studies. For example, practical classroom management skills were incorporated into the ideal image after personal experience in the classroom. Mary was different, as her overall view of an ideal mathematics teacher was less clear. Her approach was to be open-minded with the vision provided by teacher education. She did not conceptualise her image of the ideal teacher regarding all aspects in detail. Furthermore, her image was highly abstract and general, involving, for example, reflections on pedagogical content knowledge. However, the image of an ideal teacher gradually became clearer for her and she was able to envision herself more precisely by the end of her studies.

Second, the image of the ideal teacher comprises a range of features associated with being a good mathematics teacher, which are combined with personal development with differing emphasis. A student should be able to imagine him- or herself as a teacher in the future and to identify, at least partly, with the image of an ideal teacher as a personal guideline (Virta, 2002; see also Arnon & Reichel, 2007). For example, affective aspects as a teacher were somewhat disconnected in John's developmental process. John reflected on affective aspects generally but he did not identify with these in his reflections on his present state as a mathematics teacher. However, in his case, expertise in both mathematical content knowledge and pedagogical content knowledge was closely related to the developmental process. In Mary's case, pedagogical content knowledge played a relatively important role in the ideal image. However, even though conceptualisation at

the ideal level took place, the gap between the ideal and present image shows that she had difficulty in identifying herself with the ideal in this respect.

Third, the gap between the ideal and present image of teacher identity is relevant for the individual developmental process. The width of the gap between the two levels is significant (Sfard & Prusak, 2005). The ideal image directs the developmental process if it is something achievable from the present state. John described the vision of pedagogical knowledge and the skills that a good mathematics teacher should master in highly abstract terms. At the same time, his view of his present competence was in closely related to his practical teaching skills. His personal goals thus seemed to be distant from the ideal image. However, his ideal and present images of mathematical competence seemed to be closely connected. John did not have a real need for development in this respect, no need to set any further goals. For Mary, affective aspects at the ideal level were in accordance with reflections on her present state as a teacher, which involved the same themes as were associated with the ideal image. Altogether, it seems that the ideal image paves the way for reflection on one's present state as well as for setting personal aims for a developmental process inconsistently, depending on the aspect.

Fourth, individual developmental processes for students take place within the context of teacher education. The collective case of the teacher educators is one way to make the socially shared image of a mathematics teacher observable and may be juxtaposed with individual images of an ideal teacher. The overall notion of the ideal teacher was conceptualised according to the structure and the main principles of the teacher education programme. In general, the views of the teacher educators were parallel with the written curriculum, except for some issues like the societal position of a teacher, which was greatly emphasised in the written curriculum but not particularly brought up in the interviews with the teacher educators. Generally speaking, the socially shared

perspective was cognitively emphasised. However, the affective aspect emerged when the teacher educators discussed the desirable personal features of a mathematics teacher considered in the entrance examination. We may note that even though the teacher educators responsible for the programme implementation represent separate perspectives, there was no fundamental disagreement (cf. Korthagen, 2004).

In the case descriptions, the interplay between individual processes and the context appears in terms of the ideal image, although differences between the individual and socially shared image as such are not of interest here. After all, the empirical part of this research was based on only a few cases. However, the cases of individual students appear in a new way when contrasted with the socially shared image of an ideal teacher provided during teacher education. An individual gets to know about this shared ideal image through interaction with others (see, e.g., Walshaw, 2004). The social environment paves the way for individual development, for example, through providing activities and teaching experience, where the individual view of the direction of developmental process is parallel with the shared visions (see Younger et al., 2004). In Mary's case, the interplay between social and individual images took place without any major controversy. Mary adopted an open-minded stance towards her course, and was therefore willing to internalise the vision provided. However, she emphasised some issues differently from the socially shared image of an ideal teacher, including the ability to promote learning and to create a positive and encouraging atmosphere in the classroom. Only by the end of her studies, when her own view of being a mathematics teacher had been clarified, did some controversial issues emerge, for example, regarding her vision of 'the teacher as researcher'. John's case was different from Mary's. John was an example of a self-regulated student with a relatively clear image of the ideal mathematics teacher. In his case, the interplay between social and individual viewpoints was approachable, especially through controversial issues.

Both students considered the domains of teacher knowledge as a basis for professionalism in accordance with the academic vision provided at the university. The collective case of teacher educators was structured according to the individual disciplines that each educator represented. Unsurprisingly, mathematical content knowledge was crucial to the image of an ideal teacher both in individual and socially shared ideal images (cf. Hodgen & Askew, 2007). Expertise in mathematics was not something about particular content but more like a mindset that a mathematics teacher should possess, recalling the findings of Ferrini-Mundy et al. (2007). Pedagogical content knowledge was similarly associated with a good mathematics teacher. The main idea was to be able to present mathematics positively and appropriately in order to enhance individual learning. Of course, individual students emphasised somewhat different aspects of the way to do this. For example, Mary invested more energy in considering affective aspects in classroom implementation. Moreover, a different emphasis on the general pedagogical knowledge and skills emerged. For the teacher educators, pedagogical knowledge was composed of academic content that was only partly included in individual ideal images. First, the societal perspective on the teacher's role and competence for tasks outside the classroom were missing in the students' conceptualisations. This is understandable because of limited practical experience as a teacher. Mary and John discussed pedagogical competence as closely associated with classroom activities and the ability to enhance learning mathematics. Furthermore, John challenged the meaning of educational science for a professional teacher and discussed controversial issues that he had confronted in his teacher education.

In the light of these cases, thinking skills and the ability for reflective practice seemed a problematic part of the ideal image provided in the teacher education. Both Mary and John were willing to undergo self-development through reflecting on their present readiness as a teacher.

However, the idea of systematic examination of one's actions or making these reflections accessible to others were not seen essential for a good teacher. Furthermore, knowledge about research methodology and the ability to produce educational research were not seen as a relevant part of professionality (cf. Gitlin et al., 1999). Despite their critical stances, the vision of a teacher who is able to act as an autonomous professional and to make pedogogically reasonable decisions in the classroom was internalised by both students. Willingness for further development and engagement with the teaching profession in particular were seen in as essential to professionality.

The on-going process of teacher identity

The third research question, *what is the formation of emerging teacher identity like from the viewpoint of change*, was related to the on-going process of teacher identity formation The focus of the student cases has been on the developmental process through which an individual becomes a teacher (Korthagen, 2004; see also Côté & Levine, 2002). The case displays of John and Mary are structured to highlight the changes that may take place during the process in forms of the characteristics of teacher identity and the levels of the present and ideal images. For example, the view that John had of himself as a teacher with skills in classroom management and practical pedagogical issues was clarified. For him, social interaction in the school environment, not simply the possibility to take a role as a teacher but also the feedback in teaching practice, promoted the changes in his views (cf. Danielewicz, 2001). He became more aware of his needs for further development and it seems that the change took place in two respects – by becoming aware of his own present image as a teacher and by clarifying the ideal image seen as desirable. In addition to the clarification of the present and the ideal images, the changes also take place in characteristics and the way an individual stresses each of them. For example, Mary seemed to change her view of the role that expertise in mathematical content knowledge had in her teacher identity. During her studies, she associated the need to possess solid mathematical knowledge with the ability to act as a good teacher, and stress was put particularly on affective features and social skills.

The ongoing developmental process of teacher identity formation cannot be scrutinised in depth simply by external interpretation of possible changes at three separate data-gathering points (Richardson & Placier, 2001). The process of becoming a professional teacher is also examined here through self-reflections that the students explicated in the interviews and in supplementary written products. Since internalising one's role as a teacher and converting this role into one's own professional identity was of particular interest, assumptions and engagement in the developmental process as well as the degree of internalisation of the vision of a good mathematics teacher provided were discussed in the case displays. Naturally, the motivational background of a student plays an important role in the developmental process (e.g., Virta, 2002; Younger et al., 2004). Both John and Mary were willing to become and to imagine themselves as mathematics teachers. It seems that the personal developmental process can be conceptualised in two ways, not only through separate characteristics that can be conceptualised in terms of the present and ideal images, but also through the overall state of teacher identity associated with the personal feeling of professional identity. In practice, Mary and John constructed their view of professionality as teachers and became aware of own understanding about the characteristics by which they define a professional teacher. Besides, both students gradually began to feel like a real teacher (cf. Korthagen, 2004; Walkington, 2005). These cases are examples of different ways to become and to act as a professional mathematics teacher. Mary was convinced of her commitment at the outset, and study provided activities through which she became assured of her choice of future occupation. For John, the change towards having the feeling of being a 'real' teacher took place to some extent and, according to his reflections, the developmental process was to continue in his position as a teacher in a 'real' school environment.

