To become - or not to become - a primary school mathematics teacher

A study of novice teachers’ professional identity development
TO BECOME - OR NOT TO BECOME

A PRIMARY SCHOOL MATHEMATICS TEACHER

HANNA PALMER

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- a primary school
mathematics teacher

Hanna Palmér
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Abstract


This thesis is about the process of becoming, or not becoming, a primary school mathematics teacher. The aim is to understand and describe the professional identity development of novice primary school mathematics teachers from the perspective of the novice teachers themselves.

The study is a case study with an ethnographic direction where seven novice teachers have been followed from their graduation and two years onwards. The ethnographic direction has been used to make visible the whole process of identity development, both the individual and the social part. The empirical material in the study consists of self-recordings made by the respondents, observations and interviews. The empirical material is analysed in two different but co-operating ways. First a conceptual framework was developed and used as a lens. Second, methods inspired by grounded theory are used. The purpose of using them both is to retain the perspective of the respondents as far as possible.

At the time of graduation the respondents are members in a community of reform mathematics teaching and they want to reform mathematics teaching in schools. In their visions they strive away from their own experiences of mathematics in school and practice periods. Four cases are presented closely in the thesis as they show four various routes into, and out of, the teaching profession. These four cases make visible that the respondents’ patterns of participation regarding teaching mathematics changes when they become members in new communities of practice with mathematics teaching as part of the shared repertoire. But, the four cases also make visible that the existence of such communities of practice seems to be rare and that the respondents’ different working conditions limit their possibilities of becoming members in those that exist. During the time span of this study, the respondents hardly receive any feedback for their performance as mathematics teachers. Even if they teach mathematics they don’t teach it as they would like to and they don’t think of themselves as mathematics teachers. Two years after graduation none of the respondents has developed a professional identity as primary school mathematics teacher.

A primary school teacher in Sweden is a teacher of many subjects but they are the first teachers to teach our school children mathematics. For the respondents to develop a sense of themselves as a kind of primary school mathematics teacher, mathematics teaching has to become part of their teacher identities. For this to become possible, mathematics must become a part of their image of a primary school teacher as an image of a primary school mathematics teacher. Furthermore memberships in communities of practice with mathematics in the shared repertoire must be accessible, both during teacher education and after graduation. Then professional identity development as a primary school teacher would include becoming and being a teacher of mathematics.

Keywords: Primary school mathematics teacher, Professional identity development, Novice teacher, Ethnographic case study.
Acknowledgements

Why did I become interested in mathematics education and research? When writing these acknowledgements in the end of the process of making this thesis I still don’t know the answer (or answers) to that question (or questions). However, I do know that the process of making this thesis has involved many different experiences and many different moods.

I have been in schools together with novice teachers and their students, I have attended uncountable hours of lectures and seminars and I have been working on my own even more hours. Some days have brought joy while others have been more hardscrabbled. In summary, the process of writing this thesis has meant a busy, varied and interesting time.

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1. THE SETTING OF THE STUDY

This thesis is about the process of becoming, or not becoming, a primary school mathematics teacher. I am a primary school teacher and taught various subjects in primary school for several years before starting to work with primary school teacher education in mathematics. Working with student teachers made me curious about the journey of becoming and being a primary school teacher with focus on mathematics teaching. I started to evaluate my own professional primary school teacher journey which began as a substitute grade two teacher in a small municipality and ended (although the end was the beginning of something new) some years later when I began working as a teacher educator. Gradually a wish grew to better understand the process of becoming and being a primary school teacher with focus on mathematics teaching. Based on that wish, this thesis is about professional identity development.

Professional identity is the part of an individual’s identity which deals with a professional role and is, according to Heggen (2008), neither created nor finished within professional education because professional identity development is not about concepts, skills or knowledge. It is about how the individual understands him/herself as a professional actor. Such an understanding develops gradually. Becoming qualified within a profession, such as the teaching profession, is about identifying oneself as a professional practitioner in the field and one’s professional development regards both who one is and who one wants to become.

There are many studies regarding novice mathematics teachers and how they teach or, more often, how they do not teach, as intended based on their teacher training. For example, several of the studies that Cooney (2001), Phillip (2007) and Sowder (2007) refer to in their research reviews show that teacher education has little effect on student teachers, and that what student teachers learn in teacher education tends to regress when they start working as teachers. These studies often provide an external perspective where the researcher observes and evaluates teaching. Based on these studies, the perspective of the novice teachers themselves became important in the present study when trying to understand the process of becoming a primary school mathematics teacher.

The phrase in the title - to become, or not to become - is based on the perspective of the novice teachers themselves. Initially the intention with the study was to investigate novice primary school teachers’ becoming and being as primary school mathematics teachers. However, based on the perspective of the novice teachers themselves, the absence of becoming and consequently also being a primary school mathematics teacher turned out to be one central finding in the study to be presented.

The ideal for this study would have been to investigate the process of becoming, or not becoming, a primary school mathematics teacher from the beginning of teacher education and continuing through the first years of teaching. However, this was not possible within the time allotted to this thesis and, instead, the period focused on is the first two years after teacher education. Hopefully, an understanding of becoming a primary school mathematics teacher after teacher education can also reflect important aspects from within teacher education.
1.1 Aim

The aim of this thesis is to understand and describe the professional identity development of novice primary school mathematics teachers. The aim is to investigate this professional identity development from the perspective of the novice teachers themselves. This perspective implies focusing on that which the novice teachers focus on. It is about me as a researcher placing myself beside the respondents and trying to experience the world as they do. However, the descriptions of these experiences are always based on my interpretation of the novice teachers' perspective in these mutual experiences.

Based on the aim to understand and describe the professional identity development of novice primary school mathematics teachers from the perspective of the novice teachers themselves, an ethnographic direction is used in the study. This direction is described later in the chapter 'Design and analysis of the empirical material' but the intention has been to get as close as possible to the process of becoming a primary school mathematics teacher. One central aspect relating to this is, that even though the starting point of the study is primary school mathematics teachers, this starting point does not say anything about if or how mathematics may be important or not in the respondents' professional identity development. As a researcher, one should be careful about assuming that a thing being focused on in interviews and observations are also of importance to the respondents. The ethnographic direction in this study offers the possibility to discover the role of mathematics in the professional identity development of the respondents in the study.

The empirical material is analysed in two different but co-operating ways. First a conceptual framework is developed and used as a lens. Second, analysis methods inspired by grounded theory are used. These two ways are described later in the chapters 'Theoretical framing' and 'Design and analysis of the empirical material'. However, the purpose of using them both is to retain the perspective of the respondents as far as possible. As a consequence of the ethnographic direction and the use of grounded theory, no explicit research questions were initially created in addition to the aim of the study. Based on the aim to understand and describe the professional identity development of novice primary school mathematics teachers from the perspective of the novice teachers themselves, the questions to be answered about this process have to arise from the perspective of the respondents during the empirical phase of the study.

1.2 The outline of the thesis

This thesis consists of seven chapters whereof the first, i.e. this chapter, presents the setting of the study. This chapter contains a presentation of previous studies, a presentation of the teacher education from which the respondents in the study were just about to graduate and a presentation of the working situation for novice teachers in Sweden during the time for this study. In the two following chapters, the theoretical framing and the design of empirical material are presented. In the fourth, fifth and sixth chapters, the results are presented. These results are generated from both the analysis made using the conceptual framework as a lens and the categories developed by methods inspired by grounded theory. These two different kinds of
results are connected when trying to understand and describe the process of becoming (or not becoming) a primary school mathematics teacher. The seventh and final chapter contains discussions regarding the theoretical framing, the methods used, the results and the quality of the thesis.

1.3 Notions used frequently in the thesis

Student teacher – a student in teacher education  
Novice teacher – a newly graduated teacher  
Teacher educator – a teacher working in teacher education  
Placement supervisor – a teacher supervising student teachers’ during practice periods  
Primary school teacher – a teacher educated to teach in primary school which in Sweden implies grades one to six  
Class teacher – a teacher who has responsibility for and teaches the majority of subjects in one class, most primary school teachers are class teachers  
Mathematics teacher – a teacher teaching mathematics  
Primary school mathematics teacher – a primary school teacher who teaches mathematics  
Remedial teacher – a teacher working with children in special needs  
Lower primary school – grades one to three  
Upper primary school – grades four to six  
Lower secondary school – grades seven to nine.  
Short run substitute teacher – a teacher substituting for another teacher for one or a few days on short notice  
Long run substitute teacher – a teacher who substitutes for another teacher for a long time, e.g. one month or a semester

1.4 Previous studies

The literature presented in this section has been sought gradually through different databases using the following search words in different combinations: primary, teacher, novice, mathematics, mathematics teaching, professional, identity, identity development, reform, beliefs and knowledge. The searches have resulted in a wide range of literature, for example articles, books, reports, theses and handbooks. The studies presented in this section are categorised based on three themes: studies regarding (student) teachers own schooling, beliefs, subject knowledge and professional identity; studies regarding the mathematics teaching profession as a changed profession and studies regarding becoming and being a teacher within this changed profession. The purpose is to illustrate the point of departure of this study and also to illustrate gaps in knowledge that this study hopefully will contribute to filling.
1.4.1 Studies regarding (student) teachers own schooling, mathematics knowledge, beliefs and professional identity.

Own schooling is often attributed an important value in relation to how teachers and student teachers think about teaching and how they teach (Wang, Odell & Schwille, 2008). In a study by Gellert (2000), those student teachers who remembered their own schooling in mathematics as frightening, viewed it as their mission as mathematics teachers to protect their students from similar experiences. Their strategy was to reduce the mathematics content to areas where they felt secure and to avoid abstraction. Furthermore, these student teachers viewed games and problem solving as methods of making mathematics more fun without focusing on their mathematical purpose. However, in a study of non-specialist primary school mathematics teachers Hodgen and Askew (2007) found that the teachers, even if having negative experiences of their own school mathematics, through professional development could develop an identity as a teacher of mathematics. For this to happen the teacher had to “reconnect with mathematics whilst maintaining an identity as a primary teacher” (p.482).

Based on Swedish conditions, Persson (2009b) studied the motives for becoming a teacher and the images of teachers held by secondary student teachers (whereof one mathematics teacher). Persson writes about the teaching profession being special as all students have experienced it and based on that experience, the students develop individual images of teachers and teaching. The teacher role-model held by student teachers becomes an essential source of identification and contribute to the respondents’ images of the profession. The student teachers in Persson’s study embraced values and behaviours typical of the group they wanted to be a part of. Similar findings were made by Wolf-Watz (2004) in her study of Swedish novice science and mathematics teachers. According to Wolf-Watz the novice teachers had learned in school what it means to be a teacher of science and mathematics and they brought those beliefs and conceptions into teacher education and then later into the schools where they started to work.

One classic study is Lortie’s, from 1975, which emphasises that before starting their teacher education student teachers have experienced more than 2000 hours of teaching. These 2 000 hours have shaped both their images of teaching and learning as well as their understanding of mathematics. Similar studies by Frykholm (1999) show that teacher education has limited impact on student teachers’ knowledge and beliefs about teaching and that what is being learned in teacher education tends to regress after graduation when the student teachers start teaching. According to Frykholm, student teachers take decisions about teaching based on earlier experiences often established in settings very different to those in which they themselves are supposed to teach. Even if the student teachers develop their own knowledge of mathematics, they do not change their beliefs about how students should learn mathematics. However, based on an overview of studies showing the same results as Frykholm’s and Lortie’s above, though done almost 20 years before Frykholm’s study, Zeichner and Tabachnick (1981) claim that also the culture at the universities needs to be critically investigated if one wants to understand the professional development of teachers. According to Zeichner and Tabachnick, the question of teachers’ professional development must be connected to the social, economic and political contexts in both universities and schools.

Many previous studies regarding becoming and being a (primary school) mathematics teacher have focused on mathematical knowledge (or lack of knowledge)
or beliefs, and knowledge and beliefs, separated or connected, are often stressed as important components in teachers’ professional competence. However, no consensus exists regarding the meaning of knowledge or beliefs or regarding their relations to each other. In some definitions, beliefs are described as unsure knowledge while knowledge is described by others as secure beliefs (Phillip, 2007). Both definitions give an impression of one being a component of the other, but if so, which one is the component? Schoenfeld (1998) integrates knowledge, beliefs and individual goals, focusing on how teachers activate the three components in different situations. In his model, none of the components have priority over the others and they all affect each other. Other researchers emphasise the importance of separate beliefs and knowledge and treat them as two separate parts of professional competence (Phillip, 2007). In some research, teachers’ beliefs about mathematics, learning mathematics and mathematics teaching are viewed as being based on teachers’ knowledge of mathematics (Hill et al., 2008). The consequence of that view is a focus on teachers’ knowledge of mathematics. Conversely, others view beliefs as the main interest, as teachers with similar mathematical knowledge have been shown to teach differently (Ernest, 1989; Thompson, 1992; Phillip, 2007). In recent years studies of professional (mathematics) teacher identity has increased based on limitations experienced in studies of beliefs and knowledge (Ponte & Chapman, 2008). Below these three directions in studies (knowledge – beliefs – professional identity) will be further presented in separate sections.

Studies regarding (student) teachers own mathematics knowledge

In order to teach mathematics, teachers need to know not only mathematics but also about mathematics teaching (Ponte & Chapman, 2008). According to Cochrane-Smith and Lytle (1999), there are three “prominent conceptions of teacher learning” (p.250): knowledge for practice, knowledge in practice and knowledge of practice. Knowledge for practice regards the acquisition of knowledge already known by others in, for example, teacher education or in-service courses. The knowledge to be learned, the knowledge base, exists in itself outside of the profession and the basic idea is that the more a teacher knows of this knowledge base the better. Knowledge in practice is teaching as a trade, which is learned through teaching. That knowledge comes from inside the teaching profession and does not exist separately from the knower. Knowledge of practice refers to when teachers use their own school and their own classroom to investigate learning, knowledge and theories which generate knowledge of practice.

Regardless of knowledge for/in/of practice, the knowledge mathematics teachers have and/or need to have has been the focus of many studies with different purposes with an assumption that there is specificity to the mathematics that teachers need to know and know how to use (Davis & Simmt, 2006). The focus of these studies varies between the knowledge teachers have, the knowledge teachers use and the knowledge needed to teach mathematics. The common aim is to identify the professional knowledge that teachers need to have able to teach mathematics successfully (Hill, Sleep, Lewis & Ball, 2007) but in research there is no consensus regarding what teachers need to know (Davis & Simmt, 2006).

Many studies regarding teacher knowledge refer to Shulman (1986) who in the mid-1980s started to develop a model of teachers’ professional knowledge. His starting point was to reintroduce content knowledge as a part of the knowledge
needed by teachers. Through comparing tests for teachers in the USA, he had found that content knowledge had dominated in 1875 but was totally absent one hundred years later. Further, the tests were the same for teachers in all subjects and Schulman questioned if any person with teacher knowledge could teach any content. It was not just in these American tests that content knowledge was missing but also in research about teaching. Shulman called this “the missing paradigm” (p.6) because “[w]hat we miss are questions about the content of the lessons taught” (p.8). He also questioned the practice of focusing solely on content knowledge or pedagogical knowledge when researching teachers. Instead he wanted to understand “[h]ow does learning for teaching occur?” (p.8) and suggested three categories of content knowledge: content knowledge, pedagogical content knowledge (content knowledge for teaching) and curricular knowledge.

Shulman’s (1986) interest expanded to professional knowledge for teachers as “a codified or codifiable aggregation of knowledge, skill, understanding, and technology, of ethics and disposition, of collective responsibility – as well as a means for representing and communicating it” (p.4). However, an assumption of the existence of such a professional knowledge does not say anything about what it contains, what it is that teachers are to know, understand and do. In 1987, Shulman presented a model of professional knowledge for teachers, including content knowledge, curricular knowledge, general pedagogical knowledge, pedagogical content knowledge, knowledge of learners, knowledge of educational contexts and knowledge of educational ends. He stressed that the knowledge base he presented was not fixed or final but to be further investigated and refined.

Shulman’s model did not focus specifically on mathematics teachers. It was first in the 1990s that research into mathematics teachers started to focus on the mathematics content. According to Sowder (2007), two common misconceptions are that the content knowledge needed by teachers can be learned through ordinary courses in mathematics and that knowledge in mathematics is the only knowledge a mathematics teacher needs. Shulman’s model inspired research in the direction that teachers may use content knowledge in a unique way in teaching (Hill et al., 2007).

Based on Shulman’s model, Ball & Bass (2000) and Ball, Lubinski & Mewborn (2001) developed a description of mathematical knowledge for teaching. Mathematical knowledge for teaching refers to a special kind of knowledge in mathematics: the knowledge needed for teaching mathematics. Within teaching mathematics, Ball et al. (2001) and Ball, Thames & Phelps (2008) include everything a teacher does to support students’ learning of mathematics, for example: interaction in the classroom with its questions, planning of lessons, evaluation of students’ work, writing and correcting tests, contact with parents, planning and correcting homework, attending conferences and so on. All this involves mathematical knowledge for teaching.

Of special interest to Ball and her colleagues has been special content knowledge as the specific kind of mathematical knowledge needed for a mathematics teacher. According to Shulman (1987), Bromme (1994) and Ball et al. (2001), there is a difference between knowing mathematics and being able to teach mathematics. Ball et al. (2001) distinguish between content knowledge in mathematics as an academic discipline and content knowledge in relation to the mathematics taught in school. Content knowledge for teaching mathematics is qualitatively different and means more than knowing mathematics in the academic discipline. The mathematical problems and challenges a mathematics teacher faces are different to, for example, those faced by an engineer or astronaut and, therefore, other content knowledge is needed. Analysing wrong answers, using multiple representations, developing
alternative explanations and choosing usable definitions are examples of the professionally specific content knowledge needed by teachers. Pedagogical content knowledge is special knowledge which interconnects content knowledge with pedagogical knowledge. This is unique content knowledge with a core of pedagogical knowledge. For a mathematics teacher, it can imply knowledge about how students usually use and understand different representations or knowledge about mathematical operations that are often difficult for students. Curricular knowledge is knowledge about classroom organisation, teaching environments, curriculums of one’s own and other grades and subjects.

Several studies by Ball and colleagues (e.g. Ball, 1990) show that student teachers lack a rich understanding of mathematics and because of that do not see the connections between different parts within mathematics. These limitations make it hard to manage teaching in line with the intentions of the curriculum. Similarly, Cooney and Wiegel (2003) argue that primary school teachers often lack the knowledge of mathematics needed to perform mathematics teaching beyond rules and procedural knowledge. However, Ball and her colleagues and Cooney and Wiegel do not consider studies in advanced mathematics as automatically resulting in mathematics teaching focused on students’ thinking, problem solving, reasoning and connections even though such studies can be fundamental for that kind of teaching.

Based on the main interest in special content knowledge, Ball et al. (2008) further developed content knowledge into four components: common content knowledge, specialised content knowledge, knowledge about content and students and knowledge about content and teaching, where the last two coincide with pedagogical content knowledge. Common content knowledge is mathematical knowledge used in contexts other than teaching while specialised content knowledge is mathematical knowledge unique to teaching. Knowledge about content and students is knowledge that combines knowledge of students with knowledge of mathematics. Knowledge about content and teaching is knowledge that combines knowledge of teaching with knowledge of mathematics.

The research of Ball and colleagues is empirical and, according to Ball et al. (2008), it is difficult to discover what mathematical knowledge is specific to teachers. Also, it is difficult to discover how much of mathematical knowledge for teaching is culturally specific or dependent on a teacher’s teaching style. Similarly, Wilson & Cooney (2002) stress knowledge being a relative notion dependent on the context within which it operates. Llinares and Krainer (2006) write that research into knowledge for teaching has shown how complex it is and indicate a shift from treating mathematical knowledge for teaching as independent of context and instead treat it as situated in the context of teaching. Ball et al. (2001) also stress the difference between talking about teaching and actually teaching; therefore, mathematical knowledge for teaching needs to be investigated in the context of teaching.

Davis and Simmt (2006) and Baumert et al. (2010) refer to the work of Shulman and Ball and colleagues in their research regarding the knowledge needed for mathematics teachers. Davis and Simmt (2006) name this knowledge mathematics-for-teaching, implying on the knowledge needed of mathematics teachers in order to teach mathematics successfully. Mathematics-for-teaching is neither a matter of more nor to a greater depth than ordinary mathematics, it is qualitatively different. Based on empirical research Davis and Simmt stress four intertwined, not exhaustive, aspects of teachers’ mathematics-for-teaching: mathematical objects (including the ability to translate notions from one symbolic system to another), curriculum
structures, classroom collectively (since teaching mathematics always occurs in contexts that involve others) and subjective understanding. The aspects not being exhaustive imply that many other "levels of complex organization [...] affect and are affected by mathematics pedagogy" (Davis & Simmt, 2006, p.316). According to Davis and Simmt, fluency within the four aspects is important for mathematics teaching and they therefore should serve as appropriate emphases for courses in mathematics intended for teachers.

Baumert et al. (2010) investigated the connection between mathematics teachers' content knowledge, pedagogical content knowledge, instruction and students learning. Their core question was if each of content knowledge and pedagogical content knowledge make a unique contribution to instruction and students’ progress. They found both content knowledge and pedagogical content knowledge to be critical professional resources for teachers whereof pedagogical content knowledge largely was what determined the mathematical learning opportunities for the students. Content knowledge was a lower prediction for student learning but since content knowledge defines the possible scope for pedagogical content knowledge it is still as important. Therefore it is, according to Baumert and colleagues, not possible to offset the relationship between the two and focus on only pedagogical content knowledge for teachers.

Ma (1999) studied the mathematical knowledge of mathematics teachers in a comparative study of Chinese and American teachers. Her results show that almost all of the American teachers had procedural knowledge while the Chinese teachers, though having a shorter teacher education, had both procedural and conceptual knowledge. The limitations in the American teachers’ knowledge were mirrored in their expectations of students’ learning as well as their ability to teach in a way promoting conceptual learning. Ma found that the Chinese teachers had the mathematics teaching content arranged in “knowledge packages” consisting of different mathematical content connected in various ways which together offered a solid understanding. These knowledge packages contained both procedural and conceptual knowledge. Some parts in the knowledge packages were key-ideas and others were concept knots. The Chinese teachers were the holders of several knowledge packages like this which enabled them to view mathematics content group-by-group and not part-by-part. Also, the different packages were related to each other.

Ma’s results showed that the American teachers’ wish to “teach for understanding” was impossible due to their own lack of content knowledge. Teachers could not make students understand content they did not understand themselves. Content knowledge alone does not automatically contribute to good mathematics teaching, but it is a precondition. Ma calls the mathematics knowledge needed for a teacher profound understanding which means that the understanding of mathematics is deep, vast and thorough. When teaching, teachers with such knowledge can connect mathematical ideas by using multiple perspectives. The mathematics that the teachers need profound understanding of is primary school mathematics, which Ma calls fundamental mathematics. This sort of mathematics is fundamental as it is elementary, foundational, and primary. Elementary denotes being at the beginning of learning mathematics, foundational as it offers the foundations of the students’ continued learning and primary as it contains the first principles of more advanced mathematical concepts.

Ma also investigated how the Chinese teachers had achieved this profound understanding and explains it as a positive whirl. The student teachers in teacher
education have a good knowledge in mathematics (through having been taught by teachers with profound understanding), and in teacher education possible misunderstandings and teaching mathematics are focused on. However, profound understanding is reached first after graduation through the collective and individual work with mathematics by the mathematics teachers in schools. In primary school, Chinese mathematics teachers teach only mathematics and they develop a profound understanding by cooperating with colleagues, by teaching the same grade several times, by solving mathematics problems by themselves and by close studies of the teaching material.

[...] the interaction between the consideration of what to teach and how to teach it seems to be the “axle” that runs the “wheel,” while the collegiality among teachers serves as the “spokes” that connect all the pieces (Ma, 1999, p.141).

If one wants to improve the American teachers, Ma stresses that changes need to be made both in schools and in teacher education. This as the student teachers in China, as mentioned above, already have better knowledge of mathematics when starting teacher education. That is why just changing teacher education for the American teachers is not enough. One problem in America is teachers’ working conditions, which give them less time for preparation and more to prepare (teaching several subjects). Because of such organisational factors, the time required to develop the profound understanding that the Chinese teachers have after graduation, according to Ma, does not exist for the American teachers.

Rowland, Huckstep and Thwaites (2005) and Turner and Rowland (2011) refer to the work of Ma and Shulman when introducing the knowledge quartet. The knowledge quartet is an empirically-based framework developed for identification and discussion of mathematics content knowledge observed in teaching. The framework contains foundation, transformation, connection and contingency which is used to identify and describe various ways in which mathematics content knowledge influence the choices and actions of (novice) teachers in the classroom. Foundation is about possessed knowledge and understanding of mathematics, knowledge of significant tracts of the literature and thinking and beliefs about mathematics including beliefs about why and how it is learnt. Transformation, connection and contingency refer to ways and contexts in which knowledge is used in preparation and teaching. Transformation regards how the possessed content knowledge is transformed into pedagogical forms. Connection regards choices and decisions made within discrete parts of mathematics content as the coherence of the planning or teaching across an episode, lesson or series of lessons. Contingency regards contingents actions as the teacher’s response to classroom events that were not anticipated in the planning. The knowledge quartet is used by Rowland et al. (2005) and Turner and Rowland (2011) to identify and develop mathematics teaching with focus on mathematics content knowledge.

Even though there are many differences in the research presented above regarding knowledge there is also resemblance. According to Petrou and Goulding (2011) different models regarding teacher knowledge can be understood as elaborating of, and not replacing of, Shulman’s content-related categories of teacher knowledge. All the models focus on content as an important part of teaching. Regardless of using the label mathematical knowledge for teaching, profound understanding, mathematics-
for-teaching or knowledge quartet, research shows that multifaceted mathematical knowledge is an important part of becoming a primary school mathematics teacher.

Studies regarding (student) teachers beliefs

Over the past 15 years, there has been considerable amount of research on teachers' beliefs based on the assumption that what teachers believe is a significant determiner of what gets taught, how it gets taught, and what gets learned in the classroom (Wilson & Cooney, 2002, p.128).

In beliefs studies, beliefs are often not defined and when it is defined the definitions are not uniform (Mcleod & Mcleod, 2002). Phillip (2007) defines beliefs as “Psychologically held understandings, premises, or propositions about the world that are thought to be true. [...] Beliefs might be thought of as lenses that affect one’s view of some aspect of the world or as dispositions towards action” (Phillip, 2007, p.259). Goldin (2002) explains beliefs as internal representations being true for the individual. Schoenfeld (1998) explains beliefs as mental constructions representing the codification of the experiences and understandings of the individuals. These mental constructions form what the individual perceives in a situation, what the individual thinks as possible or suitable in the situation, the goals the individual puts up for the situation and the knowledge they bring into the situation.

According to Pajares (1992), the diversity in the definitions of beliefs derives from beliefs being studied within different research fields with varying aims. The varying aims he describes as differences in trying to find out what beliefs are, how beliefs are formed or the consequences of beliefs on our actions. Beliefs research often regards categorisations of beliefs about mathematics, learning and teaching and there are almost as many different categories as researchers. Typical beliefs research compares beliefs and practice by comparing categories of teachers’ beliefs and categories of teachers’ teaching. Below, research is presented regarding what beliefs are, how beliefs are formed and the consequences of beliefs on our actions. The references Phillip (2007) and Pajares (1992) are research overviews while the other references refer to the authors’ own research.

When dealing with the question of what beliefs are, Ambroose (2004), McLeod (1994) and Pajares (1992) write that beliefs have two primary sources: emotional experiences and cultural transfer. It is the emotional part that distinguishes beliefs from other kinds of knowledge. According to Goldin (2002), the foundations for beliefs can be social or individual since beliefs can be personal or socially shared beliefs. Based on that, a researcher can choose the individual or the social as the unit of analysis. Socially shared beliefs are not to be confused with normative beliefs which are beliefs you are supposed to have. However, the truth-value of beliefs is always within the individual, even when dealing with social or normative beliefs.

Based on his research overview, Pajares (1992) explains beliefs as not isolated from other beliefs but existing in clusters more or less isolated from other clusters. Beliefs-systems is a metaphor for beliefs being organised in such clusters, usually around an idea or an object. On the one hand, these beliefs-systems are personal and unique to

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1 Beliefs research is practiced within several different fields (see, for example, Fives and Buehl, 2012, for an overview). Here only research done within mathematics education is focused on. However, the problems in beliefs research presented here also exist within the other fields.
the individual; on the other hand, they refer to socially or culturally shared beliefs-systems within which individual beliefs are grounded. Beliefs-systems are not logically organised in a deductive sense but are logically organised from the perspective of the individual. Beliefs within beliefs-systems can be primary or secondary and central (other beliefs depend on them) or peripheral (they depend on central beliefs). Beliefs within a beliefs-system can also contradict each other. In another research overview, Phillips (2007) refers to studies explaining beliefs systems as being organised based on the truth value for the individual. Beliefs which have total consensus are the most central for the individual while beliefs which do not have the same consensus are less central. In the review, the importance of studying the relationships between beliefs-systems regarding mathematics teaching and larger beliefs-systems regarding teaching and learning in general are stressed.

Just like the research regarding knowledge, described in the last section, research regarding beliefs has focused on the change and/or development of beliefs. Fundamental questions are if beliefs are changeable or static and how to best change beliefs if they are changeable. According to Phillip (2007), one question in beliefs research is if changes in beliefs occur before or after changes in practice. Phillip writes that changes in beliefs can result in changes in practice and vice versa but that when one changes the other does not always change. To be able to change beliefs, you must know the beliefs held by the individual and how these beliefs are held. According to Goldin (2002), strong and resistant beliefs are those shown to be usable and powerful for the individual. This strength can be viewed from two perspectives, partly based on their magnitude of importance for the individual, and partly based on how true they are experienced for the individual. In his review, Pajares (1992) refers to studies which imply that time is important in relation to beliefs as the earlier the beliefs emerge, the stronger they are. This as they have filtered the later experiences of the individual. Newer beliefs are more vulnerable and easily influenced. Other studies show that individuals are reluctant to change their beliefs and, instead, try to interpret new experiences as old beliefs.

In several studies, teachers’ actions appear as inconsistent towards their beliefs. This is explained in different ways, for example as beliefs being situated. According to Skott (2001), beliefs are not situated, as changing in different situations. The teachers’ goals are what changes between situations. In a teaching situation, a teacher’s beliefs about mathematics interact with other beliefs of importance in the classroom, and inconsequences between actions and beliefs can be explained by the teacher’s goals in different situations. In every teacher-student interaction, there are competing motives and objects which make the contextualisation of the teacher’s beliefs about mathematics, mathematics as a school subject, teaching and learning different in different situations. Three other explanations for inconsistencies between actions and beliefs are that the individuals actually are being inconsistent, that other, not yet investigated, beliefs are dominant in the situation or that the individuals have unconscious beliefs (Wilson & Cooney, 2002).