Last, the idea of continuous self-development was included both in individual and socially shared views of teacher identity. During teacher education, the main objective seemed to be attaining readiness for further reflection and development, which takes place in the school environment through social interaction with pupils and other people involved with schooling. One of the main ideas according to teacher educators was to learn self-reflection and to take a critical stance towards one's own state as a teacher. Students did not find this academic way to conceptualise their development and to share it with others useful in their personal process (see Walkington, 2005). However, both the students and the educators shared the idea that becoming a teacher in its all aspects is not the underlying objective of teacher education. The essential idea is to start and to promote the developmental process that an individual will be involved in in the teaching profession.

ON THE TRUSTWORTHINESS OF THE RESEARCH

The traditional evaluation criteria for reliability and validity of the study design and methods used in quantitative research cannot be applied to this qualitative case study because of its different paradigmatic basis (see Lincoln & Guba, 1985; Miles & Huberman, 1994; Stake, 1995). As Bassey (1999) remarks, checking external validity in a case study is problematic. For example, the cases under examination, like John and Mary, were not selected for their potential to be representative examples of all possible students but for their potential to give some insight into the 'typical' process of becoming a mathematics teacher during teacher education. Therefore, trustworthiness needs to be elaborated through criteria appropriate for the premisses of the qualitative case study approach and for the particular purpose of this research.

The trustworthiness of qualitative research can be evaluated on various ranges of criteria (Patton, 2002; Tuomi & Sarajärvi, 2003). Patton (2002) states that the quality of a study with a pragmatic starting-point is to be judged by its intended purpose, available resources, and the procedures followed. Besides, more than meeting the requirements of each criterion of trustworthiness, the quality of the research is dependent on the coherence of the research procedure overall (Tuomi & Sarajärvi, 2003). In practice, the quality of the research report is essential for scrutinising the procedure that has been carried out. Since the issues of trustworthiness should have been brought up throughout in reporting the case, this chapter is to highlight some essential notions that have actually already been reported. In order to address the requirements, this research report includes discussion about the subject and the purpose of the research, elaboration of the researcher's engagements, selection of the cases, the relationship between the researcher and research participants, the research schedule, details of the analysis process, and validity regarding such things as ethical issues (Tuomi & Sarajärvi, 2003).

The modified range of criteria for evaluating trustworthiness is used in order to take into consideration the nature of case study research. Trustworthiness of the research is examined by elaborating *credibility*, *transferability*, *dependability*, and *confirmability* (Tuomi & Sarajärvi, 2003; see also Miles & Huberman, 1994; Patton, 2002). The questions about confirmability of the role of the researcher have already been discussed in the chapter on the case study approach, which examines its influence on the research process because of different engagements and position in the research context. In addition to these matters, *triangulation* has been added as a fifth issue particular to case study research (see Patton 2002; Stake, 1995; cf. Yin, 2003). These five categories are related to each other and partly overlap, but still comprise a comprehensive basis for discussion.

Triangulation

The aim of triangulation is to cover different perspectives in order to attain fairness during the research procedure and diminish misunderstandings of the nature of the case (Patton 2002; Stake, 2005). The question is about whether the research subject or cases are interpreted properly and in accordance with 'reality', here in accordance with intersubjectivity. To do that, the study design, data resources and data analysis should enable capturing the nature of the case. The aim is not only to capture something directly visible and explicit but also to identify tacit features and to try to understand them (Miles & Huberman, 1994; see also Lincoln & Guba, 1985). In this research, the process of teacher identity formation has been approached through the perspectives of teacher educators and students in order to reveal its multiple aspects.

There are several ways to carry out triangulation in case study research, as Stake (1995) discusses based on the work by Denzin (1989). First, *data source triangulation* examines the phenomenon of interest in different times and situations to see whether it manifests itself in the same way. The

researcher observations are to be considered in different circumstances when the phenomenon is explored through several sources. This research uses mainly the data of semi-structured interviews with the students and teacher educators since teacher identity and its formation is seen approachable through conceptualised understandings. Even if direct observations in the classroom were one option to get information about situational manifestation of teacher identity on personal identity level (Côté & Levine, 2002; see also Gee, 2000), it would not have informed about the formation of emerging teacher identity without meanings given for the experiences taken place in social interaction. Experiences promote the on-going process of identity formation, a serie of changes, but the interpretation of the appearance of teacher identity could not have been done only by an outsider, but with the students who had experienced the classroom situation as a teacher and whose understanding is of interest. Furthermore, because the opportunities for actual classroom experience are limited during the teacher education programme and the observation data would have covered separate situations only, the semi-strucutred interviews were to address the purpose of the research best. After all, the students reflected on their practical experiences in the interviews, and like this, the interviews were not too much concentrated on separate experiences but on the overall understanding of the state as a teacher and the developmental process in general.

In addition to the interviews with two kinds of research participant, written documents, the feedback questionnaires, and the official curriculum of the teacher education programme were used to augment the main data. The overall idea was to build up research data that would reveal different perspectives in accordance with the theoretical framework; for example, approaching the developmental process both from individual and contextual perspectives. The selection of research participants, especially the teacher educators, was intended to reveal multiple perspectives within this particular study programme.

Second, *methodological triangulation* took place only in augmenting the interview data with direct observations on written documents. In practice, both interview data and documents were elaborated through content analysis. However, since the structure of the written documents was also used for enhancing the researcher's understanding, direct observations were a part of the data analysis process. The structure of the teacher education programme was particularly taken into consideration. Besides, observations of the context also helped to build up a picture of the contextual features that influence individual teacher identity formation.

Third, neither *theory triangulation* nor *investigator triangulation*, which Miles and Huberman (1994) call a critical friend, was used in this research. The overall aim was to build up a framework for the theoretical approach and use case study for empirical examination. The analysis and research procedure has thus taken place only within one theoretical framework. Furthermore, investigator triangulation usually takes place in cooperative research projects in order to enhance the quality of drawing and verifying the conclusions. The research procedure here has been carried out alongside cooperation between various university partners for developing the teacher education programme. Some ideas have been presented to the teacher educators, who have commented and made critical observations in joint seminars. Even if no other person has gone deeply into the analysis, cooperation with teacher educators and student members in the joint seminars has promoted the researcher's understanding of the phenomenon.

Furthermore, member checking is the way to have critical observations and interpretations as a source of data, and to help the researcher to triangulate her own observations and interpretations (Stake, 2000; see also Lincoln & Guba, 1985; Patton, 2002; Yin, 2003). In this research, member checking was used when research participants were asked to review the case descriptions for accuracy and palatability. Both the teacher educators and the students who are represented in the

report received drafts beforehand to show them how they were to be presented and interpreted. Member checking was not only to verify the case displays but also to ensure mutual understanding of ethical issues such as protecting anonymity of the research participants. Member checking involved no major changes, but the researcher's interpretation was strengthened.

Credibility

Credibility is about whether the phenomenon has been interpreted adequately and with authenticity on the basis of the research data. Miles and Huberman (1994) claim that the question in qualitative study is not about correspondence between the findings and the real world, but about whether the findings make sense and whether they are credible for the participants and the readers. In this research, as mentioned in the paradigmatic background, the data is based on different experiences within the teacher education programme conceptualised by the research participants. Intersubjectivity, not single truth, is the basis for the social reality under examination (Biesta & Burbules, 2003).

In practice, learning from individual cases was carried out in two ways: through generalisation within and between the cases (Gomm et al., 2000; see also Huberman & Miles, 1994). In this research, these two approaches are considered as ways to draw the conclusions and to find plausible explanations. Huberman and Miles (1994) suggest that generalisation *within* the case is about describing what is happening, how it takes place and, especially, deriving an explanation for subjective experience, which is needed when the research data does not cover the whole case in every detail. Gomm et al. (2000) indicate that the data-gathering period is normally relatively short within discrete periods, or only a few people participate in the research. However, the data is interpreted as part of a wider social reality. In this research, for example, three separate data-gathering points through the academic year were to cover the developmental process over the whole year. However, the timing of these points was designed according to the structure of the

programme and, furthermore, individuals conceptualised their developmental process as a continuum during the programme. This was considered during the data analysis as well as in the design of the interviews.

Generalisation *across* the cases is about the way to carry out analysis through comparisons between the cases (Huberman & Miles, 1994; Gomm, et al, 2000). In order to be able to compare, the cases need to be conceptualised at a more theoretical and abstract level. Developing the categorisation in order to form subsets in which the data fits nicely, but is still not too general, is a challenge (Elo & Kyngäs, 2007). The development of categorisation here was established gradually through several cases starting from the original themes based on the theoretical background. In the end, after analysing several cases, the categorisation was reshaped to be applicable and to address the research task. Only then were the differences and similarities between individual cases possible to retrieve. Furthermore, it was possible to build up a more general understanding of the developmental processes which emerge in becoming a mathematics teacher within teacher education.

According to Elo and Kyngäs (2007), careful reporting is the way to increase credibility of the research, to justify and to argue for the findings. Only then is it possible to evaluate the strengths and limitations of drawing research conclusions (see also Lincoln & Guba, 1985; Miles & Huberman, 1994). The researcher should explain how the results are derived from the research data, in order to do which, data analysis needs to be reported carefully. In this research, detailed description of the procedure has been made, starting from the case selection and ending with the elaboration of the data analysis process. This description is supplemented by several appendices in order to make the analysis process transparent. As Elo and Kyngäs (2007) mention, describing the multiple phases of qualitative analysis process is demanding, but in this research, with the help of

a systematic diary that the researcher kept during the research procedure, it has been possible to follow the process from the beginning to the end in retrospect.

In addition to careful description of the analysis process, the research findings need to be structured and described in a way that transforms them into an approachable and credible form for others. One practical challenge is to make the report short enough but still not too compressed. In this report, the link between the data and findings is established by authentic citations in all cases. In addition, some content tables in the case displays help the reader to get an overall view of each case (Miles & Huberman, 1994; Stake, 1995).

Transferability

Case study research has been accused of not being 'scientific' enough, especially in relation to the generalisability that is traditionally required in research. However, 'the real business of case study is particularisation, not generalisation' (Stake 1995, p. 8). Stake (2000) also comments that instead of generalisation, the idea in case study is to expand the potential for experiences and to improve understanding of them. According to Hammersley and Gomm (2000), the challenge of 'generalisation' has been addressed with the discussion about transferability, naturalistic generalisation (Stake, 2000), and comparison both across and within the cases, which was discussed here as part of credibility (Hammersley et al., 2000; Miles & Huberman, 1994). One possibility would be to uncover causal relations and argument underlying the phenomenon in situ through eliminative and analytic induction (Patton, 2002; cf. Hammersley et al., 2000). However, the starting-point would then necessarily be in the existence of universal laws and regularities in the social world, which is not particularly the case when discussing teacher identity.

Here, transferability addresses the need to consider the meaning of the results in any larger sense, i.e., whether the conclusions are transferable to other contexts (Miles & Huberman, 1994; see also

Flyvberg, 2006). It is not a feature of the research but something that is manifested only when applying the results in another context (Lincoln & Guba, 1985; see also 2000). The researcher can enhance transferability through careful selection of the cases that are typical and understandable within the research context (Gomm et al., 2000). Otherwise, the reader must assess the transferability of the findings based on the research report.

Transferability is something that the researcher makes possible through careful reporting. Elo and Kyngäs (2007) emphasise that since the readers should be given an opportunity to consider the transferability of the findings, the case displays need to be contextualised to allow the reader to consider similarities and differences between the research context and the reader's situation (Stevenson, 2004). This research elaborates the context of the teacher education programme as well as the individual cases in detail. The description of the research procedure started with defining the cases and the contextual features of the teacher education programme at the University of Helsinki. The individual developmental processes make sense when the contextual features, such as the limited amount of teaching practice and opportunities to take a role as a mathematics teacher, are known. However, the significance of different contextual features for individual experiences, or for the developmental process cannot be shown easily. Besides, the process of teacher identity formation is approached *within* the teacher education programme in this research, with no immediate influence from the social interaction that takes place in the school environment. This affects transferability of the findings.

In addition to the description of the research context, there is a need to make the research knowledge approachable and shareble through appropriate conceptualisation (Stake, 1995; see also 2005: cf. Yin, 2003). The researcher should consider pre-existing knowledge of the topic and differences in the conceptual frameworks of the researcher and the readers. In this research,

building up the theoretical framework has been the way to conceptualise the phenomenon and to make it comparable. However, transforming the research knowledge into consistent form has been a challenge because of the various conceptualisations of teacher identity available.

Dependability

Dependability is about whether the process of the study is consistent and done with reasonable care (Miles & Huberman, 1994). Dependability affects the overall research procedure, including methods used and decisions taken during the process. The process should be reasonable and systematic to ensure that the data collection has yielded knowledge of interest and in accordance with the purpose of the research (Stake, 1995). However, dependability is not about being able to carry out the same research procedure with same outcome at another time and place as would traditionally be the case with reliability. In case study research, a systematic procedure is the way to approach the phenomenon in the intended way, especially through the interview procedure (Seidman, 1998; Kvale, 1996).

Understanding the decisions made regarding the research procedure necessitates detailed description of the phases of the research as well as its context (Schofield, 2000; Stake, 1995). One way to improve the quality of the research is to pay attention to the data-gathering situations and to the overall protocol of the empirical work (Miles & Huberman, 1994). The methodological issues and implementation of the research procedure have been discussed in detail in previous chapters. The data-gathering situations, such as the social interaction with the research participants and setting, have affected the insights gained (Keats, 2000; Seidman, 1998). The intention was to utilize the interview situations with reasonable care.

First, the structure and the questions of the semistructured interviews were carefully planned and tested; the student interview in a preliminary study that took place a year beforehand and the

teacher educators' interview in a rehearsal with a teacher educator not included among the research participants. The concepts that the researcher used in the interviews were considered especially carefully in order to avoid leading questions (Warren, 2002).

Second, external factors might have influenced the data-gathering situations (see Kvale, 1996). The first interview situations in particular were something the students had not experienced before. Moreover, the discussion and further information about the research project have probably stimulated their awareness of their internal developmental process later in the process. For example, the specific questions concerning their readiness as a teacher might have prompted active reflection about their individual development. However, even if this were the case, it is considered to increase the level of conceptualisation, and therefore, to increase access to the phenomenon of teacher identity formation. After all, the whole point of this research was the idea that teacher identity formation may be examined through cognitive stance and individual reflection (Beijaard et al., 2004). Besides, the influence that the researcher had on the process was more like enhancing than altering the development of the student.

Third, the interview situations were challenging, despite the researcher having experience of such situations beforehand. Asking the questions and introducing the themes for discussion without leading the interviewee was a challenge. It was not only about concepts that the researcher brought to the interviews but also the way different participants understood the terminology. This challenge emerged with both students and teacher eductors but not for the same reasons. With the teacher educators especially, who represented various university partners, the influence of the background discipline and various perspectives needed to be considered in the interviews. In practice, the differences were taken into account in dynamic interview situations with the possibility of using follow-up questions included in the outline of the interview (see Warren,

2002). Several interviews made it possible to revise the details of the outline during the research. In addition to careful planning, active attendance at the interview situations was strengthened by taking notes during the interview and by trying to use concepts that the interviewee used in his or her own reflection (Seidman, 1998). The reasons underlying the statements were of particular interest.

According to Miles and Huberman (1994), prolonged engagement with data sources is the way to avoid misunderstanding or misleading ideas in the research (see also Lincoln & Guba, 1985). Since the data was dependent on the students' willingness to conceptualise their own developmental process, the researcher was able to reconstruct this process only based on individual experiences. The atmosphere in the interviews thus needed to be based on mutual trust. The researcher wanted to avoid making any kind of judgement or revealing her own conceptions of the issues under discussion. In addition to a confidential relationship with the participants, different data sources and multiple data-gathering points confirmed the researcher's ability to make sense of the developmental process.

When the interviews were carried out as planned, the interpretation of the data became easier. Besides, it was helpful to be aware of different activities provided in the teacher education and to consider the possible influences in designing the two latter interviews with students. The teaching practice periods, the possibility of actually teaching, were seen as a fruitful starting-point for reflections on the developmental process in general. The aim was to take personal experiences as a point of departure for elaborating the understanding of developmental process.

Confirmability

The issues related to confirmability are 'about relative neutrality and reasonable freedom from unacknowledged researcher biases' (Miles & Huberman, 1994, p, 278). The roles of the researcher

(see Stake, 1995) have already been described in more detail in the chapter about the case study approach, so that the idea here is to summarise the influence that the researcher might have had on the research procedure. Subjectivity can be seen as a characteristic of qualitative research like this. Even if the the procedure was carried out systematically and reported in detail, I have used my 'backstage knowledge' in the interpretation process, both in carrying out the interviews and later in the analysis phase (Seidman, 1998). I have been aware of my different roles in relation to the research participants and within the context. The question is whether the overall picture has been conveyed to the reader and the decision-making and reasoning made explicit. In general, the various phases of the analysis and reasoning have been reported in detail.