However, Wilson and Cooney argue that it is problematic when research claims there is inconsistency between teachers’ beliefs and actions. According to them, there can be several other explanations for the studied beliefs not being in line with the studied actions. One explanation is that the researcher and the teacher have different interpretations of concepts, another is that the teacher might not act according to their beliefs in the situation due to practical or logistical circumstances. A third explanation is that the researched beliefs are peripheral to the teacher and that other more central beliefs are the ones being expressed in the actions. Speer (2005) focuses
on inconsistency between beliefs and actions looking at the consequences of the research methods applied. Just like Wilson & Cooney (2002), Speer argues that it is problematic when research claims inconsistency between teachers’ beliefs and actions. She thinks of teachers’ actions as expressions of their beliefs but sometimes with researchers and teachers having different understandings of the used concepts. Therefore, to say that actions are not in line with beliefs is an expression of the opinion of the researcher and not the teacher. Speer emphasises that all beliefs being attributed by the researcher and the absence of shared understanding of concepts risks the researcher and teacher using the same concepts but with different meanings. That, in turn, becomes a source of inconsistency between beliefs and actions.

According to Phillip (2007), inconsistency between beliefs and actions stop existing when researchers better understand teachers’ thinking in relation to the context. He suggests the starting point in beliefs research should be that there are no contradictions or inconsistencies between beliefs and actions.

[…] inconsistencies exist only in our minds, not within the teachers, and [we] would strive to understand the teachers’ perspectives to resolve the inconsistencies. Inconsistencies should still present problems, but for the researchers instead of teachers. (Phillip, 2007, p.276).

In recent years, one focus in beliefs research has been the problems within the research, partly regarding the absence of common definitions and partly regarding the problems with inconsistency in definitions and results. Skott (2010) explicates three problems: methodological problems in the circular argument practice being explained by beliefs and beliefs being inferred from observations of practice, the problem with the assumption that using different research methods will help shed light on the same beliefs, and the problem with the assumption of beliefs being an explanatory factor for practice and being stable across contexts. Skott writes that beliefs research is based on alienation where reified objects (beliefs) are expected to manifest themselves into actions irrespectively of how the teacher in question experiences the situations. When this is not the case, it is explained as the individual not following their beliefs, having other stronger but yet undiscovered beliefs, being inconsistent to their beliefs or having unconscious beliefs. The last is not in line with the current more socially turned research in mathematics education.

Similarly, Lerman (2002) and Lester (2002) emphasise the problem of practice being explained by beliefs at the same time as beliefs being considered as hidden within the individual and only possible to investigate through utterance and actions in the same practice as it is supposed to explain. According to Lester (2002), fundamental statements within beliefs research rest on weak logic foundations, especially the statement that beliefs affect the thinking and actions of the individual. Lester mentions two solutions to the problem, firstly, a thorough analysis of the notions and methodologies and, secondly, development of methods that make it possible to investigate beliefs directly and not based on individuals’ actions. Similar Speer (2008) expresses methodological developments as the solution to the problems within beliefs research, implying that researchers need to develop methods which they can have confidence in and ensure that respondents have the same understanding of the investigated notions. The assumption that new research methods will solve the problems within beliefs research is, however, as mentioned above, one of the problems with beliefs research mentioned by Skott (2010).
Studies regarding (student) teachers professional identity

As becoming a (mathematics) teacher involves a process of identity change, research on teachers’ professional identity formation has expanded in recent years with the mutual goal to better understand and support the needs of teachers, including student teachers (Beijgaard, Meijer & Verloop, 2004; Bjuland, Luiza Cestari & Borgersen 2012; Gee 2000-2001, Ponte & Chapman, 2008, Sfard & Prusak, 2005). The increased number of studies of professional identity has coincided with the social turn in mathematics education (Lerman, 2000), which will be further described in chapter two. In studies of identity the notion of identity is defined differently or not at all (Beijgaard, Meijer & Verloop, 2004). Definitions of identity will be focused on in chapter two in relation to the conceptual framework.

Identity incorporates a wide range of “concepts and structures, conventions, processes, skills, pleasure, satisfaction and frustration, aesthetics, a sense of wonder, and perhaps other aspects of mathematical activity […] into a unit of analysis” (Lerman, 2009 p.157). Similarly Valero (2009) writes that identity is a unit of analysis that allows concentration on the whole rather than on part of the person and on this person’s becoming, rather than knowing. Identity also plays a pivotal role in understanding the relationship between human agency and social structure.

Research […] into teacher identities is important as a means of furthering understandings of the job of teaching and what it means to be a teacher in different policy and personal contexts and different times (Day & Kington, 2008 p.9).

A teacher’s identity is neither totally collective nor totally individual. A teacher is expected to have some characteristic professional knowledge, goals and attitudes but, at the same time, teachers are autonomous and differ with regard to knowledge, goals and attitudes (Beijgaard, Meijer & Verloop, 2004). Further, the teaching profession is practiced in several different contexts, which creates a plural teacher identity, including, for example, a mathematics thinker, a teacher in the classroom, a mentor for students, a colleague, a participant in teaching and so on. The unified professional identity is a mathematics teacher but it is practiced in different contexts in different communities, for example in the classroom and at meetings, and is therefore affected differently (Schifter, 1996). Similarly, Sachs (2001) writes that every teacher has multiple professional identities, for example those of teacher, primary school teacher and teacher in different subjects.

According to Ponte and Chapman (2008), the development of a teacher’s identity is a continuing and dynamic process with multiple influences from educational, social, historical and cultural contexts in which teachers learn and work. The increase in studies of professional identity is based on the uselessness of knowing about beliefs and/or knowledge unless one understands the role of teachers and their actions in the classroom. Studies of professional identity consider not only what teachers know and/or believe but also who they are, how they view themselves as teachers, how they relate to students, how they deal with problems, how they reflect on issues, and how they identify themselves with the profession. Important, too, are their relations with parents and colleagues, their participations in professional groups and the kind of teacher they want to be.

Below, studies of the professional identity of student teachers will be presented first, followed by studies of the professional identity of teachers in general and in
relation to teaching mathematics in particular. Some of the studies presented are similar to those presented further on in the section headed *Studies regarding becoming and being a teacher within a changed profession*. The selection of studies in this section is based on their expressed focus on professional identity.

Chong and Low (2009), Chong, Low and Goh (2011) and Anspal, Eisenschmidt and Löfström (2012) have studied primary school student teachers’ professional identity development during teacher education. In the study of Anspal et al. (2012) the student teachers during their teacher education underwent a gradual shift from focusing on teaching methods and skills acquisition towards focusing on students’ learning. Practice periods were shown to be highly influential for professional identity development. Opportunities for reflection in teacher education appeared to be another important task in supporting the development of a professional teacher identity. Chong and Low (2009) and Chong, Low and Goh (2011) studied the development of professional teacher identity in longitudinal studies within teacher education and the first year of teaching in Singapore. In the study from 2011 Chong, Low and Goh examined how the professional identity and teaching practice of student teachers depended on how they viewed themselves as teachers before beginning their teacher education. They also investigated whether or not this view was challenged in teacher education. Many of the student teachers in their study, all of whom were to become primary or secondary school teachers, characterized teaching as a noble and caring profession. However, they tended to enter the teacher education with simplistic and stereotypical views of teachers and teaching. This stereotypical view led to a mismatch between their original expectations and the reality they were confronted with. In the study from 2009, student teachers were studied both during their teacher education and one year after. This study shows that from their point of entry into the profession the student teachers are preoccupied with identifying themselves as teachers. Changes in the respondents’ perception of teaching and the profession could be related to influences from the environment in school and from social factors. A significant drop in the enthusiasm about teaching was found at the time of graduation and remained the same the first year of teaching. Chong, Low and Goh stress quality teacher induction programs as important for supporting novice teachers in coping and rebuilding the positive professional identity they brought into the teacher education in the first place.

In Scotland, the region studied by McNally, Blake, Corbin and Gray (2008), an introductory year is required for novice teachers before they receive their certificates. This introductory year guarantees them one year of teaching with access to a mentor. After studying novice teachers during this year, McNally et al. concluded that emotional and relational dimensions in learning are important. The transfer from teacher education to the introductory year does not become problematic for all the novice teachers but is to be seen as a shift in identity rather than as a progression in various stages. Becoming accepted as a teacher by colleagues but also by oneself seems a central issue. Relationships with colleagues and students are so important to the novice teachers that their sense of becoming and being a teacher seems to rely on creating such relationships. Similarly, Day, Kington, Stobart and Sammons (2006), in an overview of studies focusing on professional teacher identity, show that relations with students and school culture are important. Students’ attitudes and behavior have profound effects upon teachers’ professional identity as has cooperation with colleagues, particularly those teaching the same subject. A change in one of these two aspects (students – colleagues) results in instability in professional identity, because of the key role played by emotions in the construction of professional identity. For
primary school teachers Day et al. (2006) show that personal and professional identities are closely connected and contribute to motivation, commitment and job satisfaction. For secondary teachers, the subject taught has a strong and persistent influence, as well as relationships with colleagues teaching the same subject. In addition, the status of the subject has significance.

Flores and Day (2006) and Day and Kington (2008) have studied professional teacher identity in two longitudinal studies in England. In the study from 2006 novice teachers of elementary school (10-15 year olds) were studied their first two years of teaching. The study shows that personal and professional histories, pre-service training, school culture, working relationships and school leadership influenced the professional identity development of the novice teachers. Moreover, their own personal experience of being a student was important, whether positive or negative. During these first two years of teaching the novice teachers experienced isolation, a mismatch between idealistic expectations and classroom reality, and lack of support and guidance. Owing to this and to problems associated with classroom management a shift occurred in their teaching from an inductive and student-centered towards a more traditional and teacher-centered approach. In the study from 2008, primary and secondary school teachers’ professional identity were focused on from three perspectives: professional identity, situated identity and personal identity. The results show that teacher identity is neither stable nor intrinsically fragmented, but more or less stable or fragmented at different times for a number of personal, professional and situated reasons.

Troman (2008), McDougall (2010) and Morgan (2009) who have studied how primary school teachers’ professional identity is influenced by external demands and changes, conclude that professional teacher identity has become increasingly complex. Troman (2008) investigated changes in primary teachers’ professional identity in the context of high performative primary school cultures and found that the complexity of professional teacher identity increases in line with national commitment to raising achievement. “Primary teachers are developing complex identities in order to deal with the new and uncertain roles within rapid social, cultural and economic changes and the changing experience and meaning of work in post-industrial society” (Troman, 2008, p.630). McDougall (2010) studied how Australian primary school teachers’ professional identity was affected by changes in the curriculum. The changes focused on involved the effect on literacy, where media had been introduced as a new area in the curriculum. Three kinds of professional teacher identities were found in relation to the curriculum change: traditionalism, survival and futures-oriented identity. Teachers of younger children, in particular, were likely to subscribe to a more traditional agenda and continued to teach as before. Teachers in the survival group admitted to a lack of confidence in embracing new forms of literacy and were not confident in their ability to teach it. The futures-oriented teachers included those already teaching in line with the new curriculum. On the basis of the results, McDougall stresses the importance of teachers working together in groups, adding: “the teacher’s identity has become less certain in these new times and it is becoming increasingly difficult to stipulate what the core responsibilities of the primary teacher might be” (McDougall, 2010, p.686). Morgan (2009) studied mathematics teachers who received a new curriculum containing clearer guidance regarding mathematics teaching. The teachers re-interpreted these new guidelines and their own teaching in a way that enabled them to avoid changing their own teaching. They re-interpreted their own teaching in line with the new guidelines and therefore did not experience any conflict between the teaching they were performing, or had performed, and the
curriculum. Hence, their professional identity as mathematics teachers could remain unchanged. Based on these re-interpretations, there were large consensus among teachers regarding the curriculum while there were, at the same time, large differences in their mathematics teaching.

Hodgen and Askew (2007) and Bjuland, Cestari and Borgersen (2012) investigated primary teachers with focus on their professional teacher identity in relation to mathematics teaching. Hodgen and Askew (2007) present a case of a primary teacher with negative experiences of secondary school mathematics who participates in a professional development in the subject. The study shows that it is possible for primary teachers to confront and challenge negative attitudes to mathematics and to develop a professional identity as a teacher of mathematics. To accomplish that, it is important for the teachers, besides the development of mathematical and pedagogical expertise, to explore their identities as mathematics teachers and learners. “[D]eveloping a strong disciplinary bond is central to the teaching of any subject and as such teachers need space to develop both disciplinary intimacy and integrity” (p.484). Similarly, Bjuland et al. (2012) present a case of a primary school teacher participating in a four-year mathematics development project named “Community of Inquiry”, where communities are developed within which teachers and teacher educators work together with inquiry. The results show that the primary school teacher developed her professional identity during the project. The researchers characterize elements of professional teacher identity through four identity indicators. The first regarded the teacher’s positioning in relation to students in the capacities of presenter, supervisor and coordinator. The second indicator regarded the teacher’s reflections on developing a workshop model in her teaching showing her willingness to transpose, implement and integrate workshops in her classroom. The third indicator regarded integrating and expanding models of teaching where the teacher integrated new ideas emerging in the project with previous ideas from her practice. The fourth identity indicator regarded challenging positioning in relation to didacticians. The study showed that professional identity is a continuing and dynamic process shaped by multiple engagements in different didactic activities and that it is important to focus on identity not as a fixed position but as being continuously in a process of transformation through contextual activities, reflections and personalized experiences.

Even though the studies presented in this section differs in many ways they are similar in that identity is seen as an ongoing dynamic interaction between the individual and the surroundings. “Teachers’ professional identity is not fixed nor is it imposed, rather it is negotiated through a rich and complex set of relations of practice” (Chong & Low, 2009, p.70).

1.4.2 Studies regarding the mathematics teaching profession as a changed profession

The roles and responsibilities of teachers have extended and broadened in past years (OECD, 2005). Teachers report an increasing diversification and intensification in their work leading to increasing hours spent at the workplace, broader roles and responsibilities and shorter timelines to complete tasks. Teachers have been drawn away from what they regard as the essential part of their work of interacting with students to deal with managerial priorities. Also teachers move in and out of teaching more often and teacher positions are more often short-term contracts. The latter is particularly the case for younger teachers. Together these changes have resulted in
uncertainty and professional identity crises within “what has been for many teachers a stable profession” (Day, Elliot & Kington, 2005, p.565). The teaching profession as a changed profession is the focus in this section, firstly in general, and then regarding mathematics teaching specifically.

The professional assignment for teachers in Sweden has changed a lot where the instrument for regulation has changed in direction towards efficiency. These changes have international parallelism, especially in countries related to EU and OECD (Lindström Nilsson, 2012). In different Swedish steering documents, schools have been given increased responsibility regarding both upbringing and education. The broadened assignment regarding upbringing, questions the core of the teaching profession and challenges teachers’ professional identity. Persson and Tallberg Broman (2002) have studied how this changed professional assignment is perceived by teachers. The teachers in their study express that the teacher profession has taken on social dimensions. Over 90% of the 190 primary school teachers in their study agreed completely or in part with the statement that the most important task for teachers is to create serenity in the classroom. Another shift in the profession is from being children-centred to instead focusing on cooperation with other adults. In the study by Persson and Tallberg Broman, the group of primary school teachers was especially critical of these changes.

The shift in the Swedish teaching profession towards cooperation with adults is also focused on by Gustafson (2010) when investigating what it means to be a teacher in a new era and how teachers negotiate professional identities on the basis of these changes. His conclusion is that teachers in schools perform a “myriad of constant, multidimensional and overlapping negotiations regarding professional identity in relation to the different parts of the work” (p.276, translated). According to Gustafson, there is a view in society of the teaching profession consisting only of teaching and planning teaching, a view that needs to be developed towards an awareness of the complexity of the work. Similarly, Persson and Tallberg Broman (2002) write that teacher education does not prepare student teachers for the changed teaching profession. Novice teachers in their study describe a conflict between the ideologies propagated in teacher education and the changed profession which leads to uncertainty within the professional identity.

The mathematics teaching profession has experienced changes and internationally the notion of reform is often used when referring to visions regarding “desired mathematics teaching”, often without further explanation of what is being meant by the reform. As the concept and meaning of reform will be part of the result in this thesis it will be further elaborated in this section. When the meaning of reform is being discussed, the National Council of Teachers of Mathematics (NCTM) standards, including the “NCTM’s vision of what students should learn in mathematics classrooms” (p.19) from 1989 and 1991 are often mentioned (e.g. Ross, McDougall & Hogaboam-Gray, 2002) as a starting point for the latest reform in mathematics teaching.

The NCTM document ‘Professional Standard for teaching mathematics’ (1991) contains five parts: standards for teaching mathematics, standards for the evaluation of the teaching of mathematics, standards for the professional development of

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2 In Sweden, a primary school reform with a new national syllabus in every subject was implemented 2011. However, this was after the collection of empirical data for this study and therefore that reform is not being focused on here. The vision for mathematics teaching is, however, largely unchanged and the 2011 reform applies to more explicit goals in more grades and a more explicit presentation of the content in every subject.
teachers of mathematics, standards for the support and development of mathematics teachers and teaching and (standards for) next steps. The starting point in the document is a change of the current mathematics teaching and the word reform is used in the document which is supposed to “provide guidance to those involved in changing mathematics teaching” (p.2) and to “provide direction for the reform of school mathematics” (p.2). Central in the document is “the development of mathematical power for all students” (p.1) and that “[c]omputational algorithms, the manipulation of expressions, and paper-and-pencil drill must no longer dominate school mathematics” (p.19). This earlier dominant way of teaching is named traditional practices and the standards suggest changes both regarding what is taught and how it is taught.

In the standards, traditional practice is described as a “tell, show, and do” (p.152) model but now, with the reform, students are expected to build their own repertoire of mathematics knowledge where the teacher asks questions and follows leads but does not present solutions. Desirable mathematics learning is when students construct their own mathematical understanding, develop mathematical arguments, identify connections and validate possible solutions, all of which happens best when they work in groups, engage in discussions, make presentations and take charge of their own learning. Different representations, e.g. computers, but also using words and writing, are mentioned as important where teachers need to know a variety of ways to model mathematics concepts and procedures as well as the various advantages and disadvantages associated with them.

Instruction should incorporate real-world contexts and children’s experiences and, when possible, should use children’s language, viewpoints, and culture. Children need to learn how mathematics applies to everyday life and how mathematics relates to other curriculum areas as well (NCTM, 1991 p.146).

The teachers’ own knowledge of and confidence in mathematics are presented as affecting both what they teach and how they teach it. Even if a lot of content in the document relates to teachers, their assessment and their teaching, a lot of emphasis is put on the student where the teachers “facilitate learners’ construction of their own knowledge of mathematics” (p.127).

2000 NCTM published a new standard named Principles and Standards for School Mathematics. In the document it says that the previously released NCTM standards have influenced state standards and curriculum frameworks, instructional materials, teacher education, and classroom practice but as with any educational innovation, the ideas of the standards have been interpreted in many different ways and been implemented with varying degrees of fidelity (NCTM, 2000). The Principles and Standards for School Mathematics build on and consolidate messages from the previous standards documents. NCTM has also published the document A Research Companion to Principles and Standards for School Mathematics that provides the anchoring of research and theory for Principles and Standards for School Mathematics (Kilpatrick, Martin & Schifter, 2003).

The standards from NCTM are not the only standards in the United States but the ones most visible in European standards and research. Another standard in the United States is the Common Core State Standards (CCSS) in English and mathematics being implemented in 45 states 2011-2016. The Common Core State Standards for Mathematics (CCSSM) describes a variety of expertise that
mathematics educators at all levels should seek to develop in their students. Eight standards define what students should understand and be able to do in their study of mathematics. These eight standards derive from NCTM standards and the National Research Council’s report *Adding It Up*. The CCSSM standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations. The CCSSM standard doesn’t either provide reform in the same way as the NCTM standards (Common Core State Standards Initiative, 2012).

Based on their research review regarding the reform in mathematics teaching, Ross, McDougall and Hogaboam-Gray (2002) argue that the question is not if mathematics teaching in line with the reform contributes to the learning of students which, according to their review, it does, but rather why the implementations have been so uncommon and what can be done to support teachers who want to change their mathematics teaching. Similarly, Ball, Lubinski and Mewborn (2001) argue that too little is known about what it takes for teachers and students to work in line with the reform in schools. Ross et al. (2002) split their reviewed studies into three groups: studies focusing on the eventual effects of the reform on students’ learning, studies focusing on obstacles in the implementation of the reform and studies focusing on how to overcome such obstacles. In their review Ross et al. find that the reform is motivated by the low results in mathematics that students achieve after “traditional teaching” (Ross et al., 2002, p.124) and also by the awareness of society making increased demands regarding the use of mathematics in the future. Ross et al. describe the reform as a widening of the mathematical content and application area for all students (including low achievers) where mathematics becomes a dynamic discipline rather than a “fixed body of knowledge” (Ross et al., 2002, p.125). Similarly, the mathematics tasks are complex, open and adapted to reality with several possible solutions. The focus when working on these tasks is on the construction of mathematical ideas by using communication, laboratory materials and cooperation. Assessment is integrated into everyday teaching and the teacher becomes a co-learner and creator of mathematical tasks rather than an expert. Furthermore, the self-esteem of the students becomes a central part of the mathematics teaching. This description is very similar to the NCTM standards described above.

Skott (2004) describes the reform as a development of both the theoretical foundations in mathematics teaching and “more or less research-based attempts to let the theoretical perspectives inform the design of mathematics teaching and learning” (Skott, 2004 p.228). Within research, the reform has led to attempts to understand the mutual and interactive possibilities for learning in mathematics classrooms. The development of the theoretical foundations includes both constructivist and socio-cultural understandings of knowing and learning with the focus on classroom interaction. Regarding theoretical foundation, Nelson Scott (1997) derives the reform to a socio-constructivist view of mathematical knowledge where knowledge is taken to be a product of work of communities of creative individuals implying a new role for teachers as “facilitators of the development of students’ mathematical thought, rather than as deliverers of concepts, facts, and skills” (p.3).

According to Skott (2004), the reform implies a shift from teaching to learning but with increased emphasis on the teacher in this learning where mathematics is widened to include the involvement of students in joint and individual activities aimed at developing preliminary conjectures of “taken-as-shared and experientially real mathematical objects” (p. 237). In line with Ross et al. (2002) and Nelson Scott (1997), Skott summarises reform mathematics teaching as finding and challenging
students’ understanding and involving students in experimenting, investigating, generalising and formalising. Moreover, the teacher should facilitate the emergence of communities of mathematical practice. Skott points out, however, that the reform is not a single uni-directional development in mathematics education but a movement towards an understanding of “institutionalized mathematical learning from both individual and social perspectives, while including a process perspective on the subject itself and developing teaching-learning processes in line with these understandings” (Skott, 2004 p.228). Skott also writes that recommendations within the reform sometimes degenerate into caricatures of what not to do (for example, not using whole class interaction or routine tasks) instead of focusing on what to do.

1.4.3 Studies regarding becoming and being a teacher within a changed profession

In this section, studies focusing on novice teachers (both mathematics teachers and others) and teacher change are presented. In essence, studies focusing on student teachers are presented first, followed by studies of novice teachers. Finally, some studies of experienced teachers whose teaching, for various reasons, has been affected by the reform are presented. (There will be some additional studies presented in chapter two since they are of interest in conjunction with the conceptual framework.)

Studies focusing on student teachers within a changed profession

Goodman (1988) did not specifically study mathematics teachers but how student teachers, during their last long practice period, succeeded in implementing the reform-orientated teaching they encountered during their teacher education. The student teachers in Goodman’s study were impacted by their teacher education and they often referred to it regarding their ideas and teaching strategies and they used activities learned in teacher education during their practice period. The practice schools are described as traditional and strongly influenced by a strict teaching program adopted by the school district. This teaching program controlled both the content and the design of the teaching at the practice schools. Goodman describes how the student teachers seem to enter a pre-existing world where different placement supervisors allow different amounts of student initiative. During the practice period, Goodman studies how the student teachers deal with this “pre-existing world” and finds that almost all finally influence the on-going teaching. Goodman describes the student teachers’ path to influence as five phases: overt compliance, critical compliance, accommodative resistance, resistant alteration and transformative action. Almost all of the student teachers (all but one) went through all of the phases but not in all subjects.

At the beginning of their practice period, the student teachers in Goodman’s study expressed a desire to fit in with the procedures and teaching at the schools (overt compliance). They then became critical of the on-going teaching but still accepted teaching that way (critical compliance). Some of the student teachers

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became critical on their first day while others developed this critical approach more gradually. The next phase was when the student teachers started to make their own small contributions to the teaching. These contributions were not in line with the strict teaching program adopted by the school district (accommodative resistance). These contributions expanded as the student teachers actively tried to make the teaching more meaningful for themselves and for the students by breaking with the traditional patterns of the strict teaching program adopted by the school district (resistant alteration). In the last phase, the student teachers transformed the teaching both with regard to how and why (transformative action). These transformations were mainly made in science and social studies. Apart from the strict teaching program adopted by the school district, the student teachers expressed that time and energy limited them in their desire to be creative in all subjects. According to Goodman, it is a huge endeavour to try to change teaching as a student teacher but his study shows that such changes are possible.

Frykholm (1999) also studied student teachers during their practice periods but during shorter periods than those in Goodman’s study. The student teachers in Frykholm’s study were to become mathematics teachers. His results are similar to results by Cavanagh and Prescott (2007 & 2008) who interviewed a group of secondary school mathematics student teachers during their last year of teacher education and then during their first year as qualified teachers. Both in Frykholm’s study and in the study by Cavanagh and Prescott (2007 & 2008), the respondents in teacher education were taught to teach mathematics according to the reform. However, the cultures of the schools where the student teachers did their practice periods and, in the study by Cavanagh and Prescott, later started to work did not support that kind of mathematics teaching.

Almost all of the placement supervisors in Frykholm’s (1999) study taught mathematics non-reformative as did the student teachers during their practice period. Frykholm proposes lack of teaching experience and expectations from the placement supervisors as possible explanations for them doing so. Several of the student teachers also said that they did not teach in accordance with their thoughts about good mathematics teaching. According to Frykholm, teacher education must make the students to problematise this duality and support them in changing their teaching. Cavanagh and Prescott (2007) describe teacher education and the mathematics teaching in schools as “two separate communities of practice that are, in many respects, at odds with each other” (p.190). Before their graduation, the student teachers in their study talked about avoiding the perceived conflict with other teachers after graduation by becoming a “textbook teacher” (p.188).

Studies focusing on novice teachers within a changed profession

According to Winslow et al. (2009) “there is a huge variation, among systems of education, when it comes to official regulations for the institutional transition from university to school – if they exist at all” (p.98). The first years of teaching after teacher education look different in different countries but with the similarity that novice teachers have to teach and learn to teach at the same time. Some countries have central regimented inductions for one or several years whilst novice teachers in other countries directly after graduation start to work under the same working conditions as experienced teachers. The existing inductions are different and in a
research overview Feiman-Nemser, Schwille, Carver and Yusko (1999) summarize induction “as a phase in learning to teach, a process of enculturation, or a formal program for the support, development and assessment of beginning teachers” (p.31). Induction is used to label a phase (or stage) in teacher development and a time of transition and “induction happens with or without a formal program” (Feiman-Nemser et al., 1999, p.7-8). However, more generally induction refers to formal programs for novice teachers which in some countries are connected to standards and teacher assessments. When induction is explained as stages one common model is that novice teachers at the initial stage is preoccupied with their own personal adequacy, at the middle stage focused on their teaching, at a later stage start to concentrate on student learning. The idea of (separate) stages has in later research been questioned, especially the late insertion of attention to students learning. The induction research overview by Feiman-Nemser et al. (1999) shows that novice teachers most frequent and serious problems are classroom discipline, students’ motivation, dealing with individual differences, assessing student work and relating to parents. The review also show that novice and expert teachers differs when it comes to the ability to interpret classroom phenomena, discern important events, use routines, make predictions, judge typical and atypical events and evaluate performance.

In an anthology of current research regarding novice teachers in northern Europe (Fransson & Gustavsson, 2008), the editors summarise the contributions in a number of conclusions and recommendations. The contributions in the anthology are not directed at primary school teachers or mathematics teachers specifically but can still be of interest to this study. In the anthology, the lack of a common model in northern Europe regarding the professional development of novice teachers is emphasised. Reference is made to an EU-report showing that there is very little systematic coordination between teacher education, novice teachers starting in the profession and in-service education and professional development. The few existing examples are seldom connected to school improvement or research. One conclusion in the anthology is that novice teachers are in a special situation since they struggle to find their own teacher identity while simultaneously dealing with (educational) situations. Novice teachers often receive help in the beginning providing them with a safety net but not automatically making them better teachers. Similar Wang, Odell and Schwille (2008) in a research review regarding teacher induction write that teacher induction programs historically have focused on the personal comfort levels of novice teachers but that feeling comfortable not necessarily lead to effective teaching and student learning. According to Fransson and Gustavsson (2008) the help, instead of acting as a safety net, should focus on content knowledge and pedagogical content knowledge, encouraging novice teachers to question and challenge existing teaching. Some implications for the future are made in the anthology where the need for research from the perspective of the teachers is requested.

In their review of research regarding teacher induction Wang et al. (2008) focused on novice teachers’ teaching the first year after graduation. According to Wang et al. there is an underlying assumption in teacher induction that a link exists between

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induction, novice teachers’ conceptions, teaching practice and students’ learning. However, none of the studies in their review addressed the effects of induction programs or their components on students’ performance. Based on their studies of student teachers and novice teachers Flores and Day (2006) stress that induction ought to focus on the development of professional identity through exploring personal biography within supportive school cultures.

The novice teachers in the previous mentioned study by Cavanagh and Prescott (2007 & 2008) found the first year after graduation as stressful, chaotic and emotionally draining. With a full teaching load, lesson preparation became a luxury and instead of focusing on students’ understanding, the teaching became a case of covering the content. The novice teachers were torn between wanting other teachers to perceive them as effective and their need for support. They claimed that they would adopt a reform-approach to mathematics teaching when they saw “themselves as competent teachers who had earned the respect of their colleagues and their students” (2008, p.412). Cavanagh and Prescott’s conclusion is similar to that of Frykholm (1999), that novice teachers need skills to deal with the impact of school culture. Frykholm also stresses the problem of placement supervisors and how they teach mathematics as they often teach in the opposite way to what is taught in teacher education.

Potari and Georgiadou-Kabouridis (2009) studied the transfer from teacher education to profession in a four year longitudinal study of one mathematics teacher starting with her last year in teacher education. Potari and Georgiadou-Kabouridis studied both the micro level (classroom) and the macro level (social and institutional contexts) and the influence of these on the professional development of the teacher. During the four years of the study, three different forms of support were given to the teacher. In the first year, support came from the university, the second year from colleagues at the school where she started working and in the third and fourth years from an in-service course organised by one of the researchers. The study shows that during teacher education the teacher developed a view of mathematics teaching separate from the mathematics teaching she herself had experienced as a student. When she started to work as a teacher, she became aware of the difference between ideal and reality. Being accepted by colleagues and parents became important to her during the first year and she felt responsible for her students. Her mathematics teaching was traditional with only elements of activities from her teacher education. The third and fourth years were more like the year at university in that the in-service course included reading literature and group discussions. Because of this support, she managed to connect the research with her own teaching and started to teach in line with her ideas of good mathematics teaching. According to Potari and Georgiadou-Kabouridis, their study shows that changes are possible but require the kind of support the novice teacher in their study received. This result is in line with Ross et al. (2002) who indicated that reform mathematics teaching increased students’ learning in mathematics in classrooms where there had been a significant implementation of the reform.

Since there is no uniform picture of the reform and even less consensus regarding how it should be investigated, it is, according to Ross et al. (2002) difficult to discuss teacher change. Both Potari and Georgiadou-Kabouridis (2009) and Ross et al. (2002) indicate in-service courses with individual and joint reflection together with external leaders as the most effective when implementing reform mathematics teaching. The content in these in-service courses should include both content knowledge and pedagogical content knowledge. Group reflections should focus on
both new strategies in the classroom as well as the predominant teaching. Such cooperation between teachers seems to have the largest influence on teachers with less experience as the cooperation reduces their work load and clarifies expectations.

With regard to the problems of implementing the reform, Ross et al. (2002), just like Lortie (1975), emphasise the difficulty with teachers making changes in direction towards something they have not experienced themselves. This problem is also discussed by Frykholm (1999) in the above mentioned study of student teachers during their practice period. The student teachers in Frykholm’s study did not see the wholeness of the reform but had a fragmentary understanding, making them focus on and implement detached parts. According to Ross et al. (2002), reform mathematics teaching increases the demands on teachers as they must be able to respond to students’ ideas and solutions. Different studies in their overview indicate that teachers often lack the skills for doing this. Reform mathematics teaching can also make teachers feel less effective as planning time is shortened and teachers’ contributions in the classroom are less visible. Furthermore, the review indicates that teachers when teaching in line with the reform have problems covering the curriculum and meeting parents’ expectations.

Säll (2000) does not focus on mathematics teachers specifically, but on Swedish primary and lower secondary school teachers in general, when studying how images of the teacher’s role and knowledge change from starting teacher education to the first years of teaching. Säll names the different images held by the student teachers as entertainer, director and illuminator and studies how these images change over time. Säll’s study shows that teachers’ employment conditions influence their image of the teacher’s role. Likewise, the possibility of collaborating with other teachers helps new teachers in their working situation. However, the respondents in Säll’s study often taught subjects or grades they were not educated for and were at risk of isolation making it hard for them to develop their teacher identities.

Schools differ and are therefore different social contexts having different impact on the individual teachers. You have to understand the interplay between the individual teacher with hers/his intentions and perspective on teaching and the contextual obstacles and possibilities existing within different school environments” (Säll, 2000, p.112 translated).

Similarly, Paulin (2007) has studied Swedish novice teachers, focusing on their difficulties. Her respondents were both primary and secondary school teachers and Paulin wanted to understand the process of them becoming teachers in general. Just like the studies by Gustafson (2010) and Persson and Tallberg Broman (2002) presented above, Paulin’s study shows that the teaching profession contains much more than teaching. In the classroom, the teacher has to pay attention to the individual students, and take responsibility for the learning of the whole class as well as establishing and maintaining order. To manage this, teachers need to have both social and educational skills. One difficulty mentioned by the novice teachers in Paulin’s study is that they are not able to realise their visions and expectations which causes them frustration and drains their energy to work.

In a Finish study of novice primary school teachers (no special subject focused on) the novice teachers were, more often than their experienced colleagues, to teach students with special problems and to teach subjects they were not educated in. It had become legitimate for the experienced teachers to claim the less demanding work tasks. In the study, seminars were conducted with groups of novice teachers to
increase the knowledge of their situation and to support them in their work. Conclusions in the study are that the teacher education needs to prepare the student teachers better regarding the complexity of teacher work and that novice teachers are not just novice, they are also a resource of knowledge and competence (Aspfors, Bendtsen & Hansén, 2011). The phenomenon that it has become legitimate for experienced teachers to claim the less demanding positions can be contrasted to other countries (e.g. China) where novice teachers contrary are not expected to do the same job or have the same skills as experienced teachers. Instead the novice teachers get assigned to less difficult classes and released teaching time to be able to participate in inservice activities and consult with and observe guidance teachers (Feiman-Nemser et al., 1999).

Skott (2001, 2004 & 2009) has focused on novice teachers and their social context when starting to teach. The teachers in his studies are Danish mathematics teachers influenced by the reform (as referred to by Skott above). Skott calls the new role of teachers “forced autonomy” (2004, p.227) derived from the demands on the teacher as a central figure in reform-based teaching in the curriculum. Based on his studies, Skott widens the meaning of this forced autonomy from only including mathematics and mathematics teaching to including all decision making made by the teacher in the classroom. According to Skott (2001 & 2004), teachers have multiple and sometimes conflicting teaching priorities which are contained in every teaching situation. Decision making with conflicting motives forces teachers to prioritise. If it is not possible to integrate the visions of mathematics teaching with other broader teaching goals, the teaching will not be in line with the reform. Even if the reform is believed in, other teaching demands and/or goals can be prioritised making the teaching look inconsistent to an observer. According to Skott different situations do not make teachers think differently about mathematics teaching but different situations make teachers prioritise differently. The teachers’ qualifications in mathematics must be connected to their qualifications as teachers in a broader perspective as well as to research in mathematics education. Another result from the studies by Skott (2001) is how teachers bring a pattern of action in one teaching situation into new situations which lack the context of the original situation. In the original situation, the teacher acts based on the context but afterwards the teacher continues with the same action with new groups of students without the basis of the original context.

Bjerneby Hall (2006) has studied Swedish student teachers and their first years as upper primary and lower secondary school mathematics teachers. The respondents were followed from the beginning of their teacher education and eight years forward with the focus on how they formulated arguments for mathematics teaching in school. During their teacher education, the student teachers discovered that mathematics teaching can be a laboratory, that the learning of mathematics is improved by communication and that there are different ways of solving mathematics problems. They talked about themselves as not having experienced that kind of mathematics teaching, neither as school students nor during their practice periods.

At the end of their teacher education, the respondents in Bjerneby Hall’s study had individual perspectives when arguing for mathematics in school focusing on the needs of the individual students. The most common argument was that students need mathematics to handle their everyday lives, to be able to take charge of their own interests in society and they need mathematics skills in future education. The respondents were critical of directed teaching; instead they stressed a creative and exploratory approach in mathematics teaching. They said that they would use a text
book when teaching but emphasised the importance of having a varied teaching approach. The variation was motivated by increasing the interest and motivation of the students to learn mathematics. The respondents also emphasised the importance of laboratory elements, connecting teaching to everyday life and the importance of understanding and self-esteem. Even though they wanted to teach like this, the respondents highlighted various obstacles and difficulties which would stop them from implementing this teaching, for example, assessments, time pressure, marking and finishing the courses on time. According to Bjornery Hall, teacher education offers, “or almost provokes” (p.204), a change of perspective in the student teachers. There is, just as indicated in the previously mentioned international studies by Goodman (1998) and Frykholm (1999), a gap between the intentions of society and teacher education and the practice period during teacher education. Also, the respondents in Bjorneby Hall’s study lacked mathematics teachers as role models.

The time after graduation was experienced as hard and demanding by the respondents in Bjorneby Hall’s study. Two reasons cited for that were the heavy workload and the lack of mathematics teacher colleagues. Also, there was a shift in their talk about mathematics teaching to where a good mathematics lesson became a quiet lesson where the students were engaged, implying they were concentrating on solving tasks in the textbook. The good in mathematics lessons was more related to the climate in the classroom than to the mathematics, and variation was now expressed as a way of keeping the students calm by using different fun activities. After graduation, the lack of time and the students were emphasised as obstacles by the respondents. Other obstacles mentioned, connected to the first two, were national tests and rating. Some of the respondents encountered strong traditions and preconceptions about mathematics teaching in schools. In her final summary, Bjornery Hall writes that teacher education provides an initial qualification for the professional but that the continued education and development of the mathematics teacher is done at the school.

Another study of Swedish mathematics teachers during and after teacher education focused on how lower primary school teachers talk about mathematics teaching (Persson, 2009a). Just like Bjornery Hall, Persson writes that the student teachers, by soft coercion, are lead into the “style of thought” (p.143) predominant at the university. However, the student teachers did not experience this kind of mathematics teaching during their practice periods and they were not confident of their own knowledge when meeting parents and actually teaching. During teacher education, the respondents talked about traditional and tradition as something negative and this is shown by Persson to be common in literature regarding mathematics education. Persson met some of the respondents again after their graduation and, after observing their teaching, she concluded that they had been able to convert their talk about mathematics teaching into action. However, Persson also mentions that some of the respondents changed their teaching because of her visit. To make professional identity development possible for mathematics teachers they, according to Persson, need to teach the subject making the difficulties in getting a primary school teaching job in Sweden problematic. Moreover, the wish to be accepted influences the mathematics teaching of the respondents and Persson advocates an active follow-up by the university.

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5 The difficulties of getting a primary school teaching job in Sweden are discussed in the last section of this chapter.
The research to be presented in this thesis is in line with that of Bjerneby Håll (2006), Persson (2009a) and Skott 2001, 2004 & 2009. However, Bjerneby Håll and Persson do not focus on processes but rather on talk or arguments. In Persson’s study, a basic assumption was that the respondents’ talk would change and the focus was on the outcome, the product, and the relationship between this outcome and current steering documents. In this thesis, the aim is to understand and describe the process, the professional identity development, of primary school mathematics teachers which can be understood as a continuation of the work started by Skott. A continuation of that work of trying to understand the process of becoming a teacher from a social perspective may also shed new light on the results in the studies by Bjerneby Håll and Persson.

Studies focusing on experienced teachers within a changed profession

Gellert (2008) studied experienced mathematics teachers who were consciously trying to change their mathematics teaching in line with the reform. Gellert calls the mathematics teaching they wanted to develop “productive practicing [that] foregrounds the connection of computation skills with higher order thinking skills” (p.98). Gellert focuses on routines as teaching demands a lot of routines making it possible for the teacher to pay attention to what is needed in each teaching situation. These routines function both as backing and support as well as conservative counter measures against change. Based on earlier studies of novice teachers, Gellert stresses that teams of teachers seem to be effective when integrating novice teachers in the predominant school culture and he describes the respondents in his study as a “community of teachers who purposely tried to improve their practice of mathematics teaching” (p.98) having more or less the same experiences of mathematics teaching. To be able to change their mathematics teaching, the teachers had to give up their routines which resulted in an increased work load making the change process problematic. The teachers lost control when the routines were abandoned which created insecurity. According to Gellert, changes in teaching go through phases where the situation in the classroom is initially more difficult than before. Groups of teachers, like the community of teachers who purposely tried to improve their practice of mathematics teaching in Gellert’s study, can be supportive and teacher groups may also need external support when they become uncertain and doubtful. The increased work load related to the abandoned routines can be related to the above mentioned induction research (Feiman-Nemser et al., 1999) regarding how novice teachers differ from experienced teachers when it comes to using routines in the classroom.

Also Ensor (2001) has studied the connections between education and teaching in a study of experienced mathematics teachers taking an in-service course. Her study shows how the content in the in-service course is re-contextualised by the teachers when teaching. A central difference between the teacher in the study by Potari and Georgiadou-Kabouridis (2008) mentioned earlier and the teachers in Ensor’s study is that the teacher in Potari and Georgiadou-Kabouridis’ study received support while the teachers in Ensor’s did not. In Ensor’s study, the teachers agreed with the teacher educator but had a harder time converting the ideas into actual teaching. The course influenced how they talked about teaching but only elements of activities from the course were implemented in the actual teaching. This is very similar to the teacher in
the study by Potari and Georgiadou-Kabouridis during her second year where she did not receive support from the university. In Ensor’s study, the teachers talked about the in-service course in relation to their own mathematics teaching but the meaning of the concepts had changed. The teachers had not forgotten what they had learned in the course but they had re-contextualised the meaning of it. As such there seemed to be inconsistency between the viewed teaching and the talk but there was no inconsistency in relation to the re-contextualisation.

1.4.4 The point of departure for this study

The teaching profession, with or without focus on mathematics teaching, is often described in terms of a changed profession without any continuity between teacher education and schools. Graduating from teacher education and starting work as a teacher is described as a transfer or shift in professional identity where the interplay between the individual and the social is highlighted as central to develop understanding of. Several of the studies mentioned in this chapter are, however, based on interviews and/or diaries and/or questionnaires which do not include the social dimension. Based on the previous research presented, the target group (primary school mathematics teachers), the aim (to understand and describe professional identity development from the perspective of the respondents) and the ethnographic direction (trying to catch the interplay between the individual and the context) in this thesis all taken together seem to fill a void.

1.5 The work situation for novice primary school teachers in Sweden

In Sweden, children start school at the age of seven and primary school imply grade one to six. Before starting school most children have attended one year in pre-school class which most often is located at schools but taught by preschool teachers. Primary school teachers are educated to teach several subjects and most primary teachers work as class teachers. This is similar to other countries around the world as most primary school teachers are educated as generalists (Tatto, Lerman & Novotný, 2009).

While collecting the empirical material for this study (2009–2010), it was difficult for primary school teachers in Sweden to get jobs, especially in certain municipalities. In the teachers’ union members’ newspaper it was stressed that novice teachers’ entry into the profession after graduation varied based on the municipality in which they started work. It was difficult to change municipality as accumulated working time as teacher was not valid if one changed municipality. In the local newspaper of the municipality in which the university is located, the need to take better care of short run substitute teachers was discussed during this time.

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5 For example, statistics from the Employment Office in "Where are the jobs? An estimation of 2010 and a long term outlook." http://www.holmestrign.se/files/1002021427416/varlinnsjobben2010.pdf (111021) The difficulty was also mentioned by Persson (2009a).
6 The members’ newspaper of the union is published biweekly. For example, Lärarnas Tidning 09(13)
7 See, for example, Smålandsposten (the local newspaper) 101009.
though there were no teacher jobs available, neither were there any short run substitute teachers. They chose to take other jobs as they felt badly treated. Problems mentioned by the short run substitute teachers included the lack of forward planning and poor salary.

At the time of this study there was no national or local teacher induction in Sweden. In a study of the student teachers starting at the present university 2007, about half imagined a secure labor. An alumni survey of student teachers graduated from the present university 2006 and 2007 showed the transfer from student teacher to teacher being long and complicated. The novice teachers had been able to substitute but not in the grades and/or subjects they were educated in (Lindström Nilsson, 2012).

In 2010, an alumni survey of student teachers who graduated from 21 different teacher education programmes in Sweden 2007-2008 was carried out. The teacher education those teachers had undergone was the same as for the teachers in this study. The alumni survey showed that most of the teachers had worked as teachers but only 64% had wholly or partly taught the subjects or grades for which they were educated. However, when compiling the alumni survey it was emphasised that both questions and answers were hard to analyse. For example, one of the questions asked was if the teacher education has resulted in the teachers having the knowledge of/ in subjects, learning and the profession that the education was aimed at. 73% agreed totally or to a large extent with this claim while 27% were more uncertain (did not agree or agreed to some extent). But, is it good or bad that 73% of the teachers thought of themselves as having the required knowledge when 27% were uncertain if they had sufficient knowledge in the subjects they taught? And what does the question mean? Is knowledge of/ in subjects, learning and the profession that the education was aimed at one question or several questions?

1.6 Presentation of the teacher education

In this section, the teacher education from which the respondents in this study graduated is presented briefly. The teacher education is an integrated teacher education where professional and subject studies take place concurrently. Each respondent’s path through this education is presented in the chapter on the design of the empirical data. There is a long tradition of teacher education at the present university. A study from 2003 regarding the origin of student teachers at the university showed that about half of them were recruited from homes without experience of higher education, four-fifths came from a region nearby and about half came from smaller towns (Persson, 2009b). A similar study of the student teachers starting 2007, showed that 82 percent of the primary school student teachers were women. About a quarted had started their teacher education directly after upper secondary school making the median age 20. Of these 70 percent were from the

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9 http://intragen.lpu.se/rololyb_fe/132502/Bilaga%206%20L%20C%20A4gralumni%201.pdf (111101) Some may react to the fact that the university can be identified through this reference. However, the author of this thesis is also a teacher educator at that university, a circumstance that has consequences for the study. This is elaborated on in a later section regarding ethics in which the university is exposed anyway. According to Floyd and Arthur (2012) institutional anonymity is meaningless for insider researchers since whatever efforts are made to preserve anonymity an online search will identify the institution. Instead inside researchers are to work on the assumption that the site of their study cannot be anonymous and instead focus on ensuring that research participants are not identifiable.
surrounding region and for the majority of them the teacher education had been their first choice of university education. Their main motives were social engagement with children and not interest in teaching and content knowledge (Lindström Nilsson, 2012).

The teacher education\(^\text{10}\) in question started 2001. Compared with the previous teacher education content knowledge was emphasised with decreased practice periods (Lindström Nilsson, 2012). The teacher education is comprised of at least 210 credits. It is a joint education programme aimed at student pre-school and primary school teachers and leisure-time pedagogues where the groups have some courses together and some separately. The respondents in this study were studying for a teaching degree in lower and upper primary school and it is that track within the teacher education that is presented here.

The teacher education consists of three integrated parts: general educational area (90 credits including 15 credits practice period), orientation\(^\text{11}\) (60-90 credits including at least 15 credits practice period) and two specialisations (60 credits). Orientation relates to subjects or subject areas and is chosen by the student teachers before starting teacher education. Every university can offer different orientations and at the current university ten different orientations are on offer. Two of them contain mathematics: Swedish and Mathematics for Primary School and Science, Technology and Mathematics for Primary School. The 60 credits specialisation can consist of two long or several short courses intended to broaden or deepen the knowledge of the student teachers. The choice of specialisations and the choice between broadening or deepening knowledge are made by the student teachers during their teacher education. However, to achieve a teaching degree aimed at primary school, a specialisation of 30 credits in basic reading, writing and mathematics are required for those students who do not have these subjects within their orientation.

The layout of the teacher education and the students’ possibility to choose orientation and specialisations bring about primary school teachers qualified to teach mathematics entering the profession with different backgrounds in the mathematics subject. As a minimum they take 15 credits, at most 52,5 credits, of courses within the field of mathematics education. The common courses that all students in the orientations containing mathematics take are named students’ learning and concept development in mathematics (7,5 credits) and mathematics education – mathematics from the start (7,5 credits). The eligible credits are courses named mathematics and teaching (7,5 credits), students with special needs in mathematics (7,5 credits), support and development of mathematical ability (7,5 credits) and final teacher education Bachelor thesis on mathematics education (15 credits). All these courses are labeled as courses in mathematics education and no courses in pure mathematics are offered in the primary school teacher education.

Numerous goals are described in the degree programme and only some with extra relevance to this study will be mentioned here. After teacher education, all student teachers are supposed to have gained cognitive, cultural, communicational, creative, critical, social and educational competence. The student teachers should demonstrate the knowledge and competence required to realise the goals in the school curricula. They should also demonstrate knowledge in the subjects required in the targeted

\(^{10}\) \url{http://www.student.vux.se/utbildning/pdf/200808281300330001.pdf (111017)} A new teacher education was implemented in Sweden 2011.

\(^{11}\) In Swedish, this is called inriktning which translated to English is specialisation. But, since the third part in the teacher education is named specialisation (specialiserings) another word had to be used in English.
profession including knowledge about the scientific foundation of the subjects. To become a primary school teacher, student teachers must also demonstrate a very good knowledge regarding basic reading, writing and mathematics.
2. THEORETICAL FRAMING

In the process of framing this study theoretically, identity and identity development was first focused on. However, no theories regarding identity and identity development connected to (mathematics) teaching were found whereof more than one theory needed to be used to understand and describe the professional identity development of primary school mathematics teachers. In this chapter the process of finding and elaborating such theories will be described. The chapter is not to be seen as a research review of identity and/or professional competence but as a presentation of the directions, boundaries and definitions chosen in this thesis based on initially broader readings.

Eistenhart (1991) distinguish between three types of research frameworks (theoretical, practical and conceptual) whereof a conceptual framework\textsuperscript{12} is used in this study. The purpose with having a framework (theoretical, practical or conceptual) is to have a structure for the conceptualising and the design of the study. A framework makes it possible to make sense of the data and transcend common sense. According to Lester (2005) a conceptual framework is built from different sources, e.g. previous research and literature that the researchers argue as being relevant and important when addressing the research problem. Using a conceptual framework implies the researcher to argue that the concepts chosen and the relationships among them will be appropriate and useful given the research problem under investigation (Eisenhart, 1991). Building, evaluating and methodologically operationalising a conceptual framework is described in this chapter.

Based on the aim of this thesis, two notions in particular are focused on: identity and professional competence. Both of these notions are objectifications which, according to Sfard (2008), imply that we talk about them as if they were physical objects. Instead of talking about them as processes expressed as verbs, we talk about them as nouns, for example, we say one identity, several identities. Objectification is not only a way of talking about the “same thing” it is also what creates the “things” we talk about. Once notions become objectified, we talk about them as if they exist as physical objects even though an objectified notion refers to something we cannot observe. For example, we cannot find or look at an identity but we talk about identity as something that exists, something that people have and something that can be investigated.

Objectification is done in two steps. The first step is reification which refers to how talk about processes and actions is converted into talk about objects. We observe actions but talk about them as objects (for example, he has got a lot of knowledge). The second step in objectification is alienation where the objects are presented in an impersonal way as if they existed independently without the presence of specific people (for example, the level of knowledge in society is too low\textsuperscript{13}).

According to Sfard (2008), one of the problems with objectification is the assumption that permanence and representativeness in objectified notions as objectifications made today are often viewed as valid also in the future. Another

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\textsuperscript{12} Lester (2005) writes that the process of creating a conceptual framework is quite similar with bricolage. However, Wedge (2010) and Gellert (2010) write that a bricolour choses among those tools that are personally available and that has not been the case when creating the conceptual framework in this study. Instead the intention has been to construct "the optimal tool for the very research purpose" (Gellert, 2010, p.539).

\textsuperscript{13} Other examples are mathematical knowledge for teaching, profound understanding, mathematics-for-teaching and knowledge quartet mentioned in the first chapter.
problem is the ontological collapse that occurs when we talk about notions as if they were equivalent to physical objects. This becomes a problem as objectified notions, unlike real physical objects, do not refer to anything directly observable. Objectified notions are originally based on actions and they need to be de-objectified to be possible to study. In this chapter, such a de-objectification is made of the objectified notions identity and professional competence.

Professional identity as a primary school mathematics teacher is the focus of this thesis, not identity in general. Based on the aim of investigating this identity development from the perspective of novice teachers themselves, the meaning of professional identity and identity development really is a result rather than a starting point. However, to be able to plan the study and the empirical material to be collected, some de-objectifications of identity and professional competence were made at the beginning of the study. In the following sections, identity is focused on first and, after that, professional competence. Then, these two parts are connected in a conceptual framework. This conceptual framework is then evaluated in accordance with guidelines from Radford (2008) and Prediger, Bikhner-Ahsbah and Arzarellos (2008). The last section in this chapter is comprised of a methodological operationalisation of the framework.

However, before turning to identity and professional competence, some epistemological positions will be made clear. According to Lerman (2000) “there has been a turn to social theories in the field of mathematics education” (p.20). The expression social turn is intended to signal the emergence into the mathematics education research community of theories that see meaning, thinking, and reasoning as products of social activity. This social turn has developed from anthropology, sociology and cultural psychology.

The term situative refers to a set of theoretical perspectives and lines of research which conceptualise learning as changes in participation\textsuperscript{14} in socially organised activities and individuals’ use of knowledge as an aspect of their participation in social practices (Borko, 2004). Peressini et al. (2004) have used and argue for using such situative perspectives in studies of mathematics teachers’ teaching.

To explore the connections among professional development activities and processes on the one hand, and individual teachers’ knowledge and instructional practices on the other, researchers must use the multiple conceptual frameworks and units of analysis that situative perspectives provide (Borko, 2004, p.8).

Pressini et al. (2004) explain situative perspective as whereas cognitive perspectives focus on knowledge that individuals acquired situative perspectives focus on practices in which individuals have learned to participate. From a situative perspective, “individuals’ acquisition and use of knowledge [are considered] as aspects of their participation in social practices” (Pressini et al. 2004, p.69). Within a situative perspective identity is viewed as a function of participation in different communities and identity is not stable but dynamic and situated whereof both the individual and

\textsuperscript{14} Two metaphors for learning are acquisition and participation (Sfard, 2006). Learning in the acquisitionist metaphor is an “act of increasing individual possession” (p.153) in the form of knowledge and concepts acquired by the individual. Learning in the participationist metaphor is to develop participation in a community where “patterned collective forms of distinctly human forms of doing are developmentally prior to the activities of the individual” (p.157).
the community must be considered (Ponte & Chapman, 2008). To participate means both to absorb and be absorbed in a community and from a situative perspective, the physical and social context in which an activity takes place is an integral part of the activity, and the activity is an integral part of the learning that takes place within it. “How a person learns a particular set of knowledge and skills, and the situation in which a person learns, become a fundamental part of what is learned” (Putnam & Borko, 2000, p.4). Sfard (2006) describes this duality as “individualization of the collective” and “collectivization of the individual” (p.158, italicising the original). Also, individuals are participants in social contexts even when physically being separated (Cobb & Bowers, 1999).

Boaler and Greeno (2001) have studied the mathematics identity of students based on a participatory perspective. If translating their focus on students into student teachers, learning to teach mathematics becomes a trajectory of participation in the practices of mathematics teaching discourses. Similar Borko (2004) write that teacher learning, from a situative perspective, is a process of increasing participation in the practice of teaching and, through that participation, becoming knowledgeable in and about teaching. To understand teacher learning, it must be studied within the multiple contexts within which teachers do their jobs, taking into account both the individual teachers and the social systems in which they are participants.

2.1 Identity

The starting point in the search for a theory suitable to describe and understand the professional identity development of novice primary school mathematics teachers became theories focusing on identity and identity development. In this section the use of identity in this study will be presented based on a placement in the field of identity in general.

The word identity derives from the Latin identitas meaning the same. Even though there is no uniform definition of or ontological basis for identity, there is a common view of identity being about conformance in an individual as being the same from day to day and from situation to situation (Stier, 2003).

According to Petersson (2003), identity can be seen as both individual and collective. Individual identity answers the questions “who am I” and “who am I not” while collective identity answers the questions “who are we” and “who are we not”. Collective identities are individuals’ feelings of belonging to larger communities which are not to be seen as firm or fixed but as processes where both the balances within and between collective identities constantly change. According to Petersson and Robertsson (2003), it is often easier for the participants in a community to tell which people do not belong and why rather than to tell the connecting features.

According to Kinnvall (2003), identity has its primary roots within sociology and psychology. Within these two disciplines, the research can be divided into four main categories: macro-sociological perspectives, micro-sociological perspectives, social identity theories and psychological theories. Within the macro-sociological perspectives, the social is focused on with a passive view on actors and subjectivity. Within the micro-sociological perspectives, the relationship between social knowledge and subjectivity is more dynamic; identity is viewed as a result of the individual’s interaction with the surroundings. Within social identity theories, identity is studied in terms of group processes with focus on the psychological level.
Finally, physiological theories focus on mental structures and processes within cognitive psychology as well as trying to map the relationship between subjectivity and social context. Neither within nor between these research perspectives is there a uniform definition of identity. This can partly be explained by the different ontological stances. Sometimes identity is defined as who one is, implying identity is an entity like a physical object. In other definitions, identity is treated as a discourse dependent on experience within the individual, not to be seen as an object (Kinnvall, 2003). Similarly, Stier (2003) points out different kinds of identity in research: self-defined individual identity (I am), externally-defined individual identity (he/she is), self-defined collective identity (we are) and externally-defined collective identity (they are).

Peterson & Robertson (2003) and Kinnvall (2003) argue that it only makes sense to investigate identity in context, and if one wants to understand how identity is constructed, the focus should be on the interplay between the individual and the context. According to Linares and Krainer (2006), it is a challenge to find out where, how and why teachers learn given the complex process of personal, social, organisational, cultural and political factors involved. If teacher identity and identity development are to be seen as a process of learning, a model has to be created for how to understand that learning process with all its involved factors. The creation of such a model is the goal of the conceptual framework to be developed in this chapter. Based on its aim and epistemological stances, this thesis is conducted within a micro-sociological perspective with focus on self-defined individual identities. These self-defined individual identities are, according to Stier (2003), shaped and reshaped by different contexts; therefore, both contexts and individuals are of interest also when researching self-defined individual identities.

Early work on identity focusing on the interplay between context and individual is Mead’s symbolic interactionism. Mead worked at the University of Chicago in the early 1900s but did not publish any lengthy texts. However, several of his shorter texts were compiled later and supplemented with notes from his students at the university. One such compilation is Works of George Herbert Mead. Volume 1. Mind, Self, & Society from the Standpoint of a Social Behaviorist, edited by Morris (1967). According to Kinnvall (2003), Mead was originally interested in how different positions in society could be recognised linguistically. This interest expanded to include interest in how individuals develop feelings about themselves and develop identities in relation to different roles, positions and cultural images of matter to the individual. This interest was especially focused on collectively shaped self-perceptions, such as those of teachers, good mums, punks, the theoretically sophisticated and so on. According to Mead (Morris, 1967), individuals belong to a social order and the social psychology he represented studied the relationships between individuals and the communities that they belonged to. According to Mead, an individual’s behaviour could only be understood in terms of the behaviour of the social groups of which the individual was a member. These communities were both socially functional groups and abstract social classes or subgroups. The starting point is a social whole within which the individuals can be analysed.

For social psychology, the whole (society) is prior to the part (the individual), not the part to the whole; and the part is explained in terms of the whole (p.7) [...] a person is a personality because he belongs to a community, because he takes over the institutions of that community into his own conduct (p.162).
According to Mead, no line can be drawn between our own selves and the selves of others, "since our own selves exist and enter as such into our experience only in so far as the selves of others exist and enter as such into our experience also" (p.164).

The individual experiences himself as such, not directly, but only indirectly, from the particular standpoints of other individual members of the same social group, or from the generalized standpoint of the social group as a whole to which he belongs (p.138).

Further, Mead wrote about self and mind where he, unlike the valid at that time, implied the body was not the self but that self was a social structure proceeding in the context of social experience. Based on other peoples’ responses and positioning in communities, the individual makes the generalized other as an overall picture of all these responses, and positioning makes a uniform self possible even if being a member of several communities.

More recent theoretical work in line with identity as interplay between context and individual has been done by Lave & Wenger (1991), Wenger (1998) and Sfard (2008) who similar to Mead place identity as the pivot between the individual and the social. Talking about identity in social terms does not, according to Wenger (1998), imply that the individual is denied but that individuality is seen as a part of a social community. It is the individual’s version of his/her and others experiences in social communities that creates the identity, not the social community as such. According to Sfard and Prusak (2005), Lave and Wenger (1991) and Wenger (1998), learning and identity are two aspects of the same phenomenon. Learning is about identity and identity development as all learning gives significance to the kind of individual we are, our identity. Lave and Wenger (1991), Wenger (1998) and Sfard (2006) define learning as participation in line with the situative perspective used in this thesis, where learning is a process of being a member of, not learning about, the world. All learning forms our identity by changing our ability to participate, belong to and negotiate meaning in the world. This ability is configured in social contexts where it forms our identity. As such, identity development is a way of talking about how learning changes who we are and who we become through participation in different communities of practice\(^\text{15}\) (Wenger, 1998).

Identity and identity development according to Wenger

One part of the conceptual framework to be used in this thesis is Wenger’s theory regarding identity. This theory will be used as the identity development part in professional identity development. In this section, this theory is presented, after which, in section 2.3, it is further developed in relation to how it is used in this thesis. Any sections that follow which refer to Lave and Wenger (1991) are specified, otherwise, Wenger (1998) is referenced.

According to Wenger, identity involves three simultaneous processes, one regarding communities of practice, one regarding identification and negotiation, and one regarding memberships in communities of practice and ownership of meaning.