The subjective stance as a researcher has been influential for confronting the overall view of the phenomenon. On the one hand, a person like me, who is familiar with the research context, and who has experienced the process of becoming a teacher, is more likely to be able to note essential features during the research process. From this viewpoint, subjectivity means an opportunity to identify with the role of the students involved with the developmental process and to understand the viewpoints of the teacher educators. However, subjectivity as a researcher might have led to bias in interpretation. Involvement with cooperation in developing the teacher education programme and personal experience has probably promoted sensitivity to the issues of individual development, such as the meaning of practical experience. Unacknowledged influences have been diminished by the theoretical knowledge influencing the whole data analysis process and awareness of the different roles that I have had as a researcher.

DISCUSSION

The discussion is divided into four sections. First, the research purpose and its practical implications are considered, second, the research findings and conceptual framework in general; third, the implications for the teacher education programme, and some remarks are made about contextual features meaningful for teacher identity formation. Last, a few ideas for further research are suggested.

On the relevance of the research

The basis of this instrumental case study research was pragmatism, as the main research purpose emerged originally from practical experience. The need to understand the process of becoming a mathematics teacher within the teacher education programme was the primary research aim. The case study approach was seen as a research method and strategy to reveal the nature of the formation of emerging teacher identity (Stake, 1995). As Biesta and Burbules (2003) state, some interplay between theory and practice is essential when the research purpose is to foster understanding and provide practical, better-informed practice. Since the criterion of relevance can emerge from inside or outside the research field (Gellert, 2008), the research needs to be appraised from two perspectives – how well the research purpose fits with its context, and how well the study is linked to existing research knowledge of the topic.

First, the relevance of using teacher identity as a central concept in this research needs to be considered. The possibly restrictive feature of the teacher education programme is the limited amount of teaching practice included. The developmental process largely takes place through the imagination of the student, and is not especially promoted through practical classroom experience. The absence of school experience and the role of the student during the educational studies are somewhat problematic when discussing about teacher professional identity (cf. Walkington,

2005). After all, taking a role as a teacher gives a person the opportunity to see himself in teaching profession and to experience interaction in the classroom (Danielewicz, 2001; see also Gee, 2000). However, the experiences, which promote the individual developmental process and mediate socially shared views of being a teacher are not simply those in the school environment. Even if students do not have a real position as a teacher at school, they have different kinds of experience that are involved in the individual developmental process. A teacher should possess expertise in different knowledge domains; for example, mathematical knowledge that one does not learn through teaching.

Even if students have only slight experience of taking a role as a teacher, and teaching practice periods do not simulate a real teaching position in a school context, it is possible to conceptualise the process of 'becoming a teacher' through teacher identity. This research was focused on the early steps as a teacher, the beginning of the developmental process of teacher identity formation. A student has opportunities to take a role as a teacher both in real life as well as in imaginary thinking through various study tasks. Besides, during the teacher education, a student should build up a solid base for further development in school work, not only concerning the knowledge and skills that a teacher should possess, but also commitment to the teaching profession and further development (see also Merenluoto, 2003). Altogether, conceptualisation of the developmental process through teacher identity is well reasoned, especially if identity formation is seen as a continuous process that progresses in a teaching career at school as well.

Second, as Beijaard, Korthagen, and Verloop (2007, p. 105) state, understanding how teachers learn is essential for promoting teacher development. They continue that answers to the question of understanding learning of teachers may improve both initial teacher education and further professional development of teachers. In this research, the focus was on teacher identity formation

in general, where learning has a significant role in seeking change. The point of departure as well as the findings of the research have an interface with educational reality. Furthermore, the research provides information about individual development through conceptualised understandings, especially the early steps in becoming a teacher within the teacher education programme. The features of Finnish teacher education have been taken into consideration in the conceptual framework, especially those through which teacher identity can be recognised and discussed. The most essential is the conceptualisation of the process of becoming a teacher and, through that, to highlight some meaningful points during teacher education.

Third, in building up understanding of teacher identity from the theoretical viewpoint, I have steered my way through a fragmented field of educational research and have tried to position the study in the conceptual framework provided by recent research. Identity formation in general is a vast area influenced by both the psychological and social sciences (Côté & Levine, 2002). Furthermore, when the concept of 'identity' has been applied to the educational field to address the special features of teaching and learning, those of the teaching profession particularly, the more complex the conceptual basis has turned out to be. It was a challenge to clarify the assumptions and to establish a theoretical framework based, at least to some extent, on the variety of conceptual frameworks and approaches in the field. Choosing the main concepts for the framework was particularly problematic. This research cannot be considered to be foundational for conceptualisation of identity formation in general; however, it does provide a modified perspective for formation of emerging teacher identity by conceptualising what professionalism means for mathematics teacher identity and how the developmental process takes place. Any attempt to build up a coherent picture of different research strands is valuable.

Reflections on teacher identity formation

The present research was based on several premises. Firstly, teacher identity is something that is recognized by 'someone' (Gee, 2000; see also Beijaard et al., 2004) and, furthermore, this 'someone' is both a person, the one who is becoming a teacher, and the others who are somehow involved with the process within a social context (Côté & Levine, 2002; Danielewicz, 2001). Identity formation involves both external processes, which emerge from social interaction in a particular context, and internal processes, which are related to a personal self, as described in the social psychological framework of Côté and Levine (2002). The interplay between a person and a context is thus essential for the developmental process that takes place through giving meaning for experiences. Secondly, as elaborated in the theoretical part of the report, defining the concept of teacher identity through characterisation requires stipulation of its associated aspects. In this research, subsets of cognitive and affective aspects have been the basis for discussing teacher professional identity (e.g., Fajet et al., 2005). The individual state as a teacher and the developmental process may be recognised through the characteristics associated with being a teacher. Besides, socially shared views of the profession may also be elaborated through the individual aspects. Thirdly, teacher identity formation is also considered as an on-going process, a dynamic entity (Danielewicz, 2001; see also Beijaard et al., 2004; Richardson & Placier, 2001). However, one's state as a teacher may be captured by the person involved and by others through observing the way teacher identity is manifested at the personal identity level (Côté & Levine, 2002). This makes the state of teacher identity recognisable and therefore, experiences through given meanings promote understanding of teacher identity.

The process of teacher identity formation is seen here as a serie of changes towards being a good teacher, which is mediated by experience. The meaning of a continuum of experiences in the developmental process emerged alongside the theoretical review (see Samuel & Stephens, 2000).

The Deweyan idea of a continuum between past and future mediated by present experience is seen here as essential. The experiences that an individual has in social interaction within a given context promote teacher identity formation. The significance of various events depends on the person and his/her understanding of what has been internalised through previous experience (Côté & Levine, 2002; see also Sfard & Prusak, 2005). The image of an ideal teacher is seen here to pave the way for individual development, as in the work by Arnon and Reichel (2007) (cf. Sfard and Prusak, 2005). The image of one's present state as a teacher (How am I as a teacher at the moment?) and the image of an ideal teacher (How would I like to be as a teacher?) are crucial to the developmental process (see also Beijaard et al., 2004). From the individual perspective, teacher identity formation is about reflecting on one's present state as a teacher through experience in social interaction. Besides, it is about becoming aware of one's personal view of a good mathematics teacher and, depending on individual commitment to the developmental process, aspiring towards the desirable state as a teacher in the future (see Krzywacki-Vainio & Hannula, 2008). The formation of teacher identity is possible to capture through conceptualisation of understandings.

An individual has an active role in constructing professional identity as a mathematics teacher within the context (see e.g., Coldron & Smith, 1999; Danielewicz, 2001). The idea in this research was to construct a conceptual framework for analysing emerging teacher identity and its formation based on characterisation, the images of the present and ideal state as a teacher, and the idea of the on-going process. In practice, as was the case with Mary and John, the individual state of teacher identity was elaborated at two levels, the present and the ideal images. The profile of the state as a teacher was possible to scrutinise through the affective and cognitive aspects associated with being a teacher at both levels. The formation process and changes could be examined based on the three data-gathering points. Altogether, it seems that an individual constructs own way of being a

teacher first at the ideal image level, and then gradually identifies with the teaching profession at the present level (cf. Arnon & Reichel, 2007). In the context of Finnish academic teacher education in particular, becoming a professional mathematics teacher is not merely about taking the obligatory studies but also envisioning a personal way of being a teacher. Awareness of the image of an ideal teacher, especially of desirable characteristics, is essential. Gradually, with educational studies and practical school experience, students internalise their role as a teacher and begin to feel like a 'real' one. At this point, being a teacher is not only a matter of a designated state but also the present state of teacher identity (Sfard & Prusak, 2005).