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\(^{15}\)The meaning of the notion communities of practice will be described further on.
These processes are interwoven and focus on the same phenomena, identity and identity development, but from three different perspectives.

**Communities of practice**

A community of practice is a set of relationships between people, activities and the world; it is a shared learning history. A community of practice does not have to imply a well-defined group or visible social bonds between the members in the community. Rather, it implies mutual engagement in a practice around which the members have an understanding about what they are doing and what it means for their lives.

The practice in a community of practice involves mutual engagement, joint enterprise and a shared repertoire. Mutual engagement is the relationships between the members, about them doing things together as well as negotiating the meaning within the community of practice. Maintaining this mutual engagement can be harmonious or conflict-ridden. Mutual engagement is what gives rise to communities of practice as they start to develop. Joint enterprise regards the mutual accountability the members feel in relation to the community of practice and it is built by the mutual engagement. The joint in joint enterprise refers to the enterprise being negotiated as in the negotiation about what matters and what don’t, what to do and what not to do and the appropriateness of different actions. Sometimes parts of a joint enterprise becomes reified, for instance in standards which then becomes a part of a shared repertoire. The shared repertoire in a community of practice regards its collective stories, artefacts, routines, gestures, concepts notions and actions as reifications of the mutual engagement and joint enterprise. These shared repertoires can be produced or adopted. The shared repertoire proceeds from, and is a resource in, the negotiation of meaning within the community of practice. The shared in shared repertoire does not imply that the shared repertoire always is unified but that it has been and continues to be negotiated.

A community of practice can emerge or be designed. Regarding designed communities of practice, Wenger points out that even though the frames may come from the outside it is the members’ response to those frames which creates the community of practice. All members in a community of practice have a unique place and a unique identity. Through their mutual engagement, their identities are connected but they do not coalesce. As such, homogeneity is neither a pre-condition nor a result of a community of practice. Some communities of practice are built by complementary competences and others by overlapping competences. A community of practice is continuously developed by its members. New members develop full membership through legitimate peripheral membership (Lave & Wenger, 1991). Thus, giving new members legitimate peripheral membership in a community of practice is a tension between continuity and change.

Wenger mentions a couple of external factors which indicate the existence of a community of practice. In a community of practice, there is a rapid flow of information where initial dialogues are not needed; instead, there is jargon and shortcuts in the communication. When talking to members of a community of practice, there is an overlap regarding which persons are “included” and the members know what the other members know, what they can do and how they contribute. Similarly, the members evaluate with ease the adequacy of actions and productions. In a community of practice, specific tools, representations, artefacts, knowledge, stories and internal jokes exist. This shared repertoire has been negotiated over time and is continuously negotiated through the mutual engagement of the members. Important to remark is communities of practice being a theoretical construct and

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what’s being treated as a community of practice or not depends, according to Wenger, on when “it is (or is not) useful to view a social configuration as a community of practice” (p.122).

A community of practice can be a part of a larger collection of communities of practice which, in different ways, are connected to each other. Such connections can be in the form of overlaps, boundary practices, boundary objects or brokers. Overlaps imply two communities of practice overlapping to some extent while other parts are separate. Examples of such overlaps are communities of practices with shared historical roots, related businesses, shared institutional belonging, shared artefacts, and geographical relations or with some common members. A boundary practice is a practice designed to deal with the boundary between two communities of practice. A risk with a boundary practice is the possibility of it developing into its own community of practice instead of remaining a boundary between two or more other communities. Boundary objects are reifications connecting two or more communities of practice. Brokers are individuals who actively try to introduce elements from one community of practice into another. When two or more communities of practice are part of larger collections, these collections can be studied based on how they interact and how that affects the individuals’ identities. Also, transfer between the communities of practice can be studied regarding what is being transferred and if and how, for example, the action or artifact transferred changes.

Identification and negotiation
Identity and identity development can be understood as the negotiated experience of self through participation and reification in the learning trajectory within and between communities of practice. Reification refers to the process of giving form to our experience by producing artefacts that congeal experiences into thingness. The negotiated experiences of self are made through the complementary duality of identification in communities of practice and negotiation of the meaning in those communities of practice. Identification and negotiation through participation in communities of practice regards “identifying with” while identification and negotiation through reification in communities of practice regards “identifying as”.

Participation is not something we turn on and off and our participation in the world is social even when it doesn’t clearly involve interaction with others. As such participation is not restricted to engagement in activities but goes beyond as different forms of participation in various communities of practice. An individual can participate in a community of practice through engagement, imagination and/or alignment. These three, by Wenger called modes of belonging, involve different approaches and different conditions and they do not require or exclude each other.

Participation through engagement implies active involvement in a community of practice and requires the possibility to participate in its activities. Engagement does not only affect the learning trajectory of the individual within, but also the development of the community of practice. Mutual engagement is what gives origin to a community of practice.

Participation through imagination implies going beyond time and space in a physical sense and creating images of the world. Imagination makes it possible to feel connected to people we have never met but who, in some way, match our own patterns of actions. Imagination is a creative process transcending engagement making it possible to create new images of the world and ourselves. Since participation through imagination does not have to imply mutual engagement, it
alone cannot build new communities of practice but it is a mode of belonging in communities already existing.

Participation through alignment implies that the individual aligns in relation to a community of practice the individual wants to, or is forced to, be a member of. Also alignment can go beyond time and space in a physical sense, but as it does not have to imply mutual engagement, it alone cannot build new communities of practice.

All three forms of participation involve identification and negotiation but with different conditions as they involve various types of work for the individual and they can even come into conflict. As they have different strengths and weaknesses, they function best in combination. Since imagination and alignment expands participation and reification beyond time and space in a physical sense, individuals can participate in, and sense a belonging to, communities of practices without visible shared practice.

Studying individuals’ modes of belonging in communities of practice is not about classification, it is about how the communities of practice have been and are developed and about the individuals’ learning trajectories within and between communities of practice; that is, identity development. Since identity is a never ending negotiation and identification in communities of practice, it is not an object but an endless becoming. Identity is temporary and identity development is constantly ongoing as a learning trajectory through a nexus of communities of practice. Our identities are shaped in the tension between our different memberships and modes of belonging in various communities of practice and the identification and negotiation within these. Identity is how we, through these identifications and negotiations, experience ourselves and how others reify us.

Membership in communities of practice and ownership of meaning

Membership in communities of practice and ownership of meaning can be focused on regarding an individual’s membership within one or between different communities of practice. The movement towards central membership in a community of practice is both a quantitative change, in that the individual spends more time in the community of practice, and a qualitative change, in that the individual is given extended responsibility and extended ownership of meaning (Lave & Wenger, 1991).

Memberships in communities of practice affect our identity in various ways. Some learning trajectories are peripheral; others are inbound, inside, on the boundary or outbound. A peripheral participation\(^{16}\) is a learning trajectory that will never lead to full participation. An inbound learning trajectory is participation aimed at developing full participation. Boundary learning trajectories are when an individual’s learning trajectory connects different communities of practice. According to Wenger, an individual with such a learning trajectory is a broker. A broker is neither inside nor outside but has enough distance to bring new perspectives and enough legitimacy to be listened to. Being a broker implies bringing elements from one community of practice to another. This is often a huge challenge. A broker must avoid two opposites; he or she must not become a complete member of or be refused by either one of the communities of practice. An outbound learning trajectory is participation leading out of a community of practice. Identity is affected both by the communities of practice of which we are members and by those of which we are not. Even as a full participant, an individual’s learning trajectory in the community of practice continues

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\(^{16}\) This peripheral participation is not to be confused with legitimate peripheral participation from Lave and Wenger (1991).
through inside trajectories. How non-participation in a community of practice affects an individual’s learning trajectory depends on the non-participation being wanted or not. Furthermore, different individuals’ learning trajectories in communities of practice become parts of each other, either they co-operate or counteract each other.

Based on the different learning trajectories mentioned above, identity development is neither individual nor linear, it is an on-going process of individual and collective contributions weaving together the past and future with the experience of the present. Being a different kind of member of different communities of practice makes identity a puzzle, not one entity but not fragmented either. Since an individual is a member of several different communities of practice, identity development is also about reconciling these different memberships. That reconciliation is not done once and for all but constantly and can be a difficult challenge for an individual moving from one community of practice to another. New members of a community of practice may have to adjust their behaviour and align with the shared repertoire in the community of practice to become a member.

Wenger also writes about economies of meaning, implying different meaning collections produced in communities of practice being spread outside a community. Such economies of meaning work in the same way as communities of practice but without the practice. Economies of meaning can be understood as parts of shared repertoires leaving one community of practice and joining new ones in which the original foundations are not present. As such economies of meaning can be a part of the shared repertoire in several different communities of practice. Some economies of meaning are spread over several communities of practice where they may be interpreted differently and have different importance to the members. Since the starting point of this thesis is individuals and not communities of practice, economies of meaning as phenomena will not be investigated (for example, regarding circulation) as units to analyse but as parts of shared repertoires in communities of practice with the focus on how the individual’s learning trajectories, identity development as teachers, are affected by them.

Sfard, Wenger and identity

Even though Wenger’s theory is the one that will be used in the conceptual framework to be presented further on, some comparisons will here be made with Sfard (2006, 2008) who also has developed a participatory theory with many parallels to Wenger’s theory. (Sfard’s theory contains much more than these parallels but here only they will be focused on.)

Sfard describes thinking as an individualised\(^{17}\) version of communication (intrapersonal) and creates the word “commognition” in order to include both what are traditionally called cognition and interpersonal communication in the same word. According to Sfard, the different kinds of communication that bring people together are discourses, and our society is divided into partially overlapping communities of discourse. Sfard’s theory focuses on the activities in these communities of discourse, “the patterned, collective doings” (2008, p.157). These regard how communities of

\(^{17}\) Individualised is to be understood as “turning patterned collective doings into activities for an individual” (Sfard, 2006, p.157).

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discourse are built using words, visual mediators, endorsed narratives and routines. Learning, according to Sfard’s theory, is to become more capable of communicating within a community of discourse, becoming more capable of handling its words, visual mediators, endorsed narratives and routines both inter- and intrapersonally.

Evidently, there are similarities between Wenger’s and Sfard’s theories. Both are about developing participation in some kind of community, community of practice or community of discourse. Words, visual mediators, endorsed narratives and routines in Sfard’s communities of discourse can be compared with shared repertoires and joint enterprise in Wenger’s communities of practice. Learning as becoming a more central member of a community of practice with its mutual engagement, joint enterprise and shared repertoire, is similar to learning as becoming more capable of handling the words, visual mediators, endorsed narratives and routines in a community of discourse. Also, both communities of practice and communities of discourses are described as being in constant change.

The reason for choosing Wenger’s theory in the coming conceptual framework is his modes of belonging. Through these, not only the content in and structure of the community is focused on, but also the individual’s different modes of belongings (engagement – imagination – alignment) and learning trajectories (identity development) within and between them. Based on the aim of this thesis, to investigate professional identity development as experienced from the perspective of the teachers themselves, this part is important.

2.2 Professional competence

Since Wenger’s theory doesn’t focus on mathematics education and/or teaching the next step in the development of a conceptual framework became looking for theories regarding the professional part of professional identity development with focus on mathematics teaching.

[...] professional development must be concerned with the whole teacher as a person, since it is the teachers’ whole self that brings significance to the meaning of the teaching act (Day, 2000, p.108).

The word professional refers to the specific scientific knowledge base and ethics of an occupation (Lindström Nilsson, 2012). The word professional began to appear in relation to schools and teachers in Sweden in the mid-1980s. The underlying reason was to clarify the difference between political issues and professional issues when the school system was decentralised. Previously, teachers had been the implementers of political decisions. After decentralisation, as a consequence of political decisions, they were to develop and argue for their own solutions and were given increased responsibility for school performance (Carlsten, 1994). According to Aspelén and Persson (2008), several of the current steering documents in Sweden (for example, SOU 1999:63) have written off the possibility of new teachers entering a pre-decided professional role. Instead, professional competence is centred where student teachers, instead of taking on a role or tradition, are supposed to edify their own role.

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18 Within professional research, the word professional is used to signify professions that require a long, specialised, theoretical and scientific education tested by examination.
There is no one definition of what constitutes professional competence for teachers. Instead, professional competence is an umbrella term under which different researchers focus on different areas and where some describe professional competence as a linear development while others refer to a process of identity development which is not necessarily linear (Sachs, 2001).

[...] analysis of teachers’ professional development needs to take into account a wide range of variables which include the teachers, their relations with other teachers, and the context in which their operate, and of course the content (Llinares & Krainer, 2006, p.445).

The focus of this thesis is not on teachers’ professional competence as a whole but their professional competence regarding teaching mathematics.

It [professional identity] is used to refer to a set of externally ascribed attributes that are used to differentiate one group from another. Professional identity thus is a set of attributes that are imposed upon the teaching profession either by outsiders or members of the teaching fraternity itself. It provides a shared set of attributes, values and so on that enables the differentiation of one group from another (Sachs, 2001, p.153).

A great deal of professional competence research regards development of and/or change in teachers’ professional competence rather than the meaning of professional competence as such. In several studies (for an overview, see, for example, Roesken, 2001), models are developed to study changes in teachers’ professional competence when they are affected by different interventions. The aim of this thesis is, however, not to intervene or to evaluate the professional competence of the novice teachers but to describe and understand professional competence as part of becoming a primary school mathematics teacher. Further, the focus is not on the novice teachers’ development of a pre-defined professional competence or “externally ascribed attributes” as in the quote above, but their becoming primary school mathematics teachers as experienced from their perspective.

Being a teacher of mathematics means developing a sense of self [as] a teacher. Such an identity grows over time. It is built from many different experiences with teaching and learning. Further, it is reinforced by feedback from students that indicates they are learning mathematics, from colleagues who demonstrate professional respect and acceptance, and from a variety of external sources that demonstrate recognition of teaching as a valued profession (Sowder, 2007, p.161).

Franke, Kazemi and Battey (2007) describe mathematics teaching as relational where teachers, students and content can only be understood if related to each other. Similar Beijaard, Meijer and Verloop (2004) write that professional competence includes both person and context and can be understood as an ongoing process where the professional competence is dynamic, not firm or fixed. According to Sowder (2007), the process of learning how to teach is an integration of all of the components needed to teach, and being a teacher is a constant professional development. Becoming a teacher also involves developing a sense of self as a teacher. Professional competence
involving “developing a sense of self [as] a teacher” is in line with investigating professional identity development from the perspective of novice teachers themselves.

As have been shown in the first chapter beliefs and/or mathematical knowledge is often focused on (or attributed upon the teaching profession) in research of professional competence for mathematics teachers. However, traditional definitions and research of beliefs and mathematical knowledge were, for several reasons, not considered as suitable in this study. One reason for this was the methodological and epistemological problems within beliefs research that were presented in the first chapter. A second reason was that, both beliefs and mathematical knowledge are objectifications. Based on teachers’ actions, researchers talk about the teachers’ beliefs and knowledge as objects (reification) and they also talk about these beliefs and knowledge as detached objects (alienation). According to Skott (2010), the notion of beliefs is “generally understood as deeply personal, conscious or unconscious, value-laden, mental constructs that carry a subjective truth value and are the result of experiences gained over prolonged periods of time” (p.194). He describes beliefs as being the result of a second order objectification where the researcher reifies the actions of individuals into beliefs. A similar treatment can be seen concerning mathematical knowledge. Just like researchers have attributed beliefs to individuals based on questionnaires, interviews or observations, researchers attribute mathematical knowledge to individuals based on similar empirical material. The actions and/or statements of individuals are reified and alienated and after that treated as objects the individuals have. But according to Lave (2009), a view of mathematical knowledge as situated in teaching leads to the conclusion that knowledge always undergoes construction and transformation when being used. Rather than being seen as static, knowledge is to be seen as changeable in relation to social, cultural and historical aspects. Similarly, Wenger (2010) writes that knowledge is about active engagement in the world implying competence in and evaluation of different situations.

A third reason for not using traditional definitions and research of beliefs and mathematical knowledge was the problem (also presented in the first chapter) in distinguishing between beliefs and mathematical knowledge for teaching which, according to Speer (2005), bring about many of the problems in beliefs research and research of mathematical knowledge. Both objectified beliefs and objectified mathematical knowledge for teaching are derived from statements and/or actions related to mathematics and mathematics teaching which may cause the problem with distinguishing between beliefs and knowledge.

A fourth reason was that the situative participatory perspective used in the study is not in line with the acquisitionist perspective often used in research of beliefs and mathematical knowledge. Fives and Buehl (2012) write that the initial goal of beliefs researchers “was to establish a clear psychological construct, beliefs, that could serve as an explanatory and predictive mechanism” (p.471) and according to Lerman (2002), Llinares and Krainer (2006) and Skott (2010), most studies within beliefs research are conducted from an individualistic and constructivist perspective. This, as beliefs research was developed at the same time and in relation to constructivism during the 1980s and, therefore, shares its focus on the individual. According to Skott (2010), that does not mean that the social is considered as unimportant in the

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19 The term mathematical knowledge here refers to the different kinds of research regarding the knowledge needed for or used in mathematics teaching that were presented in the first chapter of the thesis.
development of beliefs but, when developed, they are treated as individual constructs. However, according to Lerman (2002) and Llinares and Krainer (2006), it is first in later years that beliefs research has started to consider the social.

Finally a fifth reason for not using beliefs and/or mathematical knowledge was their normative character. That character is not in line with investigating professional identity development from the perspective of novice teachers themselves. From that perspective the meaning of professional competence becomes an empirical question without any normative model to meet.

Skott (2001, 2004 and 2009) has strived towards turning beliefs research social. This endeavour derives partly from the above mentioned problems within beliefs research and partly from findings in case studies.

If belief research focused to a greater extent on the actual and virtual communities of practices, and on teachers’ contexts as they emerge from engagement in those communities, it may shed more and different light on the relationship between the teacher’s educational and mathematical priorities on the one hand and the practices that evolve in her or his classroom on the other (Skott, 2009, p.45).

According to Skott (2010), the social turn that has been developed in research regarding other areas within mathematics education also needs to be developed within beliefs research. If beliefs research is to become social, the pre-refined and the pre-alienated processes of teachers’ participation need to be focused on. Skott suggests a shift from focusing on objectified beliefs to focusing on patterns of participation. In this study, patterns of participation will be used as the professional part of professional identity development.

According to Skott, Moesker Larsen and Hellsten Østergaard (2011) a teacher participates in “multiple simultaneous practices” (p.32) in the classroom and there are patterns in the ways in which the teacher participates in these practices. The aim in patterns of participation research is to understand how a teacher’s interpretations of and contributions to immediate social interactions relate to prior engagement in a range of other social practices. Patterns from teacher’s prior engagement in social practices are confronted with and further develop those in immediate situations. In these confrontations the patterns “merge with, transform, substitute, subsume, are absorbed by, exist in parallel [...]” and the tasks for the researcher becomes “to disentangle the multiple patterns of participation that for the teacher in question emerge in the mathematics classroom, as well as the relationships between them” (Skott, 2010, p.199).

Patterns of participation in this study

Some additions to patterns of participation is made in this study which will be described in this section. The first addition is that patterns of participation are seen as valid as the pre-refined and pre-alienated statements and/or actions previously objectified as both beliefs and/or mathematical knowledge. Objectification of statements and/or actions as beliefs or mathematical knowledge respectively are then no longer of interest. If the aim is to understand (mathematics) teachers and their
(mathematics) teaching, their patterns of participation, their pre-reified and pre-alienated processes of participation, are of interest.

The second addition regards turning specific situations into settings where the participation of the teacher is double. The teacher participates in “multiple simultaneous practices” (Skott et al., 2011, p.32) and in specific situations at the same time. Horn, Nolen, Ward and Campbell (2008) distinguish between a situation as an arena or as a setting. Arena refers to the “physically, economically, politically and organized spaces-in-time” (p.63) whilst setting refers to “personally ordered and edited versions of the arena that arise as individuals interact in these contexts” (p.63). As such, setting can be understood as the arena from the perspective of the individual. The individual participates in settings and “multiple simultaneous practices” at the same time and the merger of these participations is what gives significance to the patterns of participation.

The third addition regards the relationship between continuity and dynamics in patterns of participation as immediate and long-term patterns of participation. In a specific setting some participation in “multiple simultaneous practices” (Skott et al., 2011, p.32) are more visible than in other settings, that is, immediate patterns of participation. Several immediate patterns of participation over an extended period construct long-term patterns of participation as the patterns between situations. Even if the patterns “confront, merge with, transform, substitute, subsume, are absorbed by, exist in parallel with [...]” (Skott et al., 2011, p.33) in the immediate situation, there is a continuity which creates patterns also between situations, but the patterns are dynamic and, therefore, the individual does not act identically in different situations. As such, there are patterns both within and between settings. Since the aim of this thesis is to describe and understand professional identity development, i.e. the process of becoming a primary school mathematics teacher, the focus is on long-term patterns of participation. This implies a focus on how novice teachers make meaning of what is happening in specific settings and how these situations affect their professional identity development as changes in long-term patterns of participation regarding becoming a primary school mathematics teacher.

2.3 Connecting identity and professional competence

Wenger analyses identity while Skott (2010) and Skott et al. (2011) analyse teaching situations. According to Skott et al. (2011) different methods need to be used when studying patterns of participation as different methods may shed light on “decidedly different forms of practice” (p.34) and “decidedly different modes of participating in them” (p.34). What they call “different forms of practice” and “different modes of participating in them” will here be connected to participation and reification in communities of practices and modes of belonging by Wenger (1998). According to Österholm (2011) there seems to be a need for some form of separation between the different practices and different kinds of memberships when researching patterns of participation. By combining patterns of participation (expanded by me to include mathematical knowledge for teaching) by Skott (2010) and Skott, Moeskaer Larsen & Østergaard (2011) and communities of practice by Wenger (1998) such a separation becomes possible and a conceptual framework can be developed within a participatory perspective, making both the individual and the social possible as simultaneous units of analysis.
Human is shaped of and shapes his/her own situation at the same time. The situation is always specific in character regarding its cultural, individual and material aspects (Sages & Dahl-Hensfelt, 1999, p.139).

According to Graven and Lerman (2003), communities of practice are the primary unit of analysis in Wenger's theory of learning; however, for teacher learning, it allows the primary unit of analysis to be neither the teacher nor the learning community but “the-teacher-in-the-learning-community-in-the-teacher” (p.192). If connecting patterns of participation and communities of practice, patterns of participation can be used to describe “the teacher” in “the-teacher-in-the-learning-community-in-the-teacher” while communities of practices can be used to describe “the learning communities” (figure 1).

<table>
<thead>
<tr>
<th>The individual in the foreground</th>
<th>The social in the foreground</th>
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<tbody>
<tr>
<td><strong>Individualisation of the collective</strong></td>
<td><strong>Collectivisation of the individual</strong></td>
</tr>
<tr>
<td>An individual’s (immediate and long-term) patterns of participation regarding mathematics teaching and the sense of becoming as a teacher. Mutual engagement, joint enterprises and shared repertoires in communities of practice influence the individual’s patterns of participation. Based on analysis of the individual’s engagement, imagination and/or alignment interpretations can be made about communities of practice the individual seems to identify with and/or negotiate within.</td>
<td>Several individuals overlapping participation give rise to communities of practice through mutual engagements, joint enterprises and shared repertoires. Based on analysis of communities of practice interpretations can be made about how membership in them affects the patterns of participation of individual members.</td>
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**Figure 1**: Connecting patterns of participation and communities of practice.

Patterns of participation becomes the unit of analysis (the social in the individual\(^2\)) if the individual is in the foreground. If, instead, the collective is placed in the foreground, overlapping constellations of participation as communities of practice become the unit of analysis (the individual in the social\(^3\)). Both theories include the individual and the social but with different focus and different emphasis.

\(^2\) By the *social in the individual* is meant that the main focus is on the individual while emphasising that the individual can never be understood if separated from his/her social practices.
In all of this, patterns from the teacher’s prior engagement in social practices are enacted and re-enacted, moulded, fused and sometimes changed beyond recognition as they confront, merge with, transform, substitute, subsume, are absorbed by, exist in parallel with and further develop those that are related to the more immediate situation (Skott, Møesker Larsen & Østergaard, 2011, p.33).

[...] it [identity] is produced as a lived experience of participation in specific communities. What narratives, categories, roles, and positions come to mean as an experience of participation is something that must be worked out in practice. An identity, then, is a layering of events of participation and reification by which our experience and its social interpretation inform each other (Wenger, p.151).

In the citation of Skott et al. above, the focus is on the immediate situation with “prior engagement in social practices” in the background. In the citation of Wenger, the relationship between situations and social practices (that is, communities of practice) is the opposite, with communities of practice in the foreground and the imprints must be “worked out in practice”. As such, patterns of participation offer a language with which to explain what is happening in immediate situations while communities of practice offer a language with which to explain the emergence of what is happening.

The individual’s patterns of participation in immediate situations are an act of creating meaning in the setting with a background in communities of practice where the individual is a member. Skott et al.'s (2011) expression “[t]he practices that unfold in the situation” is seen here as how the individual’s memberships and modes of belonging in communities of practices (with different shared repertoires, mutual engagements and joint enterprises) influence the actions, the patterns, of the teacher in the situation. According to Wenger (1998), identity development is an individual’s learning trajectory through different communities of practice. That learning trajectory can be viewed through changes in the individual’s patterns of participation in settings over times (as long-term patterns of participation).

Both patterns of participation and communities of practices are needed in the conceptual framework because separately they answer different questions. Patterns of participation answer the question “how?”, while communities of practices answer the question “why?” If investigating the patterns of participation of novice primary school mathematics teachers alone, immediate and long-term patterns of participation can be described and hypothesis can be formulated as to how these patterns of participations are affected by the social. By connecting to communities of practices, however, interpretations can be made of how the individual’s patterns of participation is the merged result of learning trajectories as different kinds of memberships and modes of belonging in different kinds of communities of practices and, also, of how these memberships affect the communities of practice. This is shown in the following illustration (figure 2).

21 By the individual in the social is meant that the main focus is on the social while emphasising that the social can never be understood if separated from its individual actors.
Figure 2: An individual participates in settings and multiple communities of practice at the same time and the merger of these participations is what gives significance to the actions of the teacher.

Starting on the left, the individual is a member of several communities of practices regarding mathematics teaching. The individual has different modes of belonging in these (engagement, imagination and/or alignment) implying different possibilities regarding identification and negotiation. Some of the communities of practices overlap, conflict and so on regarding their shared repertoires and/or members. Some memberships are peripheral, others are inbound, inside, on the boundary or outbound. The individual, based on experiences and memberships in communities of practices, interpret every situation of mathematics teaching into a setting (the circle to the right). As mentioned the participation of the teacher is double and if being expressed based on the connection between patterns of participation and communities of practice the teacher participates in communities of practice and settings at the same time. The individual participates in settings and multiple communities of practice at the same time and the merger of these participations is what gives significance to the actions, the patterns of participation regarding mathematics teaching, of the teacher. By looking at patterns of participation in an immediate situation, how the individual acts can be analysed. By combining with communities of practices, why, regarding the patterns of participation can also be analysed. Several immediate patterns of participation over an extended period construct long-term patterns of participation as the patterns of becoming a primary school mathematics teacher. As such, there are patterns both within and between settings (figure 3).
Figure 3: An individual participates in settings and multiple communities of practice at the same time and the merger of these participations is what gives significance to the actions of the teacher. Several immediate patterns of participation regarding mathematics teaching over an extended period construct long-term patterns of participation as the professional identity development of becoming a primary school mathematics teacher.

By coordinating the two theories, it is also possible to analyse from the opposite direction. By looking at several individuals’ participation in joint situations (virtual or physical), it can be analysed how these individuals’ participation by mutual engagement, joint enterprise and shared repertoire give rise to communities of practice.

One remark needs to be made regarding situations (or settings if seen from the perspective of the respondents). All of life is participation in multiple situations but the individual seldom splits his or her participation into situations. In research, where one situation ends and another starts is most often decided from the outside, based on the interest of the researcher. For instance, the same mathematics lesson can be interpreted and analysed as one situation (one mathematics lesson), three situations (introduction – students working with tasks – conclusion) or several situations (single interactions teacher-student) and so on. In this thesis the scope of situations will differ in relation to long-term and immediate patterns of participation.

To talk about professional (primary school mathematics teacher) identity based on patterns of participation and communities of practice means freezing an ongoing process. To talk about professional (primary school mathematics teacher) identity development based on learning trajectories in communities of practice means freezing the ongoing process several times over a prolonged period of time. By freezing and objectifying the ongoing process, one can talk about professional (primary school mathematics teacher) identity; however, it is important to remember that the professional identity is not an object within the individual but an objectification of an ongoing process.
2.3.1 Professional identity development as a primary school mathematics teacher

The aim in this thesis is not to understand who the respondents "really is at heart" or to present a complete picture of their professional identity development. Rather, their professional identity development is to be understood as a swarm of interactions and ongoing relations where the professional identity development, the learning trajectory, is a process of identification and negotiation without start or end.

In this thesis, the individuals are the primary analytic unit, with communities of practice in the background. Communities of practice are observed indirectly, not directly, based on the patterns of participation of the individuals. Not all patterns of participation are of interest, only those regarding becoming a primary school mathematics teacher. Based on them, interpretations are made of which communities of practice the individuals are members or want to become members, their modes of belonging, their participation and reification and how these different memberships or non-memberships influence their patterns of participation. An individual's patterns of participation can be the reason for the membership in one community of practice and the exclusion from another, at the same time. The patterns of participation of the individual influence and are influenced by communities of practice they are members of, want to become members of, are excluded from and the kind of membership they develop. An individual may also deliberately change their patterns of participation to influence these possibilities of membership and/or exclusion.

As such, based on Kinnvall's division of identity studies presented earlier, this study is conducted in a micro sociological perspective implying identity as a result of the individual's interaction with their surroundings. By freezing the process and objectifying the individual's patterns of participation in communities of practice you can talk about professional identity. By doing this and comparing these objectifications several times over a period of time, you can talk about professional identity development. However, the identity and identity development are not objects within the individual; they are objectifications of an ongoing process.

When any human being acts and interacts in a given context, others recognize that person as acting and interacting as a certain "kind of person" or even as several different 'kinds' at once [...] (Gee, 2000-2001 p.99).

Gee (2000-2001) defines identity as being recognised as a kind of person in a given context. Similarly, Morgan (2010) writes that establishing a (positive) professional identity as a mathematics teacher involves positioning oneself "within discourses of education in general and mathematics teaching in particular" (p.109) in ways that allow being seen by others and oneself as a (good) teacher of mathematics. Wenger (1998) uses certain person and specific kind of person as terms for the identity being formed by learning. In relation to this study, being recognised as a kind of person in a given context implies two different perspectives of recognition: being recognised as a primary school mathematics teacher from the outside, by other people, and/or from the inside, one's own perspective.

The objectification of the process between patterns of participation and communities of practice as described depends on how we are recognised as a special "kind of person" (Gee, 2000-2001) in a given context. However, to be able to understand and describe this recognition, you must look at the process as the interplay
between patterns of participation and communities of practices. The conceptual framework presented here makes it possible to investigate both the recognition and the process.