However, the developmental process is not straightforward and, as emerged from the cases of John and Mary, discrete aspects of an ideal mathematics teacher do not automatically direct the individual development. This ideal image directs identity formation only if it is linked with an individual process (Arnon & Reichel, 2007). The width of the gap between the present and the ideal image is significant. The ideal image directs the developmental process as if it is something attainable from the viewpoint of the present state. Moreover, an individual needs to be engaged with the developmental process and to set personal goals on the basis of the ideal image. In fact, it was shown that the ideal image directs and is linked to the personal developmental process differently, depending on each characteristic. The ideal image is constructed through a range of characteristics, from which the personal developmental goals emerge. The view of the present state as a teacher influences an individual and creates prioritisatism of personal goals, i.e., concentrating on shortcomings that need to be improved. The conceptual framework lacked the level of personal developmental goals, something through which the ideal image would have been mediated as part of an individual process.

The individual developmental process is promoted by social interaction and the experiences that mediate socially shared ideas of being a mathematics teacher. An individual manifests his or her state as a teacher in interaction with others in particular situations, so that others influence the formation process (Côté and Levine, 2002). Danielewicz (2001) calls this 'going public'. In teacher education, the individual has an opportunity for interaction and for getting feedback in the teaching practice lessons, indirectly and intentionally. The self-presentation of teacher identity, as well as recognising one's state as a teacher is accessible through characteristics associated with being a professional teacher, for example, the fields of expertise that a good mathematics teacher should possess. While an individual has become aware of socially shared ideas of being a mathematics teacher in the Finnish school system, s/he tries to fulfil the expectations of a real teacher at the interactional level, the feedback in social interaction being based on recognisable characteristics apparent in individual behaviour. The boundaries between what is individual and what is socially shared are of interest. The view of an individual and the socially shared view of being a teacher should converge sufficiently to produce feedback that promotes professional development in that context. After all, the question is not only about individual development and the view of being a teacher, but also about the need to be recognised as a professional by others and to attain a position as a 'real' teacher (cf. Gee, 2000). The range of characteristics does not need to be exactly the same, as was the case in this research, but individual and socially shared views need to overlap enough in order to fulfil the requirements as a believable professional.

However, in academic teacher education, like the context of this research, the opportunities to teach in the classroom and to manifest one's state as a teacher are limited. The process of becoming a mathematics teacher is not mainly guided by teaching experience situated in 'real school life' but largely by the academic learning processes. Student teachers thus need to be able to use their imagination to identify themselves as teachers during their academic studies. For

example, neither the students nor the teacher educators highlighted practical skills associated with becoming and being a good mathematics teacher, possibly because of limited teaching practice experiences included in the programme. The ideal image level is seen as essential to the individual developmental process, as well as the boundary between individual, internal processes and social, external processes during teacher education (see Danielewicz, 2001). The ideal image is the level at which individual and social interface. Student teachers become acquainted with socially shared conceptions of a good teacher through social interaction with others, reshaping their own personal understanding of being a teacher by filtering socially shared ideas, and aspiring to manifest them at the interactional level (Beijaard et al., 2004; Côté & Levine, 2002).

The title of this study is about emerging teacher identity, which raises the question of attaining the state of being a 'real' teacher. Here, the main research task concerning the process of teacher identity formation during the teacher education programme has been approached from both individual and social perspectives. The emphasis has been on the role of an individual who is seen as an active subject who constructs a professional identity within a given context (e.g., Beijaard et al., 2004). As Bohl and van Zoest (2002) point out, the existence of teacher identity is dependent on both individual and social views. On the one hand, an individual needs to internalise a role as a teacher, and begin to feel like a real professional through fulfilling the characteristics that s/he associates with being a teacher. On the other hand, in addition to individual feelings about one's state as a teacher, the others need to consider a person as a teacher (Brown, 2003; Walkington, 2005). Only when these two requirements are met does teacher identity supercede taking a role as a teacher. This research concerns the early steps of developmental process of formation of teacher identity and, depending on individual experiences and motivational background, students are in different phases of their process when they graduate from the university.

The subsets for collection of characteristics are one way to approach teacher identity in a particular context (see Beijaard et al., 2004). These characteristics were the way to describe what it means to become and to be a professional mathematics teacher, particularly in the Finnish educational system. However, although the various characteristics of a good teacher could be applied to other educational contexts, the emphasis and possibly the rationale underlying the desirable characteristics differ according to context. In this research, the social view of teacher identity was defined through affective and cognitive aspects that emerge from the teacher education curriculum as well as from the perspective of each teacher educator. There are several ways to establish the framework for these characteristics, and the researcher's own understanding, influenced by practical experience and educational research, has had an influence on the structure. Expertise in thinking skills and the ideal of a teacher as a researcher are important in academic teacher education in Finland. The autonomy of a professional teacher and the idea of different kinds of good teachers are seen as characteristics of the Finnish educational system (Lavonen et al., 2007). In this research, individual students seemed to identify with the idea of an autonomous status as a teacher, as well as the need for constituting one's own way of being a professional teacher. However, 'a teacher as researcher' was not associated with the image of being a good teacher. Individual views did not converge with the socially shared view, even if the idea of 'a teacher as researcher' is greatly stressed in the study programme. No further conclusions can be drawn here based on so few cases, but general discussion could be a desideratum.

Implications

The relevance of this study is its connections with the context and possible applications for developing the study programme. As Younger et al. (2004) state,

> the challenge for teacher educators is to frame teacher education courses in such a way that beginning teachers are provided with the contexts and methodologies whereby they can reflect upon their own preconceptions and refine their own understandings as to how they

> themselves learn as teachers, to enable them in turn to facilitate the learning of pupils and to fulfil their own clearly articulated aspirations to become quality teachers (p. 262).

From the perspective of teacher eduction, the interplay between external and internal processes of teacher identity formation is of specific interest in considering implications for aspiring for *more intelligent* practice (see Biesta & Burbules, 2003). In practice, the main question is not only what we should offer within the programme but also how we should implement the studies.

The need for experience as a teacher in the classroom emerged in the research findings. The teaching practice periods during teacher education provide an opportunity for a student to take a role as a teacher, even if not on a large scale (cf. Danielewicz, 2001). Naturally, a greater amount of teaching practice lessons would make it possible to engage with social interaction, and furthermore, to get feedback on the manifested state as a teacher. However, a student could not have a real position as a teacher during the pre-service teacher education in any case. Such a position is possible only in full employment in the school context, while in the research findings, it was the greatest deficiency of the programme. First, taking a role as a teacher was meaningful for the developmental process because of the possibility to clarify the view of oneself as a teacher. For example, the meaning of different knowledge domains might change as a result of practical experience. Furthermore, in order to enhance the process of becoming a teacher from the beginning of the programme, students could benefit from teaching experiences before graduation from university, usually during the last academic year. The constraint is that students have to complete enough courses in mathematics and in another school subject to ensure a level of content knowledge and skills before entering teaching practice.

Second, practical experiences are not only important because of taking a teacher's role and being able to see oneself in the teaching profession. The feedback that a student gets from teaching

practice lessons as well as from cooperative activities with other students strengthens the view of oneself both in terms of the present and the ideal image. Teacher educators, sometimes the other students in teaching practice schools as well, provide useful feedback for further reflections and may guide the process. The ideal image that is mediated in the teaching pratice should be considered carefully, not only from the viewpoint of the school system and practical requirements as a teacher but also for augmenting the academic work. The idea of research-based teacher education including theoretical studies in educational sciences especially should emerge somehow in practical work. Students sometimes miss the link between theoretical studies and practice (Gore & Gitlin, 2004). Besides, discussions during the teaching practice periods usually relates to a personal developmental process that involves affective aspects in addition to the knowledge and skills needed as a teacher (Korthagen, 2007).