2.4 Evaluating the conceptual framework

A connection between theories depends on the structure of the theories involved and the goal of the connection and can be made at the level of principles, methodologies, or questions or as a combination of these (Radford, 2008). The goal of the connection presented in this thesis was to better understand an empirical phenomenon by including both the individual and the social in the development of a conceptual framework capturing both the professional part and the identity development part of professional identity development. Also, based on the epistemological stances, the conceptual framework was to be within a participatory perspective with identity and professional competence as processes and not as objectified objects. Below a comparison of Wenger’s (1998) theory and Skott’s (2010) and Skott et al.’s (2011) theory will be made based on basic principles, questions, starting points, notions and methodology.

Regarding the basic principles both theories are within a participatory perspective focusing on processes involving both the individual and the social. According to Radford (2008) different theories emerge as responses to particular questions. The use of communities of practice and patterns of participation in this study is in line with the questions the two theories initially sought to answer, and it was the aim of the study that constituted the need of the connection.

Regarding starting points the cores of Wenger’s and Skott’s and Skott et al.’s theories may appear rather different at first sight. The two theories have different ranges. Skott’s and Skott et al.’s theory is new and under development, while Wenger’s theory is better established. Wenger’s starting point is learning and Skott’s and Skott et al.’s is beliefs. However, the two theories have a common starting point when looking at old phenomena (learning – beliefs) but from a (new) social perspective. Wenger’s starting point is to make a social theory of learning and Skott’s and Skott et al.’s is to turn beliefs research social.

But, if moving further into comparing notions, social may imply different things in various degrees. Wenger asks the question, “what if we […] placed learning in the context of our lived experience of participation in the world?” (Wenger, 1998, p.3). Similarly, Skott (2010) suggests “that a more participatory stance is adopted in research on the role of teachers for classroom practice” (p.1). The basic claim behind the notion of participation is that “patterned collective forms of distinctly human forms of doing are developmentally prior to the activities of the individual” (Sfard, 2006, pp.157, original italicisation). Further comparison of notions show more connections between the two theories. Wenger writes that knowledge always undergoes construction and transformation in use, and that things assumed to be natural categories, such as “bodies of knowledge”, “learners” and “cultural transmission”, require reconceptualisation as cultural, social products. This can be compared to Skott’s and Skott et al.’s re-reification goal. What Wenger calls “cultural transmission” and “bodies of knowledge” respectively, can be seen as similar to traditional reified beliefs or mathematical knowledge. As such, both Skott, Skott et al and Wenger work with re-reification of notions focusing on processes. Certainly, a community of practice is a
reification, but Wenger describes communities of practices as theoretical constructs to be used as analytical tools to describe a process, the process of identity.

Regarding methodology, neither Wenger nor Skott or Skott et al. explicitly mention it in their theories. However, inferences can be drawn based on the kind of data they themselves produce in their studies indicating a common direction towards attended approaches. To be able to discover patterns of participation and communities of practice, an attended approach, e.g. ethnography, is needed. Österholm (2011) has compared patterns of participation with traditional beliefs research. He writes that when researching patterns of participation, all prior experiences are of interest and that there seems to be a need for some form of separation between the different practices and different kinds of memberships. This requested separation is acquired by the connection with communities of practice. Further, Österholm writes that within patterns of participation it seems to be difficult to talk about change since there is nothing to change. The use of patterns of participation in this study as long-term and immediate makes visible the process of constant mutual change in patterns of participation and communities of practices.

In summary, using words from Prediger, Bikhner-Ahsbah and Azrarello (2008), the conceptual framework implies coordination as built by well-fitting elements from different theories being useful when the empirical elements of the theories complement each other and, coordinated thus, support a more complete analysis.

2.5 The use of Wenger’s and Skott’s theories in other studies

In this section other studies which also use Wenger’s and Skott’s theories will be presented. The notion of communities and/or communities of practices is used in several studies without reference to Wenger; however, only studies that refer to Wenger or Lave and Wenger (1991) are presented here. The focus of this section is the use of Wenger’s and Skott’s theories in the presented studies in relation to their use in this study. The presentation is based on a division of the studies into four sub-sections. The first sub-section regards studies that use Skott’s theory. The second regards studies that use Wenger’s theory from 1998. The Third regards a study that use Wenger’s theory from 1998 but want to supplement the theory. The fourth sub-section regards studies that use communities of practice but with reference to Lave and Wenger (1991) and not Wenger (1998).

Studies using Skott’s theory

As mentioned before, Skott started to develop patterns of participation research as a social reaction towards the problems within beliefs research. In two published articles, two different cases are presented and analysed. In the first, Skott (2010) presents a case of a novice teacher who is inspired by current reform efforts, but gets his first teaching position at a conservative private school. The novice teacher tries to balance the management’s and his colleagues’ emphasis on basic skills and performance on tests against his own concern for students’ engagement in investigative activities. In the article Skott compares an analysis of the novice teacher’s teaching made with
beliefs versus an analysis made with patterns of participation. When analysed with beliefs the novice teacher’s actions occur as inconsistent but when analysed with patterns of participation those inconsistencies are explained as the novice teacher participation in a variety of social practices. At the same time as the novice teacher is primarily concerned with facilitating student learning, he participates in practices that are strongly affiliated with those of his previous teacher education. Often his intentions to support student learning is submerged by other concerns such as preparing them for next test or ensuring that they cover the expected text book contents according to the expectations of his colleagues and the parents.

In the second article Skott et al. (2011) present a case of another novice teacher. The empirical material in the article is from the time of her graduation and then 18 months later. Extracts from her classroom practice show how she is engaged in multiple activities when teaching mathematics, e.g. presenting procedures, making sense of the students’ mathematical suggestions, emphasising elements of understanding, solving disciplinary problems, and taking the students’ social problems into consideration. Becoming engaged in these activities the novice teacher relates to a range of social practices beyond the mathematics classroom. Skott et al write that the novice teacher’s contributions to the classroom practices are a result of the meaning she makes of the interactions and that this meaning-making activity relates to her engagement in different practices. These practices regard the reform, the novice teachers own experiences with mathematics teaching and learning as a student (“the tradition”) and the school where she is working. According to Skott et al. one of the special characteristics in the presented case is that these different practices don’t merge to any great extent. ”The tradition” is predominated and the other practices function primarily by suggesting ways of handling issues at the outskirts of the main practice.

The additions to and use of patterns of participation in this study has been described above in section 2.2.

Studies using Wenger’s theory from 1998

In studies that use Wenger’s theories from 1998, there are many differences regarding which parts are focused on and how. This first group presented contains studies by Bohl and Van Zoest (2003), Van Zoest and Bohl (2005), Goos and Bennison (2008), Franke and Kazemi (2001) and Cuddapah and Clayton (2011). There is a difference between these studies and the conceptual framework in this thesis in how communities of practices are treated as emergent or designed. In the conceptual framework in this thesis, communities of practice are investigated through the patterns of participation of the respondents. In the referenced studies, communities of practice are designed by the researchers. After designing the communities of practice, Goos and Bennison (2008) use Wenger’s theory in the same way as it is used in this thesis (except for the coordination with patterns of participation). However, Goos and Bennison place communities of practice in the foreground and the individual in the background while the positions are the opposite in this thesis. Also, Franke and Kazemi (2001) and Cuddapah and Clayton (2011) place communities of practice in the foreground. Bohl and Van Zoest (2003) and Van Zoest and Bohl (2005) place the individual in foreground, as in this thesis, but they use other parts of Wenger’s theory in their analysis than those used here. Common to all of the studies
mentioned in this section, regardless of the primary unit of analysis and/or use of Wenger’s theory, is investigating teacher learning. The studies are further presented in the following section.

Bohl and Van Zoest (2003) use Wenger’s theory of communities of practice when analysing a case study of a mathematics teacher who has participated in a, by them called, reform orientated course. Bohl and Van Zoest observed inconsistencies in how the teacher talked about mathematics teaching and how she taught. They also observed inconsistencies regarding the teacher’s teaching and her evaluation of her performed teaching. Mathematics teaching which, according to Bohl and Van Zoest, were non-reformative is described as reformative by the teacher who taught the lessons and the researchers wonder why. In their analysis, Bohl and Van Zoest use two of Wenger’s concepts: modes of participation and regimes of accountability (the set of discursive characteristics and administrative arrangements that serve to regulate peoples’ activities in communities of practice). Their conclusion is that in several of the communities of practice where the teacher is a member, her mode of participation was similar but that the classroom is very different from these “talking-communities” in terms of what is required to succeed. In the classroom, the teacher is responsible for the development of the regimes of accountability within which students function, rather than being an equal co-participant as in the other communities. Also, the teacher’s own accountability was not to the community of class but to the community of the department, the school’s administration and reform. The teacher in the study had experienced reform teaching by visiting other teachers but had no experience of either establishing such a community or maintaining one as the sole authority. Nor was there any community within which she could engage in joint activity with other teachers who also wanted to change their mathematics teaching. As a consequence of all this, the teacher, instead of teaching according to the reform, recontextualised the meaning of the reform in relation to her classroom practice.

In a study from 2005, Van Zoest and Bohl develop a framework for analysing secondary school mathematics teachers learning to teach through practice. In the framework, they want to capture a breadth of social contexts and parameters within which, according to them, learning to teach takes place. Their framework has many similarities with the conceptual framework in this thesis but there are also differences. In their framework, Van Zoest and Bohl combine Shulman’s division of teacher knowledge, identity development according to Wenger and cognitive notions of thinking as residing in one’s head. Similarities with the conceptual framework in this thesis are the focus on teacher identity and the attempt to capture a wide range of parts within this professional identity. A difference is that in their framework the three combined parts have different epistemological grounds. As previously mentioned, they defined the communities of practice that a [novice] teacher is a member of beforehand and these communities are considered as being the same for all [novice] teachers. They identify “five main communities” (p.326) of practice that novice teachers are members of during their years of teacher training and first years of teaching. In their framework, membership in a community of practice ends when the possibilities for physical interaction ends. Their framework is applied to one community of practice at a time and when they write about how to expand the framework to layers of communities of practice that the individual is a member of (in their case, five), they write:

In summary, mathematics teacher identity [...] is what individuals carry with themselves as they move from context to context, or as they interact
among multiple communities at the same time. Within that cache they embody their knowledge; beliefs, commitments, and intentions; and all of the ways they have learned to think, act, and interact socially (Van Zoest & Bohl, 2005, p.338).

This can be compared with, what in this thesis is described as, long-term patterns of participation but with the difference that long-term patterns of participation is not something individuals carry with them but a process. Further, Van Zoest and Bohl write "the way that a MTI [mathematics teacher identity] manifests itself in different communities can vary dramatically depending on the task at hand and the identities of the other people involved" (p.338). This can be compared with, in this thesis described as, immediate patterns of participation. Another similarity between the framework constructed by Van Zoest and Bohl and the conceptual framework in this thesis is the split and interconnection of “[a]pects of self-in-mind [and] aspects of self-in-community” (p.332). However, within these parts, Van Zoest and Bohl place knowledge, beliefs, commitments and intentions. Regarding knowledge, as mentioned previously, they proceed from Shulman while the foundations of beliefs, commitments and intentions are not explored in the same manner.

Even though Van Zoest and Bohl identify communities of practice in advance from an outside perspective, these communities are seen as emerging. Franke and Kazemi (2001), instead, design communities of practice in their studies. Before starting the design, Franke and Kazemi had researched teacher development for several years, focusing on knowledge as a personal property of individual teachers. About their change of direction, they write:

In our work, we now consider teachers’ classrooms, the work in professional development meetings, and teachers’ informal interactions with colleagues and staff as sites for their learning and practice (Franke & Kazemi, 2001, p.71).

Often, these interactions are seen as peripheral in understanding teaching and teachers but Franke and Kazemi found them to be a significant aspect of teacher development. In their study, they create communities of learners consisting of mathematics teachers and a researcher. In these communities of learners, work from teachers’ classrooms is used as the focus for the meetings. The purpose of the communities of learners is to create space for teachers to share, challenge, and create ideas about the development of children’s mathematical thinking. Franke and Kazemi stress that the communities of learners they design are not separate from the teachers’ classrooms but can mirror the interactions and identities there.

Similarly, Goos and Bennison (2008) and Cuddapah and Clayton (2011) design communities of practice but they use more of Wenger’s concepts when analysing their communities than Franke and Kazemi. Goos and Bennison’s aim is to analyse the processes through which a community of practice is established and maintained. As in this thesis, they use Wenger’s concepts of mutual engagement, joint enterprise and shared repertoire in their analysis. However, as mentioned previously, they placed the communities of practice in the foreground in their study. In their study, Goos and Bennison created an internet based communication forum for their teacher students to use during their last year in teacher education and after graduation. The students were free to use the forum as they wanted and the students’ contributions in the forum were not assessed or graded. Instead, Goos and Bennison were interested in
how the students used the forum and if it developed into a community of practice. By analysing mutual engagement, joint enterprise and shared repertoire in relation to the forum, Goos and Benison found that a community of practice emerged and, according to the teachers involved, the face-to-face interactions before and during the use of the forum were important for this to happen.

Also, Cuddapah and Clayton (2011) designed a community of practice with novice teachers but they arranged physical sessions with them and analysed the development of the group and its function as a resource for new teacher support. The group of novice teachers met several times every second week and every session had a theme. The sessions were planned and led by experienced educators. In their analysis, Cuddapah and Clayton specifically used Wenger’s quartet practice – meaning – identity – community and they expressed the interrelationship between these as symbiotic. Cuddapah and Clayton describe how the group of novice teachers developed a special community of practice where they all were new members. Regarding this, Cuddapah and Clayton refer to legitimate peripheral participation which is a notion from Lave and Wenger (1991).

**A study using, but wanting to change, Wenger’s theory from 1998**

In this group, only one study is presented. Graven (2004) uses Wenger’s theory, similar to Cuddapah and Clayton (2011) above, with the emphasis on the relationships between practice, community, identity and meaning. However, Graven wants to expend that quartet with confidence as a fifth part. Based on an ethnographic study of an in-service teacher education program, Graven (2004) argues that the notion of confidence is pivotal in understanding and explaining mathematics teacher learning. Graven works as the co-ordinator of an in-service course in which a community of practice emerges. Graven considers confidence as both a product and process of these mathematics teachers’ learning. It was the teachers who used the word confidence and this was in relation to four different categories: confidence in mathematics classroom practice, confidence in relation to understanding the new mathematics curriculum, confidence through being involved with more informed people through the in-service course and, finally, others having confidence in them. The teachers’ confidence within these four categories increased during the in-service course and two new categories also emerged: confidence regarding broader participation in activities relating to education and confidence in doing further studies. As a result of her studies, Graven wants to add confidence to Wenger’s quartet of practice, community, identity and meaning.

**Studies using communities [of practice] but with reference to Lave and Wenger (1991)**

Stein, Silver and Schwan Smith (1998) refer to Lave and Wenger (1991) when using communities of practice and legitimate peripheral participation to investigate how teachers at a school develop mathematics teaching according to the reform. Their starting point is that teacher education and in-service courses are constructions of cooperating and reflexive communities of practices. In these, teachers’ learning is a part of the ongoing teaching rather than a result of specially designed courses and
workshops. In the communities of practice, the teachers plan together, discuss each other's teaching, develop common assessments and support each other's process of change. Stein, Silver and Schwan Smith study one such community of practice at a school where the participants want to develop their mathematics teaching in line with the reform. They express several advantages with using the theory of Lave and Wenger in their own and similar studies of teachers and teachers’ learning. One advantage is that communities of practice make it possible to investigate the wholeness, not just the individual, making it possible to discover multiple sources of teachers’ learning. Another advantage is that communities of practice make it possible to investigate teachers’ motivation for change.

Zaslavsky and Leikin (2004) refer to Lave and Wenger (1991) when they study the professional development of the mathematics teacher educators involved in an in-service development program for junior and senior high school mathematics teachers. Zaslavsky and Leikin view the teacher educators involved in the project as one community of practice and use communities of practices to analyse the professional growth and various kinds of learning of these teacher educators. However, the connection to Lave and Wenger (1991) is absent in the analysis where, instead, other parts of the framework Zaslavsky and Leikin built is used.

Summary of other studies using Wenger’s theory

As seen above, Wenger’s theory is used in different ways in different studies. Since the theory is broad and yet detailed, it is not strange that researchers focus on and use smaller parts. Even though they are all different, one similarity in the studies that use Wenger's theory is the perception that the theory is suitable for studies of teachers’ learning or/and teachers’ development.

Below (figure 4) is a summary of the use of Wenger’s theory in this thesis. As can be seen, compared to the studies presented in this section, all of Wenger’s theory is not used in this thesis either. The biggest difference, however, does not regard the use of the theory but the view of communities of practices as emerging and to be investigated based on the patterns of participation of the individual, and not as designed or defined beforehand.

![Figure 4](image)

**Figure 4.** A summary of identity and identity development as identification and negotiation of self through participation and reification in learning trajectories within (and between) communities of practice. These learning trajectories can be peripheral, inbound, inside, on the boundary or outbound. The nexus of several learning trajectories makes identity and identity development neither individual nor linear, but an on-going process.
2.5.1 Critique of Wenger’s theory

The research of Graven (2004) above where she wants to add confidence to Wenger’s theory can be seen as critique of the theory. Other critique is found in research regarding management and economy. That critique is mainly focused on the character of communities of practice and not on the whole theory regarding identity and identity development. Critique mentioned is that Wenger doesn’t place enough emphasis on issues of power (Fox, 2000 & Roberts, 2006), trust, the predispositions of communities of practice or their nature regarding size and spatial reach (Roberts, 2006). However, I believe that Wenger addresses both power and predispositions when he writes about different memberships and learning trajectories in and between communities of practice. Wenger writes that communities of practice are not to be seen as harmonious and that power and conflict can be central parts of their practice. Based on the mutual engagement, joint enterprise and shared repertoires (predispositions) in communities of practice power is dealt with differently. Power exists in the negotiation both within and between communities of practice and may also become reified as laws or prescriptions. Regarding size and spatial reach Wenger writes that communities of practice are theoretical constructs and the use of them must be in line with the aim since too broad or too narrow constructions of communities of practice will not make the theory useful.

2.6 Operationalising the conceptual framework

Identity can be investigated from an internal perspective (how individuals recognise themselves as a special kind of person) or from an external perspective (how someone else recognises the individual as a special kind of person). In relation to the aim of this thesis, to investigate professional identity development from the perspective of the teachers themselves, the notions of identity and identity development must be made operational to be investigated from an internal perspective. Making that possible is a methodological issue when trying to capture the perspective of the other both by definition and by the nature of the data collected.

If one wants to know an individual’s unique experience of and perspective on an event there is, according to Atkinson (1998), no better way than letting the person express it in his or her own words and narratives are frequently used in studies of (mathematics) teacher identity (for example Troman, 2008; Bjuland et al., 2012).

[… ] narratives refer to the self-authored, written or oral stories, which allow teachers to present their teaching or learning experiences from their perspectives and to weave descriptions of their thinking, feelings, attitudes, and other personal attributes relevant to these experiences into their stories (Chapman, 2008 p.18).

The aim with narrative analysis is to share the experience of particular groups so that others may know life as they know it and develop understanding of the meaning individuals give to themselves, to their lives and to their contexts. Further “[n]arrative analysis can be used to portray the insider’s view of what a particular job is “really like” (Cortazzi, 2001 p.386). By collecting and analysing several narratives from
respondents it is, according to Cortazzi (2001) possible to distinguish their perspective on particular themes or processes. “Every narrative is a version or view of what happened. Most narratives do not simply report events but rather give a teller’s perspective on their meaning, relevance and importance” (Cortazzi, 2001 p.384). However, it is not enough to simply analyse narratives. Accounts needs to be taken of the functions of the particular narratives, the cultural conventions and the contexts within which they occur (Cortazzi, 2001).

Chapman (2008) describes narrative as a story that tells a sequence of events that are significant for the author and his or her audience. Also a narrative has an internal logic that makes sense to the author. Further Chapman writes that narratives are useful to capture teachers’ perspectives and the situated complexities of their work and classroom practice. Similarly Franke and Kazemi (2001) in their study of mathematics teacher development (presented in the previous section) found that the teachers’ identity development was best captured in the stories the teachers told in informal interactions.

Sfard and Prusak (2005) link identity and narrative and define identity as “a set of reifying, significant, endurable stories about a person” (p.14). The stories are told by the individual but are simultaneously influenced by and located in different social settings. What Sfard and Prusak call social settings can be interpreted in terms of Wenger’s communities of practice. The reifying in the stories refers to the fact that, when we talk about ourselves, we have a tendency to talk about actual states rather than actions. Actions are reified in stories by and about an individual and in the stories impressions from activities in various situations are frozen into a joint story about ourselves.

Sfard and Prusak distinguish between different kinds of identity stories based on who tells them and to whom they are told. First-person identity is an identifying story told by the identified person him- or herself. Second-person identity is also an identifying story about the identified person, but told to the identified person. Third-person identity is a story about the identified person told by a third party to a third party. Sfard and Prusak’s first-person identity is in line with the purpose of investigating identity development from the perspective of the individual. If connected to the conceptual framework in this thesis, the stories are the individual’s freezing of the mutual process of patterns of participation and communities of practice based on how the individual is recognised as a “kind of person”, by herself and others.

Building on the connection between patterns of participation and communities of practices and inspired by narratives and identity as stories, identity in this thesis is operationalised as:

The reifying and significant stories that teachers tell about their patterns of participation regarding education in mathematics, in the present and the future, interpreted with a background in contemporary multiple communities of practice.

The emphasis on the individual’s stories agrees with the aim of investigating professional identity development as seen from the perspective of the teachers themselves. The background in contemporary multiple communities of practice make it possible to take the cultural conventions and the contexts (Cortazzi, 2001) within which the stories occur into account. However, unlike Sfard and Prusak (2005), the stories are treated as expressions of identity, not as identity per se. Consequently, in
this study, identity as stories is used as a methodological tool while the theoretical foundation is the conceptual framework withholding patterns of participation and communities of practice. The individual’s stories offer the freezing, while the conceptual framework offers the understanding of the process.

Telling a life story the way one sees it can be one of the most emphatic answers to the question “Who am I”? (Atkinson, 1998, p.12).

Through life stories individuals and groups make sense of themselves; they tell what they are or what they wish to be, as they tell so they become, they are their stories” (Cortazzi, 2001 p.388).

The stories, that Atkinson (1998) and Cortazzi (2001) call life stories in the citations above, refer to an individual’s stories about his or her life. As the stories are not the experienced life per se but are a representation, the telling of a life story is a way of organising experiences and creating and/or verifying identity. Life stories are about how individuals perceive themselves and how they want others to perceive them. The stories gathered in this thesis are not about the respondents’ whole lives but selected parts of life stories, stories regarding becoming a primary school mathematics teacher. These are stories about how the individuals perceive themselves and how they want others to perceive them as primary school mathematics teachers. Further, in life stories gathered by researchers with a social science goal in mind the role of the researcher is crucial as they shape and assemble the stories and without the researcher there would be no story (Plummer, 2001).

To make identity development visible in this thesis, the notions of current identity and designated identity (Sfard & Prusak, 2005) will be used in relation to the present and the future in the operationalisation of identity. According to Sfard and Prusak (2005), identity development is connected to first-person identity stories of two kinds: those about the current state (current22 identity) and those about states expected to be (designated identity). Identifying stories of current identity are told in the present tense, while identifying stories of designated identity are told in the future tense or as wishes, commitments, obligations or necessities. The designated identity gives direction to the actions, influences and the needs of the individual. This is not always wanted, but can sometimes serve as binding for the individual. In the individual’s stories of current and designated identity, changes in patterns of participation regarding mathematics teaching can become visible, that is professional identity development.

The informants’ stories are them recognising themselves as a kind of primary school mathematics teacher. Interpreting their stories with a background in contemporary multiple communities of practice is me recognising them as a kind of primary school mathematics teacher. Sustaining the perspective of the teachers themselves in my interpretation, and being able to “interpret [their stories] with a background in contemporary multiple communities of practice” puts demands on the data collected which must make it possible to explore the everyday experiences from the perspective of the respondents. How that is done will be presented in the next chapter.

22 In the article referred to, current identity is called ‘actual identity’ but when talking about these notions in lectures and conferences, Sfard herself uses ‘current identity’.
3. DESIGN AND ANALYSIS OF THE EMPIRICAL MATERIAL

In this chapter it will be shown how novice primary school mathematics teachers’ professional identity development (as the reifying and significant stories that teachers tell about their patterns of participation regarding education in mathematics, in the present and the future, interpreted with a background in contemporary multiple communities of practice) have been captured and analysed in the study. As such, the chapter works as a bridge between the previous operationalisation of professional identity and the following results.

According to Petersson (2003), and in line with the conceptual framework, studying identity is to study a phenomenon in a constant process of change where capturing moments is the only thing we can do. However, according to Petersson, these moments are important as, in spite of its constant process of change, identity also has relatively firm features. These relatively firm features can, in relation to the conceptual framework, be regarded as long-term patterns of participation based on several immediate patterns of participation.

Good social science is problem driven and not methodology driven in the sense that it employs those methods that for a given problematic, best help answer the research question at hand (Flyvbjerg, 2006, p.242).

Firstly in this chapter, the perspective of the other will be problematised, followed by a section focusing on case studies. In relation to a discussion of what this study is a case of also criteria for sampling and possibilities for generalisation will be discussed. After that, the design and analysis of the empirical material is presented. Finally, sections focusing on writing and ethical considerations are presented.

3.1 The perspective of the novice teachers themselves

Based on the aim to investigate professional identity development from the perspective of the novice teachers themselves, making that perspective possible is central throughout the whole process. As previously mentioned, the perspective implies focusing on that which the novice teachers focus on. It is about me as a researcher placing myself beside the respondents and trying to experience the world as they do. However, the descriptions of these experiences are always based on my interpretation of the novice teachers’ perspective in these mutual experiences.

A first step towards the perspective of the novice teachers has been taken by the operationalisation of the theoretical framework as the respondents’ stories about their patterns of participation interpreted with a background in contemporary multiple communities of practice. Aspers (2007) writes about subjectivism which implies that the actors’ (the respondents) opinions and meanings are crucial in understanding actions. Subjectivism implies that the researcher must interact with the actors to be able to understand the world as they do and the meaning they ascribe to it.
In this study, the aim is to understand and describe the professional identity development of novice primary school mathematics teachers. Understanding can be reached by interpreting the meaning individuals attribute to actions, processes, organisations and different kinds of interactions. When doing descriptions you also may want to explain which imply finding a connection between the thing that explains and the thing to be explained. Ethnographic studies are studies that try to find such connections based on the meanings of the individuals (Aspers, 2007). According to Nygren and Blom (1999), an explanation is preceded, guided and completed by, and included in understanding. In return, explanations develop our understanding of different phenomenon. Aspers (2007) stresses that to be able to reach understanding, the researcher must be acquainted with the phenomenon to be investigated (for instance, to be able to understand loss, the researcher must be acquainted with loss), also, the researcher must have knowledge of the context and the social system within which the phenomenon is a part. Gaining understanding also requires interaction that implies that the researcher participates with, observes and interviews respondents in the field of study.

Ethnography is a special way of looking at, listening to and thinking about social phenomena, which is in line with the aim of this thesis. The notion of ethnography is used both to describe ethnography as practice (the fieldwork) and as product (the written text). Ethnography has a long and diverse history and definitions vary but they have in common that ethnography is defined as something more than a method or a methodology (Gordon, Holland & Lahelma, 2001). According to Skeggs (2001), there are large differences regarding studies being labelled as ethnographic. Some researchers label studies based on a few interviews as ethnographic while other researchers stress the importance of being present for a longer period. McDonald (2001) describes ethnography as a series of commitments that together constitute a perspective characterized by the researcher being in the presence of the studied people a long time making a holistic evaluation in terms of what they actually do. Based on Arvastsson and Ehn (2009), Aspers (2007), Hammersley and Atkinson (2007) and Skeggs (2001), common to studies being labelled as ethnographic is that they start based on an interest in a special part of human life about which the researcher tries to generate knowledge by being present. Usually, ethnographic studies imply the researcher participating, openly or hidden, in individuals’ daily lives for a longer period of time. The empirical material is gathered from many different sources, usually in relation to a few cases. The empirical works is unstructured, as in not being fixed, at the start of the study and the categories for analysing the empirical material are not decided beforehand but are generated from the empirical material.

One subfield in ethnography is educational ethnography, which started to develop in the mid 1920’s (Gordon, Holland & Lahelma, 2001). The focus in educational ethnography is on schools and educational settings broadly defined as the anthropology of education. In the beginning the researchers within educational ethnography were perceived as detached and objective observers focused on the rights and interest of marginalized groups. This perception has changed until today where the partial representation is declared and identity formation through class, gender and race is viewed as multidimensional, dynamic and relational rather than static and foreclosed (Yon, 2003). Today’s educational ethnography regards research on and in everyday life in educational settings in a wide range (Gordon, Holland & Lahelma, 2001) which is in line with this study.

In ethnographic studies both the respondents and the researcher are seen as constructors of the social situation being studied where the goal of the researcher is to
construct a theoretical picture of the social situation based on the respondents' opinions and meanings of it (Deegan, 2001; Hammersley & Atkinson, 2007).

[...] ethnographers themselves are part of the social world, and must work within whatever cultural perspectives are available to them. At the same time, this principle also insists that we can always learn to understand the world in new ways, and thereby come to better understandings of it (Hammersley & Atkinson, 2007, p.236).

One aspect of ethnographic studies is time that, according to Jeffrey and Troman (2004), can be understood as the total time used for a study or the time used for fieldwork in a study. Regarding the second, there are three ways to use time in fieldwork: compressed, selective intermittent or recurrent. Of these, the time spent in fieldwork in this study was used in a selective intermittent way which means that the time from the start to the end of the fieldwork has been long (two years) but with a flexible frequency.

Since the selective intermittent time has been shared between seven respondents in this study, the time spent with each of them is limited. That is why the study is to be viewed as a case study with an educational ethnographic direction rather than an educational ethnographic study.

3.2 Case studies

According to Ragin (1992), case and/or case study are often used without considering the possible theories embedded in the notions. However, the answer to the question what is a case has consequences regarding both the collection and analysis of the empirical material as within one study there may exist several different cases.

Every individual is similar to other individuals in many ways but, at the same time, is unique and case studies are studies of both the similar and the unique within a case (Stake, 1995). Stake (1995) distinguishes between intrinsic case studies, instrumental case studies and collective case studies. In intrinsic case studies, the aim is not to learn about other cases but to learn about that case specifically. In instrumental case studies, one case is used to develop a general understanding beyond the case itself. In collective case studies, several individuals are studied within a case study. Based on these three, this study would imply a collective instrumental case study.

According to Patton (2002) and Ragin (1992), more than one object can be studied as a unit of analysis in a case study and several case studies can be layered and nested within an overall, primary case approach. Patton (2002) calls cases “units of analysis” and expresses that what constitutes a case, or unit of analysis, is usually determined during the design stage but that new units of analysis, or cases, sometimes emerge during fieldwork or from the analysis. Typically, a case study involves many mini- or micro-case studies of various units of analysis, and the qualitative analysis process usually centres on the presentation of specific cases and thematic analysis across cases. Abbott (1992) writes of cases as instances. According to him, a particular entity may be either an instance (case) of a population (for example, members of a school) or an instance (case) of a conceptual class when the cases exemplify a property. The latter of these covers the case of professional identity.
development of novice teachers from their perspective. But is there one case (one case of professional identity development among novice teachers) or are there several cases (several cases of professional identity development among individual novice teachers)? Is it a case of someone (cases of individual novice teachers) or is it a case of something (professional identity development)?

Ragin (1992) writes that researchers will probably not know what their cases are until the research, including writing up the results, is completed. “What it [the case] is a case of coalesces gradually, sometimes catalytically, and the final realisation of the case’s nature may be the most important part of the interaction between ideas and evidence (Ragin, 1992, p.6)”. According to Ragin, the question “What is this a case of?” should be asked by the researcher again and again. He outlines a conceptual map where two dichotomies in cross-tabulation yield four possible starting points for looking at case studies (figure 5). The dichotomies regard how cases are conceived, whether they are seen as involving empirical units or theoretical constructs and whether they, in turn, are understood as general or specific.

![Table](image)

**Figure 5:** Ragin’s cross-tabulation of starting points in case studies.

The first starting point in Ragin’s cross-tabulation is specific case conceptions as empirical units. In this field, cases are found; meaning cases are seen as empirically real and bounded. The cases must be identified and established as cases in the course of the research process. As a specific empirical unit, this study is cases of students who have chosen to study to become primary school teachers and, at the beginning of the study, are about to graduate and start working as novice teachers. The aim is to find the core, the professional identity, in the empirics and delineate the process of identity development through these individuals. In a way, I design the case by selecting the novice teachers but as specific case conceptions, the empirical bounding of cases form an integral part of the research process and, therefore, need to be described from the perspective of the individuals.
The second starting point in the cross-tabulation is general case conceptions as empirical units. In this field, cases are objects, meaning cases are seen as empirically real and bounded but without the researcher feeling the need to verify them because they are general and conventionalised with case designations based on existing definitions present in research literature. As a general empirical unit, this study is a case of novice teachers. A novice teacher, on the other hand, is a theoretical construction that is used as a general description of the respondents in my selection. However, it can be dangerous to use existing definitions because they can imply different meanings to different readers. As shown in the first chapter being a novice teacher means different things in different countries. In relation to this study, the existing definition, novice teacher, may be of importance as it may influence the identity building of the respondents, but that is an empirical question.

The third starting point in the cross-tabulation is specific case conceptions as theoretical constructs. In this field, cases are made. At the start of the research, it may not be at all clear that a case can or will be discerned. Specific theoretical constructs coalesce in the course of the research, gradually imposed on empirical evidence which is in line with ethnographic research as described above. The fourth starting point in the cross-tabulation is general case conceptions as theoretical constructs where cases coalesce in the course of the research but are treated as conventions. One such convention in this study is the conceptual framework making professional identity development a general case conception as a theoretical construct.

Patton (2002) makes a different division of units of analysis for case studies than Ragin (1992) does. First, he distinguishes between focus on people or structure. Second, he distinguishes between perspectives, for instance, geography-focused, activity-focused or time-focused. Interconnecting Patton’s division of units of analysis with Ragin’s cross-tabulation would cause both Ragin’s specific case conceptions as empirical units and general case conceptions as empirical units to be in accordance with Patton’s people who share a common experience. In addition, both Ragin’s specific case conceptions as theoretical construct and general case conceptions as theoretical constructs are in accordance with Patton’s structure focused in specific time.

This study has different case conceptions at different points in the research process. At first, this conclusion puzzled me but then I came to an insight that it helped me to focus my case from different entry points at different points in the research process. Pointing out the case conception from different approaches from the same case makes visible what is in the foreground and what is in the background at different times in the analysis. When presenting the results I will return to Ragin’s four different descriptions of cases. Doing this is a way of extracting key incidents, linking them to other incidents, phenomena and theoretical constructs, writing them up so that others can see the generic in the particular, the universal in the concrete and the relationship between the part and whole. Sometimes the key incidents are empirical and sometimes they are theoretical; sometimes they are specific and sometimes they are general. When one of them is placed in the foreground, the others are placed in the background but they are still important to understand the case construct at the moment in the foreground.
3.2.1 Criteria for sampling

In quantitative studies, a population is often used as the starting point in sampling which lacks a subjective counterpart, as those who are part of a group (part of the population) must be understood in relation to how the respondents themselves define the group. The sample principle in case studies is not to maximise generalisation but, instead, particularisation, implying getting to know a specific case well, not primarily to understand how it differs but to understand what the case is and does. Generalisations are, instead, made within cases by finding patterns in the actions of individuals (Hammersley & Atkinson, 2007).

Flyvberg (2006) writes about different methods for sampling in case studies. When the aim is to gather the largest amount of information about a problem or a phenomenon (for example, professional identity development as primary school mathematics teachers), it is appropriate to choose a few cases that have as much experience as possible of what is to be investigated. Morse (2007) writes about sampling similarly to Flyvberg when he describes criteria for sampling in grounded theory studies. This study is not a grounded theory study but, as mentioned and is described later, methods inspired by grounded theory are used. Morse writes that respondents should be chosen because they are experts on the experience you want to investigate. Finding “excellent” (Morse, 2007, p.231) respondents implies them having experience of the phenomena under investigation, being willing to participate, having time to share necessary information and being able to and willing to articulate their experiences.

In the selection of the respondents, the common core of what was to be studied was incrementally focused on by using the key-concepts novice, primary school teacher and mathematics. In December 2008, a register was generated listing the students who, based on when they started their teacher education, would graduate in January 2009. (The teacher education concerned is described in section 1.6.) The register contained seventy names but short breaks in studies, failing to pass courses or applications for continued studies were not included. First to be selected were students who had chosen to write their final teacher education bachelor theses on mathematics education and who would, hopefully, also be interested in teaching mathematics after graduation. However, those were only four students (two from Science, Technology and Mathematics for Primary School and two from Swedish and Mathematics for Primary School). In total, there were only six students in the Science, Technology and Mathematics for Primary School orientation why all of them were contacted first together with the two from Swedish and Mathematics for Primary School who had written their final teacher education bachelor theses on mathematics education. These eight were contacted by phone. Four of the six in the Science, Technology and Mathematics for Primary School orientation and one of the two from Swedish and Mathematics for Primary School were to graduate in January and agreed to meet me for a first interview. Nobody refused to be part of the study; the three who did not take part had not finished their studies. Since five respondents seemed to be too few to start with, a further five students from the Swedish and Mathematics for Primary School orientation were contacted. These five were the first five on the list who answered when I called and they all agreed to meet me for an interview. As such,

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23 The students on the list had had at least one orientation or specialisation in mathematics education.
24 I had met all of these students during their teacher education; this is discussed in section 3.6.
after thirteen calls, ten students had accepted to come for a first interview and these were conducted in December 2008.

Based on the first interview (which is presented further on), seven respondents were selected for the continuation of the study. Two of the original ten respondents were not chosen as they were shown to be orientated towards preschool and not primary school and a third was not chosen as she was pregnant at the time of the interview and did not plan to start work after graduation. The seven who were left were all female, aged between twenty-two and forty-one with an average age of thirty-one. They will here be presented using pseudonyms.

**Barbro** is 34 years old when she is about to graduate from teacher education and she has taken the *Science, Technology and Mathematics for Primary School* orientation. Within her primary school teacher education she has taken 15 credits of courses in mathematics education. Before she started at the primary school teacher education she had taken 30 credits of mathematics courses within the secondary school teacher education.

**Camilla** is 24 years old when she is about to graduate from teacher education and she has taken the *Science, Technology and Mathematics for Primary School* orientation. Within her primary school teacher education she has taken 22,5 credits of courses in mathematics education.

**Gunilla** is 34 years old when she is about to graduate from teacher education and she has taken the *Swedish and Mathematics for Primary School* orientation. She has written her final teacher education bachelor theses on mathematics education. Within her primary school teacher education she has taken 52,5 credits of courses in mathematics education.

**Helena** is 41 years old when she is about to graduate from teacher education and she has taken the *Swedish and Mathematics for Primary School* orientation. She has written her final teacher education bachelor theses on mathematics education. Within her primary school teacher education she has taken 45 credits of courses in mathematics education.

**Jenny** is 22 years old when she is about to graduate from teacher education and she has taken the *Swedish and Mathematics for Primary School* orientation. Within her primary school teacher education she has taken 22,5 credits of courses in mathematics education.

**Malin** is 39 years old when she is about to graduate from teacher education and she has taken the *Swedish and Mathematics for Primary School* orientation. Within her primary school teacher education she has taken 22,5 credits of courses in mathematics education.

**Nina** is 24 years old when she is about to graduate from teacher education and she has taken the *Science, Technology and Mathematics for Primary School* orientation. She has written her final teacher education bachelor theses on mathematics education. Within her primary school teacher education she has taken 37,5 credits of courses in mathematics education.

Selection is also a question of how the respondents define themselves (Morse, 2007). Just because different criteria are used, focusing on a group of individuals, it is not certain that the respondents would place themselves within that group, for instance, as a *novice teacher* and/or as a *mathematics teacher*. The identification of the respondents is an empirical question to be answered in the study, where the selection of respondents has aimed at maximising the possibility of finding cases of
professional identity development as primary school mathematics teachers. If novice teachers who have taken an orientation in mathematics, and some also written a final teacher education bachelor thesis on mathematics education, do not develop a professional identity as primary school mathematics teachers, neither probably will those who have not taken those courses.

In case studies, it is not certain that all cases work and, according to Stake (1995), it is important to make early evaluations of the cases to see if they need to be exchanged. In this study, one immediate problem occurred when only Helena and Barbro got jobs as teachers directly after graduation. Nina spent another term at the university, Jenny and Gunilla worked as short run substitute teachers, Malin started to work as a receptionist and Camilla started to work in a preschool. (The difficulties for primary school teachers in Sweden to get jobs are discussed in section 1.5.) One question was whether to exchange the respondents who did not have employment in a primary school for other, relatively novice teachers, already working in primary schools. However, based on the ethnographic direction implying understanding being reached through the meaning the respondents make of their situation, a decision was made to keep the original respondents. If one wants to describe and understand the process of becoming a primary school mathematics teacher, the process needs to be investigated as it is from the perspective of the respondents. The varied paths into the primary school teacher profession was the reality for a majority of primary school teachers at the time of this study and, also, those varied paths were shown to contribute important insights to the analysis.

3.2.2 Generalisation

Generalisations can be understood in various ways and case studies are often said not to be generalisable (Flyvberg, 2006) since the word is seldom associated with generalisations in cases as finding patterns in the actions of individuals (Hammersley & Atkinson, 2007) but, rather, as generalisations beyond cases. However, according to Flyvberg (2006), not being able to generalise knowledge formally does not imply that case studies cannot contribute to the development of knowledge within a field or society. Also, formal generalization is only one of many ways to generalize and the possibility to generalize from a case depends on the case and how it is chosen.

One can often generalize on the basis of a single case, and the case study maybe central to scientific development via generalization as supplement or alternative to other methods. But formal generalization is overvalued as a source of scientific development, whereas “the force of example” is underestimated (Flyvberg, 2006, p.228).

Larsson (2009) presents various ways to reason about generalisation in qualitative research, both in studies where generalisation is not an aim and in studies where it is. Here, only the generalisations he mentions in relation to studies where generalisation is an aim will be presented, that is, maximizing variation, context similarity and recognition of patterns. The common motive for them is, according to Larsson, that without an aim of some kind of generalisation, it would be pointless to give such careful attention to a single case.

Generalisation by maximising variation implies the researcher maximises the variation in the selection of respondents and, by that, also maximises the possible
outcome. This has not been done in this study; on the contrary, the selection of respondents is based on their similarities and not their differences.

Generalisation by context similarity implies focusing on the similarities of the researched context and other contexts. A precondition is then that the “other context” is known and that is why the user of research results best does this kind of generalisation, not the researcher. The notion “thick description”, described later, is one way of reinforcing context similarities as descriptions of the context then become central. One criticism of generalisation by context similarity is that it presupposes that the context determines the phenomenon and not the other way around. However, we know that different individuals act differently in the same context and that the same individual may also act differently in two similar situations within the same context. In this study, context similarity can be used in relation to one half of the conceptual framework, communities of practice; therefore, generalisation through context similarity is possible only in relation to half of the process of professional identity development.

Generalisation by recognition of patterns implies an individual’s patterns described in one study being recognised in new cases. As in generalisation by context similarities, generalisation by recognition of patterns implies focusing on the similarities of the researched patterns and other patterns. Since the “other pattern” also needs to be known; the user of a research result best does this generalisation, not the researcher. In this study, recognition of patterns can be regarded as the other half of the conceptual framework, patterns of participation, and that is why also generalisation through recognition of patterns is possible only in relation to half of the process of professional identity development.

Similar to Flyvberg and Larsson above, Lincoln and Guba (1985) emphasise that there are more alternatives regarding generalisation than the extreme opposites of total generalisation and unique particularised knowledge. According to Lincoln and Guba, no generalisation is possible if proper weight to a local situation is given and, instead, they use the word transferability as a working hypothesis that cannot be made by the researcher who knows only the sending context. Instead, the researcher should provide sufficient descriptive data to make similarity judgments possible where the transferability depends on the similarity in two contexts, “the degree of congruence between sending and receiving contexts” (Lincoln & Guba, 1985, p.124). To provide this, Lincoln and Guba, as Larsson above, advocate that the researcher provides thick descriptions.

It is, in summary, not the naturalist’s talk to provide an index of transferability; it is his or her responsibility to provide the data base that makes transferability possible on the part of potential appliers (Lincoln & Guba, 1985, p.316).

Based on the above, “thick descriptions” will be offered in the results with the purpose of making it possible for the reader to evaluate context similarity and recognise patterns.
3.3 Design of the empirical material

What we often call data is our construction of other people’s construction of what they and their fellow human beings are occupied with. Designing empirical material is constructing a foundation for being able to better understand the phenomenon we are interested in (Spencer, 2001). As mentioned in section 3.1, the researcher needs to be acquainted with the phenomenon, the context and the social system the phenomena is a part of, to be able to describe and understand the phenomenon from the perspective of the respondents.

The foundation of empirical material to be designed in this study was to make it possible to analyse the respondents’ stories about their patterns of participation regarding education in mathematics and to interpret these stories with a background in contemporary multiple communities of practice. Based on the perspective of the novice teachers themselves, it was impossible to predict which patterns of participation and communities of practice are central in professional identity development.

[…] Reports that say that something hasn’t happened are always interesting to me, because we know, there are known knowns; there are things we know we know. We also know there are unknowns; that is to say we know there are some things we do not know. But there is also unknown unknowns – the ones we don’t know we don’t know. (Donald Rumsfeld, February 2003)

The citation above points to the difficulties investigating things we do not know that we do not know. To know what is central in professional identity development would mean that the question would have to be already answered. But if it was, there would not be any need for a new study. The citation also raises questions regarding what it is that we do not see that affects the things we do see. According to Hammersley and Atkinson (2007) and Aspers (2007), it is a problem that the researcher lives in the same world as the respondents and, by that, takes a large part of it for granted. Hammersley and Atkinson (2007) write about the importance of trying to make the unknown known so that we can understand it, and to make the known unknown so that we avoid misunderstanding it.

As I have been a student teacher myself and developed a professional primary school mathematics teacher identity, it is important to make the known unknown. I must avoid thinking that I understand what is going on just because I am studying a known environment. Instead, I have to, using curiosity, discover this environment again but this time from the perspective of the respondents. An advantage of the environment being known is that it increases the possibilities of getting past the directly observable. The external environment is known to me and, therefore, I can focus on finding “unknown unknowns”. As Lindén, Westlander and Karlsson (1999) express it, without pre understanding it is impossible to create a problem to investigate or find any clues to the solution of a problem. As such, my pre understanding is both an advantage and a disadvantage.

In ethnographic design of research, the empirics should influence the direction of the study (Åpers, 2007). To capture the respondents’ stories and allow for the visibility of their perspective, several methods were intended to be used. Initially, the plan was to use observations and open interviews. The reason for this combination
was to try to get as close to the novice teachers as possible in order to do justice to their stories about their day-to-day work as primary school mathematics teachers. However, quite early on, some practical problems emerged.

One problem was, as mentioned before, that several of the respondents did not get employment as teachers. Instead, two of them started working as short run substitute teachers. Working as a short run substitute teacher means that the teacher gets a call in the morning from the intermedium agency of substitute teachers and then works as a short run substitute teacher at a school for one or more days. Not knowing when and where these respondents would work made it impossible to carry out observations as the parents of the children in schools had to give their permission in advance to my presence in the class. One respondent who continued at university for an extra term then started to work as a teacher assistant and the school situation of the student she was working with made it inappropriate for me to conduct observations. Not being able to closely follow these respondents in their day-to-day work became one problem.

Further I wanted to spend more time with each of the respondents (those who got jobs) than was practically possible. Doing my PhD half time and wanting to follow several respondents at close quarters during the available time became a problem. An additional aspect of that was that none of the respondents who got jobs started working locally. Solving this time-equation became another problem regarding construction of the empirical material.

All together, these different but connected parts (the inability to closely follow the respondents in their day-to-day work and the time-equation) became the background of a third method which emerged and was used to construct empirical material, self-recordings. These empirical materials (interviews, observations, self-recordings) are used as complete empiricism (Aspers, 2007) implying that all of the empirical material constitutes a whole, on which the analysis is based. According to Hammersley and Atkinson (2007), analysis is not a separate activity in ethnographic research but starts in the pilot study and continues through the process of constructing the empirical material and writing. This process, taken in turn, is hard to describe in text, therefore, the three methods used will first be presented separately and then followed by a section focusing on the analysis.

3.3.1 Interviews

According to Petersson (2003), it is not meaningful to study identity by using inflexible questions as the changeable, multi-dimensional and context dependent character of identity must be investigated using methods with the same character. In ethnographic research, interviews may be in the form of informal conversations and/or formal interviews and the division between informal conversations and participating observation is not obvious. Also, all interviews, irrespective of the grade of formality, are seen as a social activity within which the researcher is one participant (Hammersley & Atkinson, 2007).

Except for two final group interviews, all interviews in the study, both formal and informal, have been individual. The informal interviews have been conversations in relation to observations. However, these conversations were never ordinary conversations as I, as a researcher, have an agenda. The formal interviews were qualitative, implying they were not based on a mechanical template but on the skill and personal judgement of the interviewer. Qualitative interviews are about learning
to know other people and getting knowledge about their experiences, feelings, attitudes and the world they live in. It is about understanding the world from the perspective of the respondent and developing meaning based on their experiences. The data is not discovered or given; it is created by questions and answers. As such, the empirical material is constructed in the social interaction between the respondent and the interviewer. The quality of the empirical material constructed in such interviews depends on the content knowledge of the interviewer since that knowledge influences the possibility of asking follow up questions based on the respondents' answers. A qualitative interview is not a conversation between two equal parties as the interviewer defines and controls the situation. It is the researcher who introduces the topics, follows up answers and who has the interpretative prerogative (Kvale & Brinkmann, 2009). Kvale and Brinkman do not say that the power should be eliminated but that it is important for the interviewer to reflect on their own role in the construction of empirical material. (The relationship between me and the respondents is discussed in section 3.6) Two different interviewers may receive two different answers to the same question based on their shifting sensibility and knowledge of the content in the interview. As such, there is a tension between pre-knowledge and impartiality. Aspers (2007) writes that the only thing an interviewer can use to interpret what is said in an interview is the knowledge he or she already has about the content.

The purpose of the interviews in this study, both the formal and the informal, has been to capture the respondents' stories about their patterns of participation regarding teaching and learning mathematics, in the present and in the future. At the beginning of the study, I had some experience of conducting interviews as I had used interviews in my thesis for my master's degree. However, based on increased experience and increased knowledge about the process of professional identity development (which was acquired through parallel analysis) the quality of the interviews has probably increased during the process. Thematic interview guides have been used but not followed slavishly. Apart from the initial interviews and the final group interviews when common thematic interview guides were used (appendix 1 and 2) different thematic interview guides have been used (one example is given in appendix 3) based on the working situation of the specific respondent and parallel analysis. The purpose of the thematic interview guides has been bisectional. Even if the order of the questions and follow-up questions has differed based on the interview situation, the thematic interview guides have helped to include desirable themes in the interviews. Also, constructing thematic interview guides has made it possible to try out different formulations of "the same" question and by that, hopefully, leading questions have been avoided as often as possible. The questions have been formulated so that the initiative of what to focus on and the choice of words are left to the respondents as is advocated by both Birgerstam (1999) and Kvale and Brinkmann (2009). The intention is to let the respondents decide what is central for him or her and then base the follow-up questions on that. For instance, in the interviews conducted before graduation, the respondents were asked to tell me about one or more good lessons in mathematics that they had seen or conducted. Based on the examples they gave, follow-up questions were asked regarding the content and the layout in their examples. If they talked about a lesson focusing on problem solving in groups, we would continue to talk about problem solving and group work. Another way would have been to ask them what they thought about problem solving and have them give examples of problem solving in mathematics. However, the focus and the use of the words problem solving would have been introduced by me and not the respondents.
Leaving the initiative of what to focus on and the choice of words to the respondents is in line with the aim of investigating professional identity development from the perspective of the novice teachers themselves and is also in line with the “significant” stories in the operationalisation of professional identity.

Where and when an interview is conducted is as important as the individuals who are present (Hammersley & Atkinson, 2007). The interviews in this study have been conducted both at the university and in workrooms at the schools where the respondents worked. At the university, the interviews were held without distractions but at the schools there were occasional interruptions as it was difficult to find secluded places. All of the planned formal interviews were, in one way or another, completed. At the end of the empirical period, the respondents were gathered for two group interviews at the university. During those interviews, the respondents, among other things, were shown and asked to comment on some of the tentative results. Overall, seventeen hours of formal individual interviews and two and a half hours of group interviews were recorded and transcribed and a large amount of informal interviews were conducted in relation to observations. The transcripts of the interviews are described in section 3.5.

3.3.2 Observations

According to Ehn (2009), observations, regardless of what kind, are about selection since we can only observe a small part of what is possible to see. What we see is directed by our previous understanding and all observations are constructions. Similarly, Aspers (2007) writes that even though an observation is conducted in the moment, it is dependent on prior knowledge, interpretations and descriptions, therefore, observations last longer than the time spent in the field. Aspers questions if it is possible at all to observe something without interpreting it in the same moment.

The observations made in this study have varied based on the working conditions of the respondents. Hammersley and Atkinson (2007) and Aspers (2007) advocate that you start to approach the field with a wide-angled lens looking as the wholeness and then later, based on the analysis, focus on chosen aspects in more detail. The observation of details does not imply that the wholeness is excluded; instead, an understanding of the wholeness makes an analysis of the detail possible. During the first observations, I accompanied the respondents in their schools (or preschools) for whole days, during breaks, lessons in different subjects and meetings in the afternoons. Then, progressively, parallel analysis narrowed down the focus of the observations. Spradley (1980) calls the first round of observations the grand tour observations and mentions nine things to pay attention to in observations: place (physical meaning), actors (the people involved), the activity, the objects (physical objects), acts (separate individuals’ actions), actions (set of related actions), time, goal (what individuals try to achieve) and feeling (expressed feelings).

Arvastson and Ehn (2009) present three strategies when conducting observations, all of which I have used. The first strategy is to purposefully look for a specific phenomenon, the second strategy is to spontaneously discover things you did not look for and the third strategy is to systematise the observations with the help of theoretical notions. The purposeful search in this study has been conducted with the help of the notions in, and then systematised by, the conceptual framework. By
starting to approach the field using a wide-angled lens looking for “unknown unknowns”, several unplanned discoveries have also been made.

As an observer, you can adopt a role that already exists in the field or create a new role. The choice of role depends on the aim of the study and the character of the field (Hammersley & Atkinson, 2007). Spradley (1980) describes different amounts of participation in observations where the extremes are becoming or already being a total participant or not participating at all. Between those, there are grades of participation which range from where the observer is active and does the things the observed individual/individuals do to a passive participation where the observer is present but does not interact with the other actors. In this study, there was no existing role in the schools that I could adopt. Also, there was a risk that I would be seen as a teacher educator visiting from teacher education similar to when students are observed and evaluated during their practice periods in teacher education. To avoid this, I tried to be clear that I would not judge or evaluate the teaching, rather that I wanted to experience working days together with the respondents. One related difficulty was how to present my aim to other teachers and students at the schools as I did not want to label the respondents as “novice teachers” implying that they were different and, therefore, in need of special treatment. The interest shown by the respondents’ colleagues was very varied and, when they asked, I told them that I was doing my PhD on the process of becoming a primary school mathematics teacher. Contact with the students is presented later on in section 3.6.

Experiencing working days together with the respondents, trying to find a balance between inside-outside, has implied me taking turns being a participating observer and an observing participant. According to Hammersley and Atkinson (2007), moving between these two roles makes both an inside and an outside perspective possible. As a participating observer, I actively participated in activities, and as an observing participant I withdrew and observed activities. All the time, I talked with the respondents regarding their experience in situations. This was done both in direct relation to the activities and later in formal interviews. These formal interviews were often conducted at the end of the workdays. To repeatedly talk with the respondent about what they experience in situations is an example of what Bäckman (2009) calls to “temporarily borrow the eyes of others” (Bäckman, 2009, p.131). By doing this, the researcher may grasp the multiple layers of the situation. Similarly, Lundstedt (2009) writes about accompanied observations, this implies the researcher walking with the respondent in various places while the two talk about what they see. To temporarily borrow the eyes of others is to acknowledge the value of what is seen by the other and requires interaction between the researcher and the respondent.

Observations can also be described based on the room for the observations. The schools where the respondents started to work have been my room. One good thing about this is that the different rooms (the different schools) make it possible to discover what is unique and what is general (Aspers, 2007). As such, the different rooms have been one element in making the known unknown.

As previously mentioned, time has been used in a selective intermittent way with various amounts of observation with different respondents based on their working conditions. According to Hammersley and Atkinson (2007), such a use of time contributes to the quality of the observations if they are complemented with analysis and reflection, which is the case in this study. One problem has been that the respondents, or their principals, on some occasions have said no to observations because of circumstances in the class or at the school. Hammersley and Atkinson (2007) write that such periods, periods when the respondents do not want to be
observed, may be the times when you really should observe. But, from an ethical perspective, I have not pressed the respondents but listened to their wishes. However, not having been given access to the field at different periods and the reasons expressed for this are important to consider in the analysis.

Related to access is what Hammersley and Atkinson (2007) and Aspers (2007) call *gatekeepers* implying individuals whose informal approval must be gained to really get access to the field. I have been welcomed both by the respondents (except from some periods, as mentioned above) and by students, colleagues and principals. However, the question of access is not resolved just because you have permission to participate, as participation does not automatically give access to relevant information (Hammersley & Atkinson, 2007). Rather, access is about developing social relationships with the respondents and this has mainly been accomplished during the first observations where many informal everyday conversations were held. According to Hammersley and Atkinson (2007), these conversations do not only aim at developing relationships, they also provide valuable information about the respondents.

When observing, the researcher must reflect on the impact his or her participation has on the observed situations. By being present, the researcher affects what is happening and, therefore, also affects what he or she observes (Hammersley & Atkinson, 2007; Aspers, 2007). To minimise the impact of my participation, I have tried to act as “normally” as possible, implying, on the initiative of others, joining in conversations in the coffee room, talking with students in the classroom and so on. I believe I would have affected the situations more by always being a totally passive observer as that is not acting “normally”. Another way of minimising my impact has been not videotaping my observations. Instead, I made field notes, took pictures and made some audio recordings\(^\text{25}\). The writing of the field notes is described in section 3.5.

### 3.3.3 Self-recordings

As described above, the grounds for using self-recordings\(^\text{26}\) was to construct alternative data but when starting to analyse the self-recordings, it became apparent that they contributed empirical material with its own character.

A method provides a tool to enhance seeing but does not provide automatic insight. [...] Methods are merely tools. However, some tools are more useful than others. [...] How you collect data affects which phenomena you will see, how, where, and when you will view them, and what sense you will make of them (Charmaz, 2006, p.15).

The idea of trying self-recordings came from listening to a lecture by Andrew Noyes\(^\text{27}\) in Brighton, spring 2009. Noyes had let children video-record themselves. His method and the character of his data gave me an idea of how to minimise the

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\(^{25}\) When making audio recordings, the respondent carried an audio recorder in their pocket during the lessons that I observed. Thus, it was possible to transcribe dialogues word-for-word.

\(^{26}\) The use of self-recordings in this study has been presented at the Norma-Conference in Iceland in 2011 (Palmer, 2011).

\(^{27}\) The lecture was given in Brighton, England, in May 2009. Andrew Noyes was an associate professor at the Faculty of Social Sciences at the University of Nottingham at that time.
problems of not being able to conduct as many observations as I wanted. I decided to experiment by letting the respondents record their own reflections on their day-to-day work using MP3-players. The reason for using MP3-players, rather than video cameras as Noyes did, was to make it as easy as possible for the respondents. An MP3-player can easily be carried in a pocket ready for use when suitable for the respondent. To give some insight into the kind of empirical material constructed by the self-recording, some examples are given in this section. In one way, the examples precede the upcoming results but the aim in this section is not to focus on professional identity development as primary school mathematics teachers but to focus on the character of the empirics constructed by the use of self-recordings.

The empirical examples below are from self-recordings made by Nina and Helena. Nina was the first one of the respondents who made self-recordings. After graduation, she started to work as a teacher assistant in a primary school and the special circumstances of the student she was working with made observations impossible. I sent Nina the MP3-player by mail. Earlier, I had had two interviews with her from which she knew the purpose of the study. To get her perspective on her everyday experiences, I told her that she was free to record whatever and whenever she wanted and that it was up to her to decide what was important for me to know. As possible inspiration for getting started, I told her that she could, for instance, record her thoughts about the school where she was working and about lessons she taught. After listening to and starting to analyse the content of Nina’s self-recordings I decided to let all of the respondents do self-recordings, even those I could observe. Helena was one of them. After graduation, she started to work as a class teacher in a grade six class. She also knew the purpose of my study based on observations and interviews I had had with her earlier. All of the content in Nina’s and Helena’s self-recordings offers their perspective on their everyday experiences in school.

I will start by telling you about an ordinary workday. I get to school at eight o’clock and there I meet the boy I am taking care of. [...] and at four o’clock I go home. Then my work day ends. (Nina)

The [...] in the citation above would probably not contain the same content if completed by Nina herself or by an outside observer. In her self-recording, it is Nina who chooses the main happening in her everyday experiences. Insight like this, about the focus of the respondents, helps to navigate later observations as it becomes easier to understand from the perspective of the respondents what is at the forefront and what is at the back. As such, the self-recordings offer an insight into the respondents’ everyday experiences in school as they experience them themselves.

The content of the self-recordings can be divided based on the content regarding past, current or future. All three time perspectives exist in both Nina’s and Helena’s self recordings. Recordings regarding the past include the past in a wide time perspective, from yesterday to the respondents’ own schooling.

During teacher education, I thought of school as very much just knowledge. That it was just about knowledge and that it is only a matter of keeping up with everything that is taught. (Nina)

28 This is not her first self-recording in the study, it is her first self-recording that semester.
Yesterday I got the opportunity, or got the opportunity, we had planned to split the class in two halves during the mathematics lesson. [...] After the lesson, I actually felt that most of them understood. They worked and when I looked through their papers it felt good because most of them understood what it is about. (Helena)

At the same time as these recordings say something about the past they also say something about the present. Why is it that Nina on this day starts to talk about what school is about? Why is it that Helena on this day talks about a specific lesson from the day before? The answers to these questions are to be found in the present. Another issue in Helena’s recording above is what she does not say. She does not talk about the layout of the mathematics lesson (even though her saying that she has looked through “their papers” indicates that the students have written something connected to mathematics on paper during the lesson) or about the mathematics content that the students understood. What she singles out is that their understanding “felt good”. Analysing the self-recordings in the above manner offers both the perspective of the respondents and a starting point for upcoming interviews and observations.