Academic cognitive skills and knowledge are strongly emphasised in the programme, in which the solid foundation for becoming a teacher is mathematical knowledge and skills (see Lavonen et al., 2007). A teacher is regarded as a professional who is an expert in teaching and learning mathematics, beside competence for further development later in the teaching career. From this viewpoint, mathematical content knowledge provided during the pre-service education programme is probably a good starting-point for prospective mathematics teachers (Ferrini-Mundy et al., 2007). Still, the need for a coherent view of mathematics and understanding the nature of mathematics as a school subject should be taken into consideration during the programme. Especially in mathematical education, it might be hard for students to understand intentions and the meaning of subject matter studies for their future profession (D. Cohen, 2008). It is not a new idea that among the university mathematics courses students should have an opportunity to build up a link between academic mathematics and school mathematics for gaining

mathematical knowledge (e.g., Ball and Bass, 2000). Furthermore, combining studies in education and practical experiences with strong mathematical background is a challenge.

The courses in different knowledge domains are seen as an important part of becoming a teacher. The process is not only about taking a role as a teacher and about 'learning by doing', as the competence that a teacher should possess as a professional is gained through academic studies (cf. Hiebert et al., 2002). However, it is a challenge to support students in building up an overall picture of being a mathematics teacher and to integrate all these competences together. Teacher education can be seen as a learning environment for students to develop themselves autonomously as a teacher, but the active support of teacher educators is still needed at various levels (Korthagen, 2004). In order to be able to support students in their development, a coherent view of being a mathematics teacher should be provided in the study programme. The differences between the written official curriculum and implementation of the programme should be given particular attention. For example, it seems that teacher educators emphasise subjective viewpoints of becoming a teacher, like self-confidence as a teacher, during the teacher education programme. However, the hidden agenda is a challenge for further development of the programme as the implementation of the programme varies from one educator to another.

Lastly, understanding the individual formation of teacher identity is meaningful for implementing teacher education in such a way that different aspects of teacher identity formation can be addressed. Academic teacher education seems to fail to support student teachers in combining affective and subjective aspects with academic knowledge and skills in the best possible way (cf. Eteläpelto & Vähäsantanen, 2006; Beijaard et al., 2004). Orienting student teachers toward personal development during their educational courses is a special challenge after theoretical studies in mathematics (see also Krzywacki-Vainio, 2009). However, support for personal

development is not necessary in relation to face-to-face interaction between students and teacher educators. For example, interaction with other students and enhancing self-reflective activities during the programme are also a useful way to promote individual development and benefit from social interaction.

Further research

Some ideas emerged during the research about the potential and need for further research. First, since this research was on the developmental process of becoming a mathematics teacher, the role of mathematical content knowledge arose in the data. However, as Reid et al. (2008) mention, the role of disciplinary knowledge varies between fields. The conceptual framework with separate characteristics, based on which professionality as a teacher was discussed from the individual and social perspective, might be applied to other kinds of teachers. It would be interesting to elaborate more carefully the meaning of expertise in different content knowledge areas, for example, with secondary teachers in different school subjects or with elementary school teachers (cf. Hodgen & Askew, 2007; Smith, 2007). Moreover, while the profile of teacher identity differs between individuals, the question would be about the features that are particular for teacher identity in different areas.

Second, this research is primarily concerned individual developmental process within the teacher education programme. The features of the individual process were highlighted, and contextual, external processes remained peripheral. It would be interesting to understand the mechanisms in the developmental process from a social perspective better. Like the original the idea in this research, evaluative study of the teacher education programme and its contextual features and for developing the programme could be of use. Moreover, the influence of the school context as well as cultural differences between educational systems might reveal some interesting aspects.

Thirdly, the individual developmental process was approached through interviews and written documents but not through meaning making of particular experiences in the classroom, for example, through observing interactional situations in which self-presentation of teacher identity takes place and furthermore, discussing this particular situational experience. The process of teacher identity formation could already be seen in a new perspective during the teacher education programme when manifestation of the state as a teacher, i.e., actions in the classroom, and elaboration of manifestations could form part of data-gathering. Then, the influence of others and through that the contextual influence on the formation process could be approached in more detail. However, the examination of emerging teacher identity would then not be only based on conceptualisation of research participants in general but understanding of the cases could emerge from practical experience.

Last, this research focused on the early steps of the process of teacher identity formation, on emerging teacher identity. The process of becoming a teacher continues in the school environment, through practical experience in a teaching position (McCormack et al., 2006). The plan is that the follow-up research is going to examine the meaning of school experiences and monitor the developmental process of the former students who participated in the research. Only then can something be said about the interplay between the school context and an individual, and about the continuum of experience.

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APPENDICES

APPENDIX 1 (Information letter for the student teachers)

A letter and an opportunity for enrolment that was distributed to all mathematics student teachers in the first portfolio assessment meeting (August 2005).

Research on mathematics teacher education

Dear recipient,
I am conducting research on mathematics teacher education. The focus of the research is on becoming a teacher and the formation of teacher knowledge during the teacher education programme. Both teacher educators' and student teachers' viewpoints are taken into consideration in the research.

I am searching for students willing to be research participants, who are planning to complete their educational courses largely or entirely during the 2005-2006 academic year. Those who participate in the research will be interviewed three times during the academic year.

Naturally, all data and information related to the research will be handled confidentially and anonymously.

Thank you for your co-operation,

Heidi Krzywacki
P.O. Box 9 (Siltavuorenpenger 20R), room 308a
Heidi.krzywacki@helsinki.fi
gsm. (041) 532 0235

Name:

Contact information (e-mail and telephone number):

What is your plan to complete your educational courses?

- *all courses during the 2005-2006 academic year*
- *only partially during the 2005-2006 academic year (which courses?)*

Write briefly about your background

- *Your background as a student teacher*
- *What kind of expectations do you have now for the course?*
- *Work experience as a (substitute) teacher*
- *Academic history in general*

APPENDIX 2 (Information letter for the teacher educators)

Research on mathematics teacher education

My research is about mathematics teacher education and the development of student teachers during the programme. The focus of the research is on becoming a teacher and the formation of teacher knowledge during the teacher education programme. Both the perspectives of the teacher educators' and student teachers are taken into consideration in the research.

In this research, all university teachers responsible for the courses included in the teacher education programme for mathematics student teachers are regarded as teacher educators. Teacher educators represent three different partners; the Department of Applied Science of Education, the Department of Mathematics and Statistics, and university teaching practice schools. Research participants representing the viewpoint of teacher educators should be key persons in the programme to some extent. In practice, such a teacher educator should be both, an active partner in planning and developing the study programme and responsible for course implementation as a part of the programme. Besides, the selection is also based on the structure of the programme and study arrangements during the 2005-2006 academic year.

I would be pleased to have you as one of the research participants. The interview will last approximately two hours and the plan is to complete the interviews in April or May in 2006. The interview will be audiorecorded and, naturally, all data and information related to the research will be handled confidentially and anonymously.

It would be really nice if you could participate in the research. We can talk about the research and I can give further information on the phone – I'll contact you later.

Thank you for your co-operation,

Heidi Krzywacki-Vainio
P.O. Box 9 (Siltavuorenpenger 20R), room 308a
Heidi.Krzywacki@helsinki.fi
Gsm: (041) 532 0235

APPENDIX 3 (Background information on the student teachers)

Some basic information was obtained at the first interview meeting.

- Name:
- Age:
- Experience in being a (substitute) teacher:

- When did you start at university?

- When were you accepted for the teacher education programme?
  When did you start the educational studies?

- Your major subject (first school subject) and phase of your studies in autumn 2005:
  Are there specific courses for student teachers included in your studies?
  If so, what kind of course and how many study points?

- Your minor subject (second school subject) and phase of your studies in autumn 2005:
  Are there specific courses for student teachers included in your studies?
  If so, what kind of course and how many study points?

- Study history and any previous degree:

- Have you completed some educational courses before the 2005-2006 academic year?
  If so, in which university and what kind of courses? How many study points?

APPENDIX 4 (The first interview with the student teachers)

Themes of semi-structured interviews with student teachers (autumn 2005)

Possible follow-up questions marked with *italics*.

Start

Tell me about your study history.

When did you start at university?

What about the educational studies that you have just started…?

Motivational background for becoming a teacher

What are your reasons for becoming a teacher and for completing the teacher education programme?

When did you make the decision about your future career?

Expectations and aims for the programme

Tell me about your expectations of the teacher education programme.

…specific contents? …study arrangements? …methods?

What goals you have set for your studies?

Conceptions of teaching and learning mathematics

Describe briefly your own experiences in school mathematics.

What were your mathematics teachers like?

What was it like to study mathematics?

Describe what a good mathematics teacher is like.