Often a self-recording is about only one thing or one situation. It happens a lot during a school day but the recordings seldom summarise, rather, one thing or one situation is selected. That selection is made from the perspective of the respondents and offers the perspective of the teachers on their everyday experiences. Self-recordings of current happenings often start with “today”.

*Today a teacher came around and said “Hello Nina with the enormous patience”. And then I thought ‘what?’ and she said that she thought I did such a good job. [...] And this felt really great; of course it warmed my heart hearing that. I took it as praise. [...] actually nobody else has confirmed that ‘yes we also believe it’s working out fine’. Therefore it felt extra good to hear something. After all, you are a little insecure and want people to appreciate what you are doing. (Nina)*

*Today the students started by doing test-yourself without first having worked with multiplication by ten, hundred or thousand in the text book. We wanted to test how much of it they understand now based on our explanations. It turned out to be much harder than we had thought. [...] But it was rather interesting that so many actually hadn’t understood what we had been doing during quite a lot of lessons. (Helena)*

Stories of current happenings cannot be received in the same way, for instance, in ordinary interviews or observations, as they are dependent on both time and perspective. When the respondents themselves are in charge of the recording, they have the opportunity to record in direct connection to current happenings and it is also they who choose what stories of current happenings are of value to record from their perspective.

The majority of the self-recordings regard past and current but some also regard the future, both in short and long terms.
And my goal in the near future actually is to find a job where I can have my own class. [...] And I have talked to the headmaster and she has said that they will let me go when I need to. And that feels very nice looking towards the future because I feel caught. Do I dare to say yes to another semester or am I to try finding something else. (Nina)

The plan is then reaching the diagnostic test\textsuperscript{29} this week so we can get further and start with fractions before Christmas. My plan is to do another diamond test\textsuperscript{30} with them this week to check them a little. (Helena)

These recordings, regarding different aspects of time, past – present – future, are interrelated. Recordings regarding the future and the past offer explanations of the current; while recordings regarding the past and current explain recordings focusing on the future. Past, current and future can be labelled just by listening to the self-recordings. By also analysing the self-recordings, central themes from the respondents’ perspectives can be discovered.

In relation to the definition of identity as “the reifying and significant stories that teachers tell about their patterns of participation regarding education in mathematics, in the present and the future, interpreted with a background in contemporary multiple communities of practice”, the self-recordings give a hint of what is important to the respondents in their identity development as primary school mathematics teachers. The self-recordings are them telling reifying and significant stories about their patterns of participations regarding education in mathematics, in the present and the future. Reifying as in talking about states instead of actions, e.g. “I do not really belong to any staff-team” or “I am alone at the school”, significant as in chosen by them themselves. When the respondents are in charge of what and when to record, it is they who decide what is of importance to record. Of course, they know that I will be listening and, as in most data collection situations, the receiver has an impact. Sometimes, as a receiver, I am very visible in their recordings. For instance, in her first recording Nina starts by saying “Hello, Hanna. I will start by telling you [...]. In another recording Helena says “long time since last”. However, I believe that the impact of the receiver is less when the respondents themselves are allowed to decide what and when to record and do not have the receiver in front of them. As such, I believe the content in the self-recordings is significant from the perspective of the respondents.

By the respondents choosing what and when to record, an opportunity is opened to discover what they focus on and discern in their day-to-day work. As such, the recordings guide what to talk about in interviews and what to look at in observations. The recordings are a way of being able to be there with them and yet not be there, to follow their day-to-day work without actually being present. As such, they offer empirical material that otherwise would have been impossible to collect when respondents cannot be observed. Also, when making observations, it is I who selects what I see, but by listening to their self-recordings I am invited to see the surroundings through their eyes. However, one could argue that they may

\textsuperscript{29} In the text book, every chapter starts with an introduction of the mathematical content in that chapter. The introduction is followed by a diagnostic test of that content. Based on their results in the diagnostic test, the students then continue working at different levels of difficulty.

\textsuperscript{30} The diamond test is a diagnostic test material provided by the Swedish National Agency for Education.
misrepresent their work and surroundings. Even so, the stories are still their reified and significant stories about who they are, and possibly, who they want to be.

The two data-collection problems, not being able to observe supply and teacher assistants and not being able to spend as much time as wanted with each teacher, still existed but the self-recordings contributed alternative data that could complement interviews and observations but also, as shown above, offer content with a character of its own. Instead of being very close to the respondents the whole time through observations and interviews, the self-recordings offered a way of following the respondents’ day-to-day work from their perspective which also gave me a direction in which to focus interviews and observations with the purpose of maintaining that perspective. Overall, forty-seven self-recordings were made by the respondents and then transcribed by me. The transcripts are described in section 3.5.

3.3.4 E-mails

E-mails were used to stay in contact with the respondents between interviews, observations and self-recordings. Sometimes questions were e-mailed to the respondents after observation, so as to complement or clarify something. On some occasions, extracts from observed and audio-recorded lessons were e-mailed to the respondents for comment.

3.4 Analysis

In ethnographic studies, analysis is not a separate activity after completing the empirical construction; it is an on-going process of questions and answers. As mentioned in the first chapter the research questions have not been developed before the start of the study but instead proceed from the on-going analysis. After every observation, interview or self-recording, the empirical material has to be analysed so as to be able to determine what to focus on next (Spradley, 1980). As such, the analysis is not separated from other parts of the research process either by space or by time. An ethnographic research process can be described as a whorl with rotated periods of reflection, development of questions, development of hypothesis and construction of empirical material where the included parts guide the others (Beach, 1995).

The focus in the analysis is on activities and processes, on what the respondents are doing and why. When analysing data, it is also important to question what is absent, what is not the case and what stories are not told? To be able to understand what the respondents do and why they are doing it, the researcher must understand the meaning of the respondent and how the respondent interprets the situations he or she meets. Variables and categories do not exist beforehand, they are created based on the empirical material and the starting point of the analysis is the meaning the respondents themselves imply to the studied situations. Causality in an ethnographic study is when an explanation refers to the meaning of the respondents implying there is empirical evidence that confirms the meaning (Åpers, 2007).
It is much easier to get started if one has a set of predetermined analytic terms; but terms found in the literature don’t necessarily suit the ‘unique situation with which one is dealing (Elbaz, 1988, p.176).

As mentioned, the empirical material has been analysed in two different, but cooperating, ways: with the conceptual framework as a lens and with methods inspired by grounded theory. Analysis in grounded theory, as described by Charmaz (2006), has many parallels with one of many possible analyses in ethnographic research as described by Aspers (2007). However, these parallels were not known at the beginning of this study, therefore, methods inspired by grounded theory as described by Charmaz (2006) have been used. By using methods from grounded theory categories have been developed as answers to the questions “what happens here” and “what is important here”? The conceptual framework has then been used to analyse the question of why in relation to these categories.

3.4.1 Analysis in grounded theory, ethnography and this study

The guidelines for analysis in grounded theory are systematic but flexible and they aim at constructing a theory grounded in the empirics. In grounded theory studies, empirical material is created by observations, interviews and other material and then transcribed implying the empirical material is the same in grounded theory studies, ethnographic studies and this study. The aim of this study has not been to generate a grounded theory but to understand the meaning of the respondents so as to describe and understand their professional identity development. According to Charmaz (2006), it is possible to only use parts of grounded theory and (in contrast to classical grounded theory) theories are not discovered in the empirical material, they are created. “Grounded theory guidelines describe the steps of the research process and provide a path through it. Researchers can adopt and adapt them to conduct diverse studies” (Charmaz, 2006, p.9). As such, the guidelines for analysis in grounded theory have been used to create categories, grounded in the empirical material, which have then been connected to the conceptual framework.

The first step in the analysis is to code the empirical material which does not (just like it does not in ethnography) imply using pre-constructed codes but labelling the empirical material with as many codes as possible (Kelle, 2007). To code is to label segments of empirical material with different codes implying the empirical material being separated, sorted and compared. Doing this defines what is happening in the empirical material (Charmaz, 2006). One example of a code used in the analysis in this thesis is confirmation which was a code that was used for labelling empirical material in line with two of the examples used earlier when presenting the self-recordings.

_Today a teacher came around and said “Hello Nina with the enormous patience”. And then I thought “what?” and she said that she thought I did such a good job. […] And this felt really great, of course it warmed my heart hearing that. I took it as praise. […] actually nobody else has confirmed that “yes we also believe it’s working out fine”. Therefore it felt extra good to hear something. After all, you are a little insecure and want people to appreciate what you are doing. (Nina)_
Yesterday I got the opportunity, or got the opportunity, we had planned to split the class in two halves during the mathematics lesson. [...] After the lesson I actually felt that most of them understood. They worked and when I looked through their papers it felt good because the most of them have understood what it is about. (Helena)

Charmaz (2006) distinguishes between initial and focused coding. Initial coding implies coding the transcripts line-by-line or incident-by-incident based on the question what is happening here? Coding line-by-line is better suited to transcribed interviews, coding incident-by-incident suits field notes from observations better. When coding line-by-line, the researcher also writes memos about the codes and these memos are often the starting points for the direction of new empirical material in order to develop and refine the codes. By writing memos and developing and refining the codes, categories are developed. Within these categories, there are often variations but, at the same time, the categories are coherent and, according to Dey (2007), belonging to a category is a question of grades rather that either-or. For example, returning to the code confirmation above, it was developed into the category feedback within which several different kinds of confirmation were included.

According to Lempert (2007) and Kelle (2007), writing memos is the methodological link between empirical material and the development of theories and, even though the development of a theory was not the aim of this study, the coding and the memo writing are what have identified the meaning of the respondents. Initially, memos are messy but by re-writing, constructing more empirical material to analyse and by constant comparison, the memos become more and more abstract. Constant comparison implies the researcher constantly comparing different codes with each other and with new and old empirical material. Lempert (2007) also advocates using literature when writing memos as literature may help to expand one's own understanding and naive interpretations. Literature has been used when writing memos in the analysis of this study which is visible later on when presenting the results.

The next step of the analysis is to synthesise and explain larger segments of empirical material. The first step in doing this is axial coding which is to specify the properties and dimensions of a category and see how categories are related to each other (Charmaz, 2006). This organisation can be accomplished by creating mind-maps and by writing further memos (Kelle, 2007; Charmaz, 2006). The axial coding in this study was accomplished by connecting different categories to the conceptual framework and by that trying to present a coherent description of professional identity development as primary school mathematics teachers. The last step in focused coding is theoretical coding which has not been done in this study.

Aspers (2007) presents several different methods used in ethnographic analysis whereof static-dynamic is similar to grounded theory analysis. In static-dynamic analysis, the researcher first codes the data using a code-scheme developed from the empirical material and theory. Satiation is reached when no further material is considered as likely to change the code and the researcher may also try to find negative cases that do not fit to test the codes and the theories. Static-dynamic analysis has many similarities with analysis in grounded theory as described above.

31 Other analysis methods used in ethnography, mentioned by Aspers (2007), are comparative analysis, narrative analysis, relational analysis, analysis of negative cases and analysis centred on ideal types.
even if theory is given an increased role within ethnographic analysis. However, both Lempert (2007) and Charmaz (2006) write that theory and/or literature can have an impact on grounded theory analysis. Birgerstam (1999) also describes analysis in ethnographic research similarly to Aspers (2007) when describing how the analysis starts with a complete reading of the material followed by marking key-words, making codes and creating categories. Every category is to have a core of meaning and after creating the categories their relationships are investigated. Finally, the material as a whole is read again and every category is given a place within the wholeness.

Summarised, the analysis of the empirical material inspired by grounded theory implies building and connecting categories grounded in the empirical material by using codes. As shown, this line of action is also described within ethnographic research, however, this was not known when starting the analysis and even if it had been known, as shown, the procedure would have been the same. The similarities between grounded theory and ethnographic research may have emerged from studies combining the two. According to Timmermans and Tavory (2007), grounded theory contributes to ethnography as the researcher gets to know the empirical material outside and inside and it offers tools for taking a step further from the empirical material. “Grounded theory allows researchers to distinguish with confidence between the noise and music in one's data” (Timmermans & Tavory, 2007, p.496). Conversely, according to Timmermans and Tavory (2007), ethnography is ideal when it comes to understanding interactions. The differences between the two are that ethnographers, at the beginning of their research, look more at places than processes and grounded theory is more analytic than descriptive. The focus on process is more in line with the aim of this thesis than the focus on places.

Results in both grounded theory and ethnography can be presented either chronologically or thematically and both ways of presentation are used in this thesis. The two different ways of presenting the results can be connected to Ragin’s (1992) cross-tabulation of cases. Cases of specific and general case conceptions as theoretical constructs imply being thematised while cases of specific and general case conceptions as empirical unit suit better as chronological presentations. The thematic parts are mainly based on analysis made using grounded theory while the chronological parts are analysed using the conceptual framework as a lens. At regular intervals the two ways of presenting the results, the categories and the conceptual framework, are connected.

3.5 The process of writing

Making this thesis has involved the writing of many different texts: transcripts of interviews and self-recordings, field notes, memos, categories and this final text. Atkinson (1990) differentiates between writing down and writing up where writing down is the writing of field notes and transcripts and writing up is the writing of the final text.

Field notes are a form of representation, a way of reducing just-observed events, persons and places to written accounts that can be reviewed, studied and thought about time and time again. Although the primary purpose of writing field notes is to describe situations and events, writing field notes also provide a first opportunity to develop initial interpretations and alaysis (Emerson, Fretz & Shaw, 2001).
Field notes have been written by hand during observations and complemented with photos to support memory. The photos have, for example, regarded written text on the board and tasks in the students' text books. Hammersley and Atkinson (2007) stress that there is no point in making a lot of observations if there is no time to document and analyse them soon after. After every observation, either the same evening or the day after, the hand written field notes were transcribed. Transcribing field notes involves a turning away from the field towards analysis and writing (Emerson, Fretz & Shaw, 2001). When audio recordings were made during the observations, the time was indicated in the field notes and because of that the transcribed audio-recordings could be read parallel to the field notes (an example is presented further on).

Based on Aspers (2007), the field notes focused on what was happening, when it happened, where it happened, with (by) whom it happened and how it was happening. Then the question of why had to be worked out in the analysis. However, writing field notes is not just about what you see, which is the first selection, it is also about the words you chose when you write. The words are chosen three times, first, spontaneously during the observations, then the words we choose when transcribing and third, the words used in the final text. Extremely few words are free from values, but if all such words are avoided, a text will be edulcorated, uninteresting and/or lifeless (Högdahl, 2009). Similarly, Arvastson and Ehn (2009) write that just as observations move between wholeness and details, between closeness and distance, writing field notes is about choosing and moving between perspectives and when you start to write, the analysis also begins. The character of the field notes made in this thesis is illustrated in the difference between the two examples below.

After the break we go inside, walk along the corridor towards the classroom. We are talking about what Barbro is going to do in the weekend. Just outside the class room door, we meet the headmaster. Barbro says “hello” and then she opens the classroom door and lets the children in to the classroom. When I introduce myself, the headmaster shakes my hand and says that she is very pleased with Barbro.

After the break we go inside, walk along the long corridor towards the classroom. We are talking about what Barbro is going to do in the weekend. It is very noisy in the corridor. Just outside the class room door, we meet a tall happy woman in her fifties. Barbro says “hello” and is in no hurry to open the classroom door to let the children in to the classroom. When I introduce myself to the tall happy woman in her fifties, she shakes my hand and says that she is the headmaster. She looks at Barbro, who is now standing holding the classroom door while the children walk inside, and says that she is very pleased with Barbro.

The first field note above focus on what is happening, when it is happening, where it is happening, with (by) whom it is happening, how it is happening, but it does not say much about Barbro. The second field note is expanded with more details, but also contains elements of valuation, for example very noisy, tall happy woman and no hurry to open the classroom door. Since the aim of this study is to describe and understand the meaning of the respondents, the field notes have been written in the second way, where what I see as an observer is connected to what is said by the respondents. In the second text above, the elements of valuation contribute to describing the
ambience of the situation. It is noisy but the headmaster is happy and Barbro does not seem to be stressed by the noise or the headmaster but opens the classroom door very slowly. Those elements cannot be discovered in the first field note. Writing like this is providing “thick descriptions” (Aspers, 2007, p.120) implying writing field notes in a way that makes it possible to interpret meaning in later phases when the researcher’s knowledge has increased. One part included in both extracts is what we were talking about when walking along the corridor. That is included as it shows both our relationship and me being a participating observer (not an observing participant) in this situation. I am not looking at Barbro as she walks along the corridor; we are walking along the corridor together. That part is also important in relation to the headmaster coming towards us: Barbro is not alone in this situation, she is with me (or I’m with her).

Below (figure 6, 7 and 8) are examples of transcribed field notes from an audio-recorded lesson accompanied by transcripts of the audio-recording and an interview conducted after the observation. This is an example where I have been an observing participant, implying me being in the classroom but not participating in the activities. All of the documents are copied from the original (the transcribed documents) and, therefore, written in Swedish (translations of text will be described later on). The focus here is not on the meaning of their content (because only Scandinavian people can read them) but to illustrate the techniques used when transcribing. These techniques are described in the figure texts.
Tidangivelserna är från när bandspelaren startade...

06.00
Alla åtta elever och Helena är tillbaka i klassrummet.
Alla elever har fått ut ett hafte med kopierade papper
som de ska arbeta med enskilt.

07.18
Helena sätter sig hos 2 som har räckt upp handen. De
pratar om en uppgift.

(Aktuell uppgift: Blommorna)
I den uppsöjande intervjun berättar Helena om denna
uppgift och hur hon har tänkt.

07.40
Specialpedagogen kommer in i klassrummet medan
Helena hjälper eleven med uppgiften. Det är lite
röligt. Helena och specialpedagogen hälsar inte på
varandra.

09.25
Helena sätter sig hos elev 4 som har räckt upp handen.
Helena har fokus på den elev hon hjälper och tittar
sällan upp på övriga gruppen.

(Aktuell uppgift: Födelsedag)

Figure 6 and 7: On the left is an example of field notes from an observed lesson with notes as to
when the audio-recorder was started. The picture on the right shows how the students in the group
are given numbers based on where they are seated. These numbers (bold) are then used in the field
notes when writing about individual students. The italicised text is an aid for me when later
connecting the field notes to the tasks in the student's text book. Also, I note that I ask Helena
about this sequence in a formal interview after the lesson.
06.00
Elev 2: Men jag fattar inte.
Helena: Men jag kommer då 2.

*Helena går till elev 2. I intervjuen efter observationen berättar Helena att hon har skrivit en
kommentar till en uppgift i 2:s häfte och att det nu är denna uppgift som han vill ha hjälp med.
(Uppgift 15 s.107)*

Elev 2: Vadå, en fjärrdedel och en femtedel är ju en halv.
Helena: A, ha
Elev2: Vad fan är det?
Helena: Lugn, lugn, lugn. Jag förstår precis hur du hade tänkt när du hade tittat
på det här. För visst hade du tittat på det här *(Visar på tabellen på
samma sida)* och skrivit hur många?

Elev 2: Ja
Helena: Men du, om du lyssnar nu ska du få höra. Av dom här tulpanerna här
*(Pekar i tabellen men på den kolumn som innebär blandfärg)* som har
blandfärg. År hälften röda.

Elev 2: Mm
Helena: Hur många finns det totalt?

*Inget svar, tystnad uppstår)*

Helena: Utav dom som har blandfärg?
Elev 2: Tolv.
Helena: Tolv. Ja
Elev 2: Då är det ju bara sex ju. *(Eleven har bråttom och "hoppar" på stolen.)*

Helena: Lugn, lugn, lugn. Hälften är det vi är ute efter och det är sex stycken
precis som du säger. En tredjedel är gula och röda.

Elev 2: Vad är en tredjedel? År det två?
Helena: Ta det lugnt nu. Sitt stilla är du snäll. Och tänkt så här nu. Du vet att
det är tolv sammanlagt. Och så ska du räkna ut hur mycket en tredjedel
utav tolv är.

Elev 2: Men inte av tolv vil för det är bara sex kvar för dom andra har vi tagit
till den *(Pekar på a-frågan)* År det tolv?

Helena: Det står så här. Hälften är röda och vita, en tredjedel är gula och röda.
Elev 2: Då är det fyra då alltså.

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*Figure 8: An extract from the transcript of the audio-recording made during the lesson above. The
italicised text is partly an aid for me when later connecting the transcript to the right task in the
student’s text book and, partly, things that I have seen when observing the situation, for example,
that the student is in a hurry. As such, the transcripts include some elements of valuation but they
are italicised and they, as do other elements of valuation, increase the understanding of the
situation.*
Interviews and self-recordings were transcribed in Swedish (see example in figure 9). Transcription implies transformation as the rules of spoken language differ from the rules of written language and writing transcripts word-for-word can make the respondents appear stupid (Kvale and Brinkmann, 2009). That problem, however, did not occur when writing the transcripts, only small sounds were removed.

Researcher: Så det var en uppgift som han hade gjort fel på och som du hade rättat.
Helena: Ja för med en gång när jag såg det förstod jag hur han hade tänkt.
Researcher: Ja.
Helena: Och det hade han suddat ut då.
Researcher: Ja det ville han inte ha med då.
Researcher: Han vill att alla ska vara?
Helena: Det måste vara så här. Ja den vet vi ingenting om sa jag.
Researcher: Ja, det hörde jag att du sa. Tydligt.
Helena: Ja, precis. (Skrattar)
Researcher: Tycker du att det gick bra? Om man säger i det mötet du hade med honom. Lyckades du med det du hade tänkt dig?
Figure 9: An extract from the formal interview conducted after the lesson above. In the interview, Helena talks about what she had written in the student’s text book before the lesson (the student had calculated a task wrong). She says that she knew what he had done wrong and that she thinks that she succeeded in helping him. Here, the italicised text is an aid for me when later connecting the transcript to the right task in the student’s text book. Also, the italicised text says that Helena laughs on one occasion.

After writing down field notes and transcripts, the next step is to, by analysis, write up the results. When writing up, field notes and transcripts are used to illustrate and provide evidence for the validity of the results. All results have been written in a style that, hopefully, will not be perceived as insulting or patronising. As the draft of this thesis was written in Swedish and then translated into English, the field notes and transcripts used to illustrate were translated first after the results were written the first time and, based on that, the whole meaning of the extractions has been focused on in the translation. Metaphors have been changed to equivalent English metaphors with the help of a native English speaker who also speaks Swedish.

3.6 Ethical considerations

Making and writing this thesis has involved several ethical considerations which are elaborated on in this section. Ethics in ethnographic (and maybe also in other) research is not just about formal demands but also regards moral dilemmas confronting the researcher. The ethical considerations have not only concerned the novice teachers involved and their students and colleagues, but also my own role as a researcher and my responsibility towards the research community. The last part, responsibility towards the research community, is a question of the quality of this thesis and is discussed in the last chapter.

Floyd and Arthur (2012) differentiate between formal demands and moral dilemmas as external and internal ethical engagement. External ethical engagement comprises the ethical issues, the formal demands, often considered when starting a research project. The external ethical engagements mentioned by Floyd and Arthur are: informing the respondent of the aim of the study (this has been done in this study and is discussed more below), handling the gathered information in a confidential and secure manner (this has been done in this study), all names being changed at the beginning (all names but mine have been changed in this study) and the gathered information only being used in research (this is the case in this study). The requirements for information, approval, confidentiality and appliance advocated by the Swedish Research Council (Vetenskapsrådet, 2008) are, as such, examples of external ethical engagements. Internal ethical engagement relates to “the deeper level ethical and moral dilemmas that insider researcher have to deal with” (Floyd & Arthur, 2012, p.2). The internal ethical engagements mentioned by Floyd and Arthur (2012) are: personal and professional relationships with respondents, insider knowledge, conflicting professional and researcher roles, and anonymity.

In this study, information was given to the respondents both on the telephone before the first interview and then again at the time of that interview. The purpose of following novice teachers for a long time was mentioned on the telephone and, after the first interview, the respondents were informed again and asked to take part in the study. All respondents agreed. However, a related internal ethical dilemma was that I
was known to the respondents as I had been one of the teacher educators in their teacher education. Me being known to the student teachers as a teacher educator is related to power. I have tried to be clear about them not having to take part in the study just because they knew me before. However, as nobody refused, it is hard to say if they did not want to refuse or if they felt pressured into joining. Nevertheless, several of them expressed that it was fun that someone was interested in them and that they liked talking about their teaching with me. That is positive in relation to power but raises a new question regarding my influence on their professional identity development. Will their professional identity development be different because of me being present? According to Atkinson (1998), our knowledge about ourselves increases as we tell stories about ourselves as, in the stories, we merge parts from different experiences. Also, my questions may have made the respondents reflect more on themselves and their teaching than they would have done otherwise and the stories they tell are told with me as a receiver.

Another issue related to this is that the respondents sometimes had problems to solve, for example, regarding teaching, students and/or parents. When telling me about these, they might have wanted some feedback guiding them as to what to do. According to Floyd and Arthur (2012), insider researchers may feel pressure to show some verbal or visual cues of agreement during interviews. That has been the case many times in this study. The absence of agreement and/or guidance has often felt strange and, therefore, a lot of “yes-es” from my side are included in the interviews. If this is not done, a respondent, according to Floyd and Arthur (2012) may start to give shorter answers. In several situations, I have felt a tension between my role as a researcher and my role as a teacher educator. I have often wanted to help, guide or instruct the respondents but I have tried my hardest to avoid this and, instead, kept to my “yes-es”. Yet another problem related to me being a teacher educator is that the respondents might be directing their actions and questions towards what they think I want them to say and/or do. It is possible that this has occurred on occasion but there have also been several times when the respondents react against their teacher education in both talk and actions.

When the respondents got teaching jobs, the headmaster of the schools were contacted and asked for approval regarding the observations. Sometimes this contact was made by e-mail and sometimes at a physical meeting. All headmasters contacted approved my presence and in those cases where the headmaster was contacted by e-mail I met them physically in relation to my observations. Parents were informed about the study and asked by letter for permission to observe their children’s classes (example appendix 4). This letter was handed out by the respondents to the students who took it home to their parents. The students were informed by me or the respondents as I believe that they are the ones who really have to approve my presence, even if it is the headmaster and the parents who must give the formal permission.

Regarding confidentiality, I have tried to write this thesis in a way in which the schools are described fairly without being exposed. The respondents, headmasters, teachers, students and parents at the schools know about their own school but they do not know the simulated names. Before the group interviews, the respondents were informed that they would no longer be confidential to each other if they attended. All of them wanted to attend anyway and expressed that it would be fun to meet the others and talk about their experiences. Two of the respondents then said that they knew each other and because of that already knew that they both were part of my
study. The importance of them not telling others about each other was emphasised both before and during the group interviews.

3.7 Summary design and analysis of the empirical material

The study is a case study with an ethnographic direction where seven novice teachers have been followed from their graduation and two years onwards. The ethnographic direction has been used to make visible the whole process of professional identity development, both the individual and the social part, in line with the conceptual framework, and to reach understanding by interpreting the meaning individuals attribute to actions, processes, organisations and different kinds of interactions. The novice teachers in the study were selected because they had an orientation including mathematics in their teacher education and some of them also wrote their final teacher education bachelor theses on mathematics education. The empirical material in the study is from self-recordings made by the respondents, observations and interviews. All of these have been made in a selective intermittent way and the empirical material is used as complete empiricism implying that all of the transcribed material constitutes a whole, on which the analysis is based. The empirical material has been analysed in two different, but co-operating, ways: the conceptual framework and methods inspired by grounded theory (implying building and connecting categories grounded in the empirical material by the use of codes).
4. THE RESPONDENTS’ STORIES ABOUT MATHEMATICS TEACHING BEFORE GRADUATION

The results in this and the two following chapters are derived from the operationalisation of professional identity as:

The reifying and significant stories that teachers tell about their patterns of participation regarding education in mathematics, in the present and the future, interpreted with a background in contemporary multiple communities of practice.

As mentioned before, the emphasis on the individuals’ stories agrees with the aim to investigate professional identity development as seen from the perspective of the teachers themselves. These stories are used as a methodological tool while the theoretical foundation is the coordination between patterns of participation and communities of practice. The respondents’ stories are them recognising themselves as a kind of person. Interpreting their stories with a background in contemporary multiple communities of practice is me recognising them as a kind of person. The focus is on how the respondents, or how they do not, recognise themselves as a kind of primary school mathematics teacher. In relation to the present and the future in the operationalisation, the notions of current identity and designated identity are used. Through using the notions of current identity and designated identity, changes in patterns of participation (immediate and long-term) regarding mathematics teaching are made visible.

As described in the chapter ‘Design and analysis of the empirical material’, the empirical material has been analysed in two ways (the conceptual framework used as a lens and analysis methods inspired by grounded theory). These analysis have brought forward two kinds of results: chronological results and thematic results. The respondents are similar to each other in many ways but, at the same time unique, and as mentioned before, case studies are studies of both the similar and the unique. In the thematic parts similarities will be focused on and in the chronological parts the unique will be focused on.

Four of the respondents (Helena, Nina, Barbro and Jenny) will be followed chronologically, starting shortly before their graduation and two years onwards. This chronological part is analysed with the conceptual framework used as a lens. The chronological part will be diffracted by thematic parts constituted by the categories being the results of the analysis using methods inspired by grounded theory. These thematic results are based on empirical material from all of the respondents, not just the four visible in the chronological part. Even though some parts are thematic and others chronological, together they are aimed at presenting a joint picture of professional identity development as a primary school mathematics teacher.

Citations from interviews and self-recordings as well as extracts from observations are used to reinforce and illustrate the argumentation in both the chronological and thematic parts of the results. However, the citations and extracts should not be seen as the sole material on which the analysis is based. As mentioned before, the analysis
is based on the transcribed complete empiricism from which the citations and extracts are illustrating examples. Even though the thematic results are based on the empirical material from all respondents, the citations and/or extracts are not from all of them in every argumentation as this would result in lengthy and repeated text. Instead, citations and/or extracts from one or more of the respondents are used as illustrating examples.

In this first result chapter, the respondents’ stories about mathematics teaching before graduation are focused on. First, this is done based on the cases of Helena, Nina, Barbro and Jenny. When related to Ragin’s (1998) cross-tabulation of cases, their cases are specific case conceptions as empirical units, implying that they have been identified as cases within the research process as fulfilling the sampling criteria. Helena, Nina, Barbro and Jenny will then, in chapter five, be followed chronologically the two first years after graduation. The ideal would have been to follow all of the respondents in that chronological part, however, even without doing that, the chronological parts becomes lengthy. The reason for choosing Helena, Nina, Barbro and Jenny as chronological cases is based on their cases showing four various routes into, and out of, the teaching profession. By following them chronologically and including all respondents in the thematic parts, the results give a correct representation of the empirical material as a whole.

The empirical material gathered before graduation consists mostly of interviews but also some e-mails. The interviews were held four to six weeks before graduation. In the interviews, the respondents were asked why they wanted to become teachers and if they had any mathematics teachers as role models. Also, they were asked to give examples of good teaching situations in mathematics and to motivate why they considered their examples as good examples. They were also asked to give examples and motivate the opposite, i.e. less good teaching situations in mathematics. The respondents were free to choose where the examples came from, for example, their own schooling, practice periods, literature or teacher education. A further part of the interview consisted of the respondents being asked to comment on student-teacher dialogues and student solutions to mathematics tasks. To end the interviews, the respondents were asked to talk about their expectations and plans for the time immediately after graduation.