Explain why the issues or features that you mentioned are relevant.

What kind of mathematics teacher would you like to be?

Why?

Teacher knowledge and skills

What is the best way to evolve into a good teacher like the one you described?

What kind of knowledge and skills beside experience could teacher education provide for development?

How would you like to develop yourself as a prospective teacher?

Self-assessment on strengths and weaknesses

What goals have you set for your studies? (question repeated)

What might be most challenging for you during the programme?

Reflect on the best way for you to learn new things and skills.

THANK YOU FOR YOUR ATTENTION!

APPENDIX 5 (The second interview with the student teachers)

Themes of semi-structured interviews with student teachers (December 2005)

Possible additional questions marked with *italics*.

Start

How have your studies been going during this academic year?

What courses have you completed?

Expectations and aims for the programme

[Summing up the issues emphasised in the previous interview in autumn 2005.]

Have your expectations and goals for the studies been fulfilled?

What about the relevance of your expectations and goals at the beginning…?

…specific contents? …study arrangements? …methods?

Has something unexpected surprised you?

Conceptions of teaching and learning mathematics

Describe what a good mathematics teacher is like.

Explain why the issues or features you mentioned are relevant.

What kind of mathematics teacher would you like to be?

Why is that?

How has your view of being a teacher changed during your studies?

Teacher knowledge and skills

What kind of knowledge is required as a subject teacher?

What kind of skill is required as a subject teacher?

Give reasons for your views.

How would you like to develop yourself as a teacher?

Some self-assessment on strengths and shortcomings

Relevance of the teacher education programme

What kind of knowledge and skills has the programme provided so far?

How has the programme supported your development as a teacher?

What kind of goals have you set for your studies in future?

THANK YOU FOR YOUR ATTENTION!

APPENDIX 6 (The third interview with the student teachers)

Themes of semi-structured interviews with student teachers (spring 2006)

Possible additional questions marked with *italics*.

Start

How have your studies been going during the academic year?

What courses have you completed and when are you going to graduate?

Expectations and aims for the programme

Have your expectations and goals for the studies been fulfilled?

Has something unexpected surprised you?

New viewpoints?

Conceptions of teaching and learning mathematics

What is essential in teaching and learning mathematics in your opinion?

Assess yourself as a mathematics teacher (knowledge and skills)

Some self-assessment on strengths and shortcomings

How would you like to develop yourself in future?

What is most challenging for you in being a teacher?

How has your view of being a teacher changed during the past year?

Relevance of the teacher education programme

Describe three essential features of the teacher education programme for a newcomer.

What has the programme provided for you as a prospective teacher?

Describe the essential goals for the programme.

How well have the goals been achieved in your case?

What image of being a teacher was provided in the programme?

How has the programme supported your development as a teacher?

What is the role of … (separate sections of the programme mentioned by the interviewer)

In what way has the background of students been taken into consideration during the programme?

Assess how your subject studies in mathematics has allowed you to gain readiness for being a teacher.

How would you develop the teacher education programme?

Something that you were missing…?

What would you like to maintain?

Something irrelevant…?

What are your plans in future as a teacher? Where would you like to work as a teacher?

THANK YOU FOR YOUR ATTENTION!

APPENDIX 7 (Interview with the teacher educators)

Themes of the semi-structured interviews with teacher educators (spring 2006)

Possible additional questions marked with *italics*.

Start

Tell me about your background as a teacher educator.

How did you become a teacher educator? Your remit in the subject teacher education programme…? Your attitude toward mathematics…?

Conceptions of teaching and learning (mathematics)

Describe what a good subject (mathematics) teacher is like.

Explain why the issues or features mentioned are relevant.

In what way have your conceptions changed over the years?

Role of the subject (mathematics)

Knowledge and skills of a subject (mathematics) teacher

What kind of knowledge (methodological, contentual) is required as a subject teacher?

What skills (methodological, contentual) are required as a subject teacher?

Relevance and objectives for subject teacher education

Describe the essential goals of your course and how these are implemented.

Methods used in the course? Planning process?

How do you take students' backgrounds into consideration?

What specifically supports individual development as a teacher?

What are your strengths as a teacher educator? How would you like to develop yourself?

How are the goals achieved during the course which is your responsibility?

Your notions on students' attitudes, learning…?

What are the main goals of the teacher education programme?

According to you, the most relevant in the programme?

Something that isn't so relevant…?

How well are the goals of the entire programme achieved?

What is the most challenging part of teacher education?

In future

How should the programme be developed?

What skills and knowledge should the programme provide for students?

Special experiences? Particular contents or methods?

Study arrangements

Describe your own role as a teacher educator.

relationship with students

What is the meaning of co-operation with other teacher educators for you?

THANK YOU FOR YOUR ATTENTION!

APPENDIX 8 (The first version of data categorisation, student cases)

A point of departure and background of the prospective teacher

Reasons for becoming a teacher and participating in the study programme

A point of departure as a student

- your own school experiences
- experience as a teacher
- educatability/suitability as a student

Conceptions of good mathematics teaching and the teaching profession

Features of a teacher

- knowledge
- skills
- attitude

Teaching mathematics

Identification as a teacher

How does a student identify his- or herself as a teacher?

How is the level of commitment in being a teacher?

View of self as a teacher

Motives for applying for the programme

The ideal teacher

Identification with being a teacher / socialisation with school community

The feeling of being a teacher (self-assessment)

- strengths
- shortcomings

Expectations and aims for the teacher studies

How have your personal aims change during the year of educational studies?

Evaluation of the studies

How does a student find the studies regarding his or her own developmental process?

How does the programme support individual development as a teacher?

studies in university mathematics

studies in mathematics education

studies in educational sciences

- special needs education
- minor educational thesis

teaching practice periods

practical study arrangements

- portfolio assessment work

something to be developed further

Discussion on some other matters (start, ending)

APPENDIX 9 (The second version of data categorisation, student cases)

Numbering in parenthesis is used for coding during the analysis.

Conceptions of teaching and learning mathematics (ideal and self-assessment)

general conceptions, e.g., of pedagogical thinking (100)

conceptions of the teaching profession (101)

Cognitive aspects

mathematical content knowledge (110)

assessment of personal readiness (mathematical content knowledge, 111)

pedagogical content knowledge (PCK): about teaching mathematics (120)

assessment of personal readiness (PCK, 121)

pedagogical knowledge and skills (PK, 130): e.g., relationship with pupils

assessment of personal readiness (PK, 131)

thinking skills and self development (140)

assessment of personal readiness (thinking skills, 141)

Affective aspects

personal features (attributes and social interaction) (150)

assessment of personal readiness (151)

affective aspect: attitude towards teaching profession, willingness for development (160)

school as societal institution (context outside the classroom) (170)

routines and classroom situations (experience, authority?), implementation (180)

assessment of personal readiness (181)

"I am going to be a teacher"

Background

previous learning (school) experiences (200)

previous studies (201)

oneself as a learner and as a student (202)

work experience (210)

motives for applying for the programme: choice of career (220)

Development during the course

commitment to self development (230)

changes in thinking and conceptions (conscious) (231)

developmental process (internalisation of new knowledge and skills) (232)

feeling of being a teacher (identification) (240)

taking a role as a teacher (practice) (241)

in future (commitment to the teaching profession) (250)

THE STUDY PROGRAMME AND IMPLEMENTATION

How does the programme support individual development?

orientation towards the studies: expectations and personal goals (400)

practical study arrangements (such as information)

new ideas

mathematical education (410)

The educational studies

conceptions of various disciplines (differences) (415)

meaningfulness of the studies, attitude towards the studies (416):

one's own expectations juxtaposed with the aims of the programme

mathematics education (420)

minor educational thesis

studies in educational sciences (430)

special needs education

social, historical, and philosophical basis for education

psychology of development and and learning

teaching practice periods (440)

reflection and thinking skills (portfolio assessment work) (450)

studies in general (460)

ideas for further development (studies in general) (470)

social interaction within the studies (480)

APPENDIX 10 (The third version of data categorisation, student cases)

Numbering in parenthesis is used for coding during the analysis.

Conceptions of teaching and learning mathematics (ideal and self-assessment)

general conceptions of teaching and learning (101)

school as societal institution (context outside the classroom) (170)

The teacher as an individual

general conceptions of being a teacher (e.g., pedagogical thinking) (110)

Cognitive aspects

mathematical content knowledge (110)

assessment of personal readiness (mathematical content knowledge, 111)

pedagogical content knowledge (PCK): about teaching mathematics (120)

assessment of personal readiness (PCK, 121)

pedagogical knowledge and skills (PK, 130): e.g., relationship with pupils

assessment of personal readiness (PK, 131)

thinking skills and self-development (140)

assessment of personal readiness (thinking skills, 141)

classroom implementation (routines and classroom situations) (180)

assessment of personal readiness (181)

Affective aspects

personal features (attributes) (150)

assessment of personal readiness (151)

attitude towards teaching profession, willingness for development (160)

assessment of personal readiness (161)

"I AM GOING TO BE A TEACHER"

Background

previous learning (school) experiences (200)

previous studies (201)

oneself as a learner and as a student (202)

work experience (210)

motives for applying for the programme: choice of career (220)

Development during the studies

commitment to self development (230)

changes in thinking and conceptions (conscious) (231)

developmental process (internalisation of new knowledge and skills) (232)

feeling of being a teacher (identification) (240)

taking a role as a teacher (practice) (241)

commitment to the teaching profession in future (250)

THE STUDY PROGRAMME AND IMPLEMENTATION

Meaningfulness of and attitude towards the course

orientation towards the course: expectations and personal goals (400)

conceptions of various disciplines (differences) (415)

one's own expectations juxtaposed with the aims of the programme (416)

new ideas (402)

the role as a learner: individual development (403)

relation of theory and practice (404)

Study implementation

practical study arrangements (e.g., information) (401)

study performance and activities (e.g., reading) (407)

social interaction within the course (480)

Different sections of the programme

Mathematical education

Educational studies

mathematics education (420)

minor educational thesis

studies in educational sciences (430)

special needs education

social, historical, and philosophical basis of education

psychology of development and learning

teaching practice periods (440)

reflection and thinking skills (portfolio assessment work) (450)

Evalution of the programme

the programme in general (460)

ideas for further development (the programme in general) (470)

APPENDIX 11 (The final version of data categorisation, student cases)

Numbering in parenthesis is used for coding during the analysis.

CONCEPTIONS OF TEACHING AND LEARNING MATHEMATICS (ideal and present)

General conceptions of teaching and learning

Individual teacher and teacher action

General ideas related to being a teacher (100), e.g., pedagogical thinking

Cognitive aspects related to being a mathematics teacher

Subject matter knowledge in mathematics (110, 111)

Pedagogical content knowledge (teaching and learning mathematics) (120.121)

Pedagogical knowledge and skills (130, 131)

Knowledge and skills for classroom implementation (180,181)

Thinking skills and readiness for self development (140,141)

Affective aspects related to being a mathematics teacher (160, 161)

Personal characteristics of a teacher (attributes) (150,151)

Attitudes towards the teaching profession and willingness to develop (160, 161)

Teaching and school organisation in general (170)

PERSONAL PROCESS OF BECOMING A TEACHER

Background

Learning experiences and school attendance (200, 201, 202)

Teaching experience (210)

Motives for applying for teacher education (220)

Becoming a teacher

Self-development in teacher education (230)

Identifying with being a teacher (240)

Self-confidence as a teacher (242)

Acting as a teacher and learning at work (241)

Commitment to the teaching profession in future (250)

TEACHER EDUCATION SUPPORTING INDIVIDUAL DEVELOPMENT

Meaningfulness of and attitude towards the programme

Personal aims alongside the aims of the study programme (416)

Orientation toward the course (personal aims and expectations) (400)

Conceptions of mathematics and education as a discipline (415)

Added value of the course (new ideas) (402)

Individual process and consideration of personal background (403)

Combining theory with practice (404)

Contents and implementation of the study programme

Courses and study modules

Courses in university mathematics (mathematical education) (410)

Educational studies

Mathematics education (420)

Educational research seminar (minor thesis) (421)

General educational studies (430)

Special needs education (431)

Societal, historical and philosophical basis of education (432)

Psychology of development and learning (433)

Supervised teaching practice (440)

Teaching practice I (basic module)

Teaching practice II (applied module)

Teaching practice III (advanced)

Portfolio assessment work (450)

Implementation of the studies

Practical study arrangements (401)

Studying and methods used in the programme (407)

Social interaction within the course (480)

The overall view of the study programme

APPENDIX 12 (The first version of data categorisation, teacher educators)

Numbering in parenthesis is used for coding during the analysis.

Role as a teacher educator (100)

- Position in the study programme and responsibilities (110)
  - Background and motivational background (120)
  - Research interests (130)
  - Strengths as a teacher educator: personal image (140)
  - Need for further development (150)

- Relations with students (160)
- Relations with other teacher educators within the programme (170)

Conceptions of teaching and learning (ideal) (200)

- Image of an ideal teacher and good teaching (210)
  - Knowledge (the role of school subject)
  - Skills (interactional skills)
  - Personal features
  - Affects
  - Development of the school organisation
  - Becoming a good teacher?

- Special issues in being a teacher (220)
- Change in one's own views (230)

One's own course(s) as a part of the programme (300)

- Aims and essential content (310)
- Planning process (320)
- Implementation of the course (330)
  - Characteristics of student teachers (background, differences between disciplines) (340)

- Assessment of the course implementation: aims (350)
- Special support for formation of teacher identity (360)

Notions about students and their learning outcomes (370)

The overall view of the study programme

Aims and entrance examination (410)

Assessment of the programme: the significance for individual development (420)

Idea for further development: in general and for one’s own course (430)

Changes regarding the programme: renewal of the study programme (440)

APPENDIX 13 (The second version of data categorisation, teacher educators)

Numbering in parenthesis is used for coding during the analysis.

BACKGROUND OF A TEACHER EDUCATOR

Role as a teacher educator (100)

Background and motives for being as a teacher educator (educational background) (110)

Position in the study programme (120)

Research interests (130)

View of self as a teacher educator (140)

Strengths and shortcomings (141)

Relationships with other teacher educators (150!)

Conceptions of mathematics, teaching and learning (ideal) (200)

Image of the ideal (subject) teacher and about good teaching (210)

content knowledge and skills (211)

pedagogical content knowledge (learner's perspective) (212)

pedagogical knowledge; e.g., relationship with pupils, motivation (213)

personal features (attributes, social skills) (214)

affective aspects: attitudes towards the teaching profession, willingness for self-development

Special issues in being a teacher (220)

School as an organisation and organisational development (230)

Changes in one's own views (240!)

Views of mathematics as a discipline (special features) (250)

IMPLEMENTATION OF THE PROGRAMME

One's own course(s) as part of the programme (300)

Aims and essential content (310)

Special support for formation of teacher identity (311)

Planning process (320)

Implementation of the course (330)

Assessment of the course implementation (340!)

Notions about students and their learning outcomes

Ideas for development (350)

Relations with students (generally) (360)

Characteristics of student teachers (background) (361)

The overall view of the study programme (400)

Aims of the programme and essential content (entrance examination) (410)

Assessment of the programme: its significance for individual development (420)

Idea for further development in general (430)

Changes: renewal of the study programme (440)

APPENDIX 14 (The final version of data categorisation, teacher educators)

Numbering in parenthesis is used for coding during the analysis.

BACKGROUND OF A TEACHER EDUCATOR

Role as a teacher educator (100)

Background as a teacher educator (110)

Educational background (111)

One's own school and learning experiences (112)

Work experience (113)

Position in the study programme (120)

Research as a part of the work (130)

Conceptions of oneself as a teacher educator (140)

Strengths and needs for further development (141)

Relations with other teacher educators within the programme (150)

Conceptions of mathematics as a discipline in general (160)

Conceptions of good teaching and learning (in mathematics)

Image of the ideal teacher

General ideas related to being a teacher (210)

Cognitive aspects

Content knowledge (211)

Pedagogical content knowledge (212)

Pedagogical knowledge (213)

Affective aspects related to being a teacher (215)

Personal characteristics of a teacher (214)

Attitudes towards the teaching profession

Teaching and school organisation in general (220)

Changes in one's own conceptions of teaching and learning (230)

IMPLEMENTATION OF THE PROGRAMME

One's own course(s) as part of the programme

Aims and essential contents (310)

Special support for formation of teacher identity (311)

Preparation and planning of instruction (320)

Implementation of the course (330)

Assessment of the course (340)

Ideas for further development (341)

Relationship with students in general (350)

Characteristics of student teachers (351)

The overall view of the study programme

Aims and essential content (410)

Motivational background of student teachers and application procedure (420)

Assessment of the programme: its significance for individual development (430)

Idea for further development (440)

Changes regarding the programme (450)