At the time of their graduation, the respondents’ stories had been developing for a long period, both before and during their teacher education. In this thesis, they constitute the starting-point of the professional identity development to be investigated in the following two years.

4.1 Helena at the time of graduation (the end of the autumn semester, 2008)

Helena is 41 years old when she graduates from teacher education. Before teacher education, she worked at preschools and schools for children with intellectual disabilities. The decision to become a teacher was made when Helena worked as a long run substitute teacher in a lower secondary school for children with intellectual disabilities since she “thought it was a lot of fun working in school”. She chose primary school since that education was shorter than the one for secondary school and she did not want to wait too long before finishing. She chose the Swedish and
Mathematics orientation as “the subjects complement each other”. Within her teacher education she has taken 45 credits of courses in mathematics education.

At the time of graduation, Helena does not call herself a teacher but says that she is looking forward to starting work as one. She says that it will be a challenge making as many students as possible experience mathematics as fun. She expresses this challenge as “jittery” but positive, and she longs for “starting for real”. Good mathematics teaching is, according to Helena, varied, laboratory-based, reality-related and problem-orientated.

Helena  I believe good mathematics teaching is when students have access to learning materials. [...] I love these multiplication games we made. [...] I also like the games and the problem cards. I like them.

Researcher  What makes them good?

Helena  The games are fun. Partly because many of them do not think of themselves doing math at the same time as they actually get practice. Often they do these things with someone else. There can be two or more. Then they learn from each other. You hear their dialogues and they check on and inform each other. [...] That also increases their understanding.

Good mathematics lessons are fun and lead to students cooperating, talking and developing a desire to learn and know how to learn mathematics.

And all mathematical dialogues, even an easy thing such as when you show them something on the blackboard and you say, ‘yes, Pelle, what do you think?’ And then Pelle can come forward and show ‘I thought like this’. Is there another way you can think? Maybe Lisa thinks in another way and then she can come forward and show it. Then they see that there are different ways to solve a task and that both ways lead to the right answer. You find differences; everyone is different and needs different ways to work.

Less good mathematics teaching is, in Helena’s view, when the textbook controls the teaching. Students do not cooperate but, instead, work alone in the textbook and the teacher only shows one way of solving tasks. According to Helena, this kind of mathematics teaching ends up with students having low self-esteem and a poor knowledge of mathematics. “It does not develop any mathematical thinking. [...] There is no dialogue. I don’t like that.”

The good examples Helena gives are from her teacher education and she talks in terms of “we”. When motivating her standpoints she says “I”. On one occasion, when talking about material in a school, she says “we” but it is unclear who “we” are. A good mathematics teacher has, in Helena’s opinion, “an ability to ensure that the students really understand.” The teacher ought to be able to explain the same thing in many different ways with different learning materials.

And that you also tell it to the students. That it is me who has explained wrongly if they do not understand.
A good mathematics teacher also has to be calm, structured and flexible. He or she has to help the students to trust in their own ability and adapt to every student. Helena has met a mathematics teacher like that in the municipality adult education, “thanks to my mathematics teacher, I started to believe in myself. That I, I can do this”.

When Helena starts to work as a teacher she “will rely on the textbook” since “as a new teacher you can’t cope with reforming the world”. Later, when she “feels secure”, she will start to “test new things” in her mathematics teaching. These new things involve following her description above of good mathematics teaching. In addition to security, Helena also mentions that students’ unfamiliarity with reform mathematics teaching may become a limitation in her future teaching. Helena expresses a wish that mentors would be available for novice teachers.

4.2 Nina at the time of graduation (the end of the spring semester, 2009)

Nina is 24 years old when she graduates from teacher education. However, as there are no teaching jobs available, she takes a course in physical education at the university for an extra semester. Because of that, two interviews are conducted with her before she leaves university, one before her graduation and one after her extra semester. Nina wants to become a teacher as she “wanted to work with people, above all children and young people”. The choice of primary school was partly based on her not having an interest in a specific subject and partly on her wish to work with younger children. Her choice of the Science, Technology and Mathematics orientation she describes as a “tactical choice”.

I guess I would have preferred to study physical education but since there are few physical education teachers in primary school, I thought it was wiser to have science and mathematics when finished and applying for job.

Within her teacher education she has taken 37.5 credits of courses in mathematics education. Both before graduation and after the extra semester, Nina refers to herself as “I as a teacher” and she says that she feels finished. She compares teacher education with getting a driving licence and says that she now has her driving licence but needs to work to develop.

[…] right now I feel that I can read and read and read and it is really interesting but nevertheless I feel that I have reached a point where so much is connected and it feels a little as if regardless of which subject I read it is not new and foreign like it was in the beginning […] but then, I cannot say that I am a finished teacher, because I am really not, but I feel like I need this, to try it.

Nina applies for teaching jobs in two cities, one is the city where the university is and one is where she grew up. However, since there are no teaching jobs in either town, she has applied for jobs at preschools and community youth centres “just to get a job”. Also she, just in case, has applied for further courses at the university. However, her
“goal is to find a job”. She says that it is important for her to get a job fast as otherwise she will become “craven”.

Now you feel, I feel, ready. Like when I was out on practice time [...] she [the placement supervisor] said that you feel like a finished teacher. Nevertheless, you start to feel secure within yourself and have found what you want yourself [...] Above all I feel finished. I feel I need to work now.

Good mathematics teaching is, according to Nina’s examples, varied, laboratory-based, concrete, reality-related and problem-orientated. As good, she also emphasises mathematics teaching where the students do not realise that they are being taught mathematics. Such teaching is, according to Nina, student-centred and captures the students’ interest. She says that it is “important to dare” as a mathematics teacher and that “you must go outside the frames sometimes”. Nina also talks about “the norms” and how good mathematics teaching “refers to all children”, both the weak and the strong. The good examples Nina gives are from teacher education and her practice periods. She talks about them in terms of “we” as in herself and fellow students from the teacher education.

Less good mathematics teaching is, in Nina’s view, “old-fashioned”, “traditional”, following a “patterned scheme” within the “frames” of the text book where the students do not cooperate and solve tasks in only one way.

[I have] been at two different schools quite a long time and it feels like many teachers are very controlled by the text book and that is what counts.

She says that it is “really okay” to have a text book but that you should not follow it strictly but should also work outside of it. She says that the text book can result in incorrectly interpreting the fast students as being the good ones, while the ones that really are the good ones do not get any input except “sit like that and work in their text book”.

Nina herself has experienced the less good mathematics teaching as a student and also during practice periods. Now, after teacher education, she wants to teach differently, in line with the above described good mathematics teaching. However, in the beginning, as a novice teacher, she plans to base her mathematics teaching on a text book.

I will use a text book a lot, for sure, quite a lot in the beginning since you, nevertheless, feel a little insecure and want to have something to follow, and want to have something to give to the students and so on.

She says her insecurity is based on her having limited experience but “a lot of knowledge”. The thing that makes a mathematics teacher good is not primarily knowledge “of mathematics” but an understanding of how children think and an ability to explain in many different ways. Also, a good mathematics teacher “sees every child” and connects the mathematics teaching “to what it is good for”. The latter, Nina says, is something she has missed as a student in school.
4.3 Barbro at the time of graduation (the end of the autumn semester, 2008)

Barbro is 34 years old when she graduates from teacher education. She had “wanted to become a teacher since [she] was little”. Almost ten years before she started the teacher education she is just about to graduate from, she studied secondary school teacher education for two years including 15 credits of mathematics courses and 15 credits of mathematics education courses. Both then and now in her primary school teacher education, her orientation is Science, Technology and Mathematics as they are subjects she likes a lot. Private circumstances made her leave teacher education the first time. About the change from secondary school to primary school, she says that she would like to have the level in the subjects as in secondary school but she feels “safe” in primary school. This safeness regards both knowledge and the ability to respond to students in “a pedagogically good way”. Within her primary school teacher education she has taken further 15 credits of courses in mathematics education.

Even before graduating, Barbro starts to work part time as a class teacher in a preparatory class, but she does not talk about that in the first interview. When she talks about teachers, teachers are like a collective, for instance, “[y]ou must be an engaged teacher” or “a good mathematics teacher must be perceptive”. Good mathematics teaching is, according to Barbro’s examples, varied with games, “mathematics theatres”, experiments, problem-solving, outdoor mathematics, dialogues about concepts based on the need of every student and working with connecting components. Good mathematics teaching is when the teacher “dares to vary and dares to leave the text book a little”. Good mathematics teaching is also reality-related where the students experiment their way to solutions. This kind of mathematics teaching is fun and enables the students to see that mathematics is also used outside of school.

Barbro has experienced this kind of mathematics teaching during her teacher education. She expresses surprise about one occasion when a task she had encountered in teacher education was used by the teacher during a practice period: “when I went into the practice period, they actually used something similar”. When she talks about how she wants to teach, she often contrasts it to her own schooling in mathematics. She also refers to her own way of learning mathematics but says that everyone has their own way of learning.

I believe that there are many different ways today. When we went to school, you were only allowed to work in one way. Today there are different ways. You can use units and tens separately; we were not allowed to do that. It had to be written in a special way. You may try to vary it so that you can find your way. Yes, just to dare, that, I believe, is important when teaching.

Barbro talks about “we” and “one” when she talks about good mathematics teaching but uses “I” when she motivates her examples. When she motivates why her examples are examples of good mathematics teaching, she does so by contrasting with mathematics teaching that is not good.
The text books can be a little too strict sometimes [...] for example, if you are to check the sum of an angle, they get that it is 180 degrees and that one angle is this and the other is that and what is the third? But there [referring to a task used at her latest practice period] they got, first they were to make a triangle which had as large an angle sum as possible. Then they were to come up with it being 180 degrees and not knowing that from the beginning. That I think was really good.

When Barbro gives examples of less good mathematics teaching she laughs and says “[t]hen there is many”. In the next sentence she says that “sometimes [there] are too many repeated tasks” and she gives examples from her last practice period where the teaching had been “very controlled by the text book” and how this made the students “finally think it is boring”.

[…] you are that closely tied to the text book that you don’t dare leave it. But then maybe I had both the advantage and disadvantage of having a very experienced placement supervisor who had been at the same school for forty years and who probably had been teaching the same way these forty years. So she was very controlled by the text book.

The mathematics teaching Barbro talks about as good results in joy and desire, while the less good teaching is boring. However, Barbro says that the text book can be a support in mathematics teaching and that “you” as a teacher should not be afraid to ask for help. A good mathematics teacher is perceptive, engaged, dares to teach outside of the frames and sees the individual.

I guess you have to be strong in yourself and dare to teach outside of the fairly strict frames that I feel exist within mathematics teaching at some schools. [...] You have to do in-service training the whole time to continue being a good teacher. Learn from the new and also keep the good from before because everything old is not bad. No, but being very daring, daring to fail [...]

However, Barbro has no experience of mathematics teachers of that kind and says that “mathematics teachers might have good knowledge, in mathematics, but that doesn’t mean that you can teach mathematics”. As the starting-point in her future mathematics teaching, Barbro mentions the goals and the students. Difficulties Barbro mentions in relation to starting to work as a primary school mathematics teacher is lack of experience and that different schools may be different allowing in relation to how she wants to teach mathematics.

You can’t bring too much that is new in the beginning either, you have to sneak it in a little, if it is old and deep-rooted. [...] It takes a while before you know what is working and what’s not. Then, if you fail perhaps it easy to go back to what has worked before at the school. Perhaps you fall back and get stuck in the text book [...] structure.
4.4 Jenny at the time of graduation (the end of the autumn semester, 2008)

Jenny is 22 years old when she graduates from teacher education. She has wanted to become a teacher since lower secondary school as she likes working with children and thinks that she is suitable for the profession. “Also my family and friends said I would suit as a teacher.” She chose primary school and the Swedish and Mathematics orientation as she thinks that primary school is the foundation of the education system and that Swedish and mathematics are the most important subjects. Within her teacher education she has taken 22.5 credits of courses in mathematics education.

When Jenny gives examples of good teaching situations in mathematics she starts by talking about how, during her last practice period, she had been working with geometry and fractions outdoors. She says that outdoor-pedagogy is good as the teaching “becomes more concrete” and you can use “more material”. She also says that it “becomes an environment more suitable for the children than sitting inside at their desks”. Jenny also mentions group work and “concrete material” as good mathematics teaching. Group work is good because the students can learn from it and help each other. She says that mathematics is everywhere and that you “don’t have to do it only in mathematics lessons”. She gives several examples of how she has integrated mathematics and other subjects, for instance, working with Roman numerals during a history lesson and how the students “all the time believed that it was history”.

According to Jenny, a good mathematics teacher is a teacher who has a good structure, always has a good day and who varies their teaching. A good mathematics teacher is perceptive, listens to the students and adapts the lessons in relation to all of the students. Less good mathematics teaching is, according to Jenny, when “a teacher doesn’t have any control of the class”, and where there is no “structure”. She says that one teacher “alone, locked in a classroom” can’t have control over a whole class working separately in their text books. In that case, the teacher “runs around like a dizzy hen” trying to help “all twenty-five who are screaming for help”. Jenny says that a teacher needs a structure where the students know what to do and how they can find out if they do not know. This is not just in mathematics teaching but in independent work in all subjects. The only thing that differs between teaching mathematics and other subjects is the content, and, regarding the content, “we have a syllabus”.

Different methods, is it group work, is it individual work, are you to be outdoors, are you to be indoors, are you to use the text book, not the text book, is it paper or is it you standing as you, those are parts of the structure I see. [...] it is what you have heard the whole time.

When Jenny talks about good mathematics lessons she uses “I”. She uses “we” in relation to herself and her classmates. At one point she says about herself “I as a teacher” and then starts to laugh. According to her, this is the first time she has called herself a teacher. After laughing, she continues to talk about when you can call yourself a teacher. She says that graduation is one important part from the perspective of society, but that graduation is not enough. She also mentions competence and belonging, belonging to a school, as important.
You are not, before that [graduation] you don’t feel accepted by society, so to speak. [...] And then you also think about yourself, your competence, what you know and don’t know. Sometimes I don’t believe I’m a teacher. Because then I am, because I, for instance, don’t have the knowledge an English teacher has. Or, because of not having taken some courses, I feel I lack that competence. [...] I attended the Child and Recreation Programme32 so I was a child minder. But that was not enough. [...] Then I had to move on. But, yes, in my own eyes I hope I will be accepted as a teacher. At least after graduation. But, concerning competence, I think I lack a lot, especially subjects.

When talking about her lack of competence, Jenny refers to the subjects not included in her teacher education. She expresses this as a lack since “this lower primary school teacher I have before my eyes is one with a broad education, who has knowledge in all subjects”. Jenny says that meeting parents, personal development dialogues and organising the teaching in “the right order for the best of the students” will be the most difficult parts when starting to work as a teacher. She says that she has got “really a lot” of ideas but the difficulty is to “catch the students in the right order”. Another difficulty she mentions is to become accepted.

You know, you have that picture of a teacher. How a teacher is supposed to be and how a teacher is supposed to act. And as a new teacher you may have to yield a little to your big ideas. But at the same time you want to show your best side, I don’t know. Sometimes it feels like some of the teachers out in the field, if you can say so, have this thought that you take too much initiative. Yes, now you’re newly graduated but you’re not allowed to be too full of enterprise. Yes I have, you need to have backing for what you want and what you want to do. And then I think it can be hard to suggest new ideas. This template, or how you think, well it’s not a template either because it changes the whole time. Society wants new stuff from student teachers if you can say so. Out with the old and in with the new sometimes. [...] I can come with a lot of ideas but they might say ‘What are you doing now?’ Or ‘What’s happening? We don’t work like that’. [...] Sure you can come and sneak in, you can show your ideas and what you can do and we want to take part in that but then, then you ought to stay in your place. It is not, and then sure I believe that some workplaces are like paradise, where you can lead and show initiative. [...] That’s the kind of workplace I hope you will get to.

During her practice periods, Jenny experienced both types of workplaces. When I ask her who it is who wants the old out, she answers: “The media, I think. It feels like they want something new, something fresh. But then reality says something else.” When starting work, Jenny says that she can use the text book as a basis for what to teach, “and do some other tasks related to that”. The last thing Jenny says in the interview is “[if I find a job first]. She says that she looked at the job centre earlier the same day but that there were only preschool jobs and jobs in upper and lower secondary schools.

32 The Child and Recreation Programme is a program in upper secondary school. It is possible to acquire qualifications to higher education within the program.
4.5 Thematic summing up of the respondents’ stories before graduation

A chronological continuation focusing on the unique of Helena’s, Nina’s, Barbro’s and Jenny’s professional identity development as primary school mathematics teachers will be made in the next chapter. Before that, some thematic summaries focusing on their similarities will be made in this chapter illustrating the starting position at the time of graduation. The thematic results to be presented below are based on the coding and categorisation with methods inspired by grounded theory. That coding and categorisation has been made based on the transcribed complete empiricism gathered before the respondents’ graduation. That means that the thematic results also include Gunilla, Malin and Camilla. Their stories before graduations were very similar to the four stories presented above.

4.5.1 The respondents’ stories about mathematics teaching before graduation as a dichotomy

When analysing the respondents’ stories before graduation, a question emerged regarding what it was that determined if a teaching example was considered as good or less good and if there were any relationships between the two groups of examples? If related to Ragin’s (1998) cross-tabulation of cases, this section constitutes a specific case construction as theoretical construct, implying a category emerged from the empirical material.

Before graduation the respondents give the same kind of examples regarding good and less good mathematics teaching and they talk about “we” referring to themselves and their fellow students. They have experienced less good mathematics teaching in their own schooling and during practice periods. They also differentiate between themselves and practicing teachers when they talk about their future mathematics teaching. In their stories, they motivate what they express as good examples compared with less good examples, and vice versa. For instance when Camilla is to give good examples, she says “not just this sitting with the text book but getting it in from other directions [...]” The respondents express that their examples of good mathematics teaching are “funnier”, “more suitable for the students” and that “knowledge like that lasts longer”. In relation to those statements, questions can be asked regarding ‘funnier than what?’, ‘more suitable for the students that what?’, and ‘lasts longer than what?’ The respondents consistently compare the good and the less good with each other and sometimes good mathematics teaching is described as “teaching that doesn’t …” followed by an example of less good mathematics teaching. As such, there is a visible negotiation between good and less good mathematics teaching, and the teachers’ teaching it, in the respondents’ stories.

These stories about mathematics lessons and teaching in terms of negotiation between good and less good can be represented as a dichotomy. A dichotomy means a division of something into two mutually exclusive categories. Some variables have a natural dichotomy (e.g. gender) while other variables are constructed in analysis with the purpose of clarifying. The dichotomy presented here is of the second kind. Of course, the respondents’ stories were not identical but when they talked about
mathematics teaching they expressed a distinct and concurrent picture of how mathematics teaching best should be managed. Even though I construct the external frames of the dichotomy, both by asking the respondents to give good and less good examples of mathematics teaching and by objectifying their stories into a dichotomy, the content in the dichotomy is based on the empirical material. As such, the dichotomy is an objectification of the individuals’ stories regarding good and less good mathematics teaching before graduation. This negotiation can be further divided based on them focusing on the teacher, the teaching or the students, resulting in the dichotomy below (figure 10).

<table>
<thead>
<tr>
<th>The teacher</th>
<th>The teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>- reformatory</td>
<td>- conservative</td>
</tr>
<tr>
<td>- creative</td>
<td>- controlled by the text book</td>
</tr>
<tr>
<td>- autonomous</td>
<td>- heteronomous</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The teaching</th>
<th>The teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>- group work</td>
<td>- solo work</td>
</tr>
<tr>
<td>- concrete</td>
<td>- abstract</td>
</tr>
<tr>
<td>- student-focused</td>
<td>- text-book-focused</td>
</tr>
<tr>
<td>- reality-based</td>
<td>- reality-distanced</td>
</tr>
<tr>
<td>- integrated with other subjects</td>
<td>- separate from other subjects</td>
</tr>
<tr>
<td>- varied</td>
<td>- repetitive, based on the text book</td>
</tr>
<tr>
<td>- focused on processes and problems</td>
<td>- focused on products</td>
</tr>
<tr>
<td>- mathematics is hidden</td>
<td>- mathematics is visible</td>
</tr>
<tr>
<td>- reveals different ways of thinking</td>
<td>- reveals only one way of thinking</td>
</tr>
<tr>
<td>- connected components</td>
<td>- separate components</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The students</th>
<th>The students</th>
</tr>
</thead>
<tbody>
<tr>
<td>- cooperate</td>
<td>- work alone</td>
</tr>
<tr>
<td>- active</td>
<td>- passive</td>
</tr>
<tr>
<td>- many solutions to a problem</td>
<td>- one solution to a problem</td>
</tr>
<tr>
<td>- motivated</td>
<td>- uninterested</td>
</tr>
<tr>
<td>- comfortable</td>
<td>- uncomfortable</td>
</tr>
<tr>
<td>- having fun</td>
<td>- being bored</td>
</tr>
<tr>
<td>- understand</td>
<td>- do not understand</td>
</tr>
<tr>
<td>- mathematics becomes interesting</td>
<td>- mathematics becomes uninteresting</td>
</tr>
</tbody>
</table>

33 The dichotomy is validated by the respondents in the end of this study. This is described in chapter six.
Figure 10: The individuals’ stories regarding negotiating between good and less good mathematics teaching before graduation as a dichotomy.

In their stories, the respondents talk a lot about teachers, ways of teaching and students but little or nothing at all about the mathematics content. Except for a few occasions, it is only in connection with the students’ solutions used in the interviews that mathematics contents are focused on. The focus of the respondents is on how and why, not on what and why. When they tell examples of good and less good mathematics teaching they focus on how the lesson is taught and experienced by the students but not on the mathematics content in the lesson or how it was understood. Irrespective of which side in the dichotomy, the content appears to be the same. Jenny even says that the way to teach that she emphasises is not specific to mathematics, the only thing that differs is the “content”. The content she refers to then is not the different content in mathematics but content as in different subjects.

The respondents express having experienced the mathematics teaching on the right in the dichotomy in their own schooling and during practice periods. For instance, Nina says that she has “been at two different schools quite a long time and it feels like many teachers are very controlled by the text book and that is what counts”. Similarly, Barbro tells about the teacher at her last practice period who was “very controlled by the text book” and how this made the students “finally think it [was] boring”. The respondents have experienced the mathematics teaching on the left in the dichotomy in their teacher education and they have taught like that, by themselves or together with other student teachers, during practice periods.

In the respondents’ stories, the two sides are negotiated and that negotiation is a part of their professional identity as primary school mathematics teachers at the time of graduation. Also identification is made in relation to the content in the dichotomy as they talk about and motivate the left side by using “I”, “you” and “we” while “they” is used in relation to the right side.

The dichotomy as the shared repertoire in a community of practice

In this section, the respondents’ stories regarding good and less good mathematics teaching in line with the dichotomy are connected to the conceptual framework. The respondents’ stories regarding good and less good mathematics teaching in line with the dichotomy can be understood as their patterns regarding talking about good and less good mathematics teaching at the time of graduation. The similarities in these patterns (illustrated by the dichotomy) may be based on a shared repertoire in a community of practice in which the respondents participate. Describing the respondents’ stories regarding talking about good and less good mathematics teaching as part of a shared repertoire in a community of practice implies making an objectification. The benefit of that is the possibility of being able to talk about the cohesion of the negotiation and identification of these stories.

A community of practice involves mutual engagement, joint enterprise and a shared repertoire (Wenger, 1998). The existence of a community of practice is based on its members being engaged in activities whose meanings they negotiate. In the respondents’ stories regarding good and less good mathematics teaching before graduation, several of Wenger’s (1998) external factors indicating the existence of a
community of practice are visible. There is jargon and shortcuts in communication, there is an overlap regarding which persons are “included”, adequacy in actions and productions are evaluated with ease, and specific tools, representations, artefacts, knowledge and stories exist.

Independently of each other, the respondents talk similarly about good and less good mathematics teaching. The stories presented as a dichotomy can be regarded as a shared repertoire that has been and is negotiated by its members. In time for graduation this shared repertoire, for the respondents, does not mainly regard performed mathematics teaching but talking and negotiating mathematics teaching. The respondents have experienced the mathematics teaching on the left of the dichotomy in their teacher education. Their talk about “we” in relation to this mathematics teaching imply both mutual engagement and joint enterprise as well as identification. The respondents themselves have performed teaching in line with the left side of the dichotomy during practice periods and they talk about reforming mathematics teaching in this direction after graduation. “We” have a mutual vision of how mathematics is best taught and a vision of teaching mathematics like that after graduation. The respondents talk about teacher education and fellow students in relation to “we” and Jenny also talks about “society” and “media”. “They” is used when talking about teachers working in line with the right side of the dichotomy. The respondents give some examples of “they” but their stories about “they” can also be part of the shared repertoire connecting the members.

As such, all parts which, according to Wenger (1998), characterise a community of practice are visible in the respondents’ stories regarding mathematics teaching before graduation. According to Graven and Lerman (2003), teaching in most pre-service and in-service teacher education settings occurs within a community of practice. What is interesting here is not the “existence” of the community of practice, but the shared repertoire and the framing of precisely this community of practice where the respondents became members during their teacher education. The development of a community of practice is a collective process where the respondents in the study do not express being part of the original development of the community of practice presented here. Neither did they enter the teacher education in purpose to become members in this community of practice. Instead, they, in their teacher education, became involved in mathematics teaching of a kind that they had not experienced before. For example, Gunilla talks about when, in teacher education, she saw a cubic meter for the first time, saying “[w]hy haven’t you been shown that before when you were little?”

The respondents participation in the community of practice and the characteristics of it (from the perspective of the respondents) may have changed if comparing the time when the respondents took their courses in mathematics education and now when they are to graduate. Even though the community of practice includes physical members (teacher students and teacher educators) it is in time for graduation mostly discursive focusing on the reifications in the shared repertoire and you do not have to teach mathematics to be a member; it is enough with the stories. The words the respondents use, for example varied, concrete, group work, works as reifications of experiences they have had within the community of practice. At the same time as the stories constitute the shared repertoire connecting

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[34] Teaching is not a part of the respondents’ patterns of participation at the time of graduation. However, if the community of practice is considered as “existing”, other members (for instance the teacher educators that the respondents talk about) may be teaching in line with its negotiated shared repertoire.
the members, the stories make it possible, by action or talk, to make visible who does and does not belong to the community of practice. The respondents have several examples of this from their own schooling and practice periods.

Based on the content in the respondents’ stories of good and less good mathematics teaching and their talk about changing and reforming mathematics teaching, the community of practice described above will be named the community of reform mathematics teaching. Regarding “the reform” as it is described in the first chapter of this thesis, it is important to mention that only parts of that reform are visible in the stories of the respondents. Reform in the community of reform mathematics teaching is to be understood as “the reform” from the perspective of the respondents. As described above and as visible in the dichotomy, the respondents focus on how regarding the reform while the reform, as described in the first chapter, also puts an emphasis on what, both regarding what is being taught and regarding the mathematical knowledge of the teachers. As such “the reform” can be understood as a boundary object (Wenger, 1998) that have been adapted and then reinterpreted by the (at least these seven) members of the community of reform mathematics teaching.

Based on the respondents’ stories, it is likely that they became members in the community of reform mathematics teaching during their teacher education. Even when the external frames are set from the outside, it is the members’ responses to those external frames that shape the community of practice (Wenger, 1998). However, the external frames of the community of reform mathematics teaching may have influenced how the respondents became members and their possibilities for identification and negotiation. According to Wenger (1998), an individual can participate in a community of practice through engagement, imagination and/or alignment. These three involve different approaches and different conditions and they do not require or exclude each other. They involve different types of work for the individual and they can even come into conflict. Since they have different strengths and weaknesses, they function best in combination. Through looking at patterns regarding engagement, imagination and alignment, the respondents’ memberships in the community of reform mathematics teaching can be analysed.

Participation through engagement involves active participation and is dependent on time and place. As for engagement, none of the participants mentions being a part of the original negotiation of the shared repertoire, but they have been engaged in its teaching during their teacher education, e.g. Helena says “I love these multiplication games we made”. Engagement being dependent on time and place is an explanation of the relatively limited (only stories) engagement of the respondents at the time of graduation. However, being interviewed is a new possibility for them to engage by including me in their negotiation. As such, they have been and still are an active part of the survival and transmission of the community of practice and they identify with it. Their use of “we” implies the belonging and interaction that existed during teacher education. The engagement expressed at the time of graduation is mostly about the future, how they will reform mathematics teaching in line with the left side of the dichotomy.

Participation through imagination implies going beyond time and space in a physical sense and creating images of oneself and the world. The respondents’ stories at the time of graduation contain imaginings of future mathematics teaching. They express a sense of belonging with others who think of mathematics teaching as they do even if they have not met all of them in a physical sense.

Participation through alignment implies the individual aligns, in relation to the activity system the individual wants to, or is forced to, become a member of and can
go beyond time and space in a physical sense. Since the core of the community of reform mathematics teaching seems to be located within teacher education, the respondents' membership may not have been optional but mandatory for passing their exams. On one occasion, Gunilla says that she does not agree with "everything" but, apart from that, the respondents do not express aligning with anything without wishing to and they often speak of their motivations in the first person. Jenny differs a little from the others by saying "[s]ociety wants new stuff from student teachers" implying having been given a mission. This is further emphasised by her use of "template" when she describes the content of this mission. Her mission as a novice teacher to reform mathematics teaching can be understood as alignment in the community of reform mathematics teaching. However, she does not express this as something negative, quite the opposite.

Based on the mutual engagement, joint enterprise and shared repertoire in the community of reform mathematics teaching, the respondents seem to have developed individual patterns regarding how they talk about and want to teach mathematics. They all identify, to different degrees, with the community of reform mathematics teaching through engagement, imagination and/or alignment. The identification expressed through imagination is identification with few certain role models. The respondents can express how they want to teach mathematics but they have seldom met this kind of teaching in their own schooling or during practice periods. Quite the opposite, they are critical of their own schooling and several of the teachers they have met during their practice periods. How this lack of role models may affect their professional identity development as primary school mathematics teachers is focused on in the next section. For all except Jenny, imagination seems to be the main mode of belonging. Jenny also identifies through imagination but mostly by expressing alignment. The other respondents also align but they do not express having been given an assignment in the same way as Jenny does.

At the time of graduation, it is possible that the respondents are less central members in the community of reform mathematics teaching than they were when studying mathematics courses during their teacher education. For instance, Gunilla says that it is awhile since she studied "the course" and that mathematics is "far away". This can be an expression of how the respondents miss the time and place dependent possibilities, the mutual engagement, for identification and negotiation. At the time of graduation, the respondents are in an empty space regarding mathematics teaching. None of them have studied courses in mathematics education in recent time which is why time and place for identification and negotiation do not exist naturally within their teacher education. Neither have they started to work (Barbro has but she does not talk about it) which otherwise could have enabled new possibilities for identification and negotiation through engagement. As such, imagination and/or alignment are the main possible ways to participate in the community of reform mathematics education.

The above described membership in the community of reform mathematics teaching and its influence on the respondents' stories can be understood as the starting point of their professional identity development as primary school mathematics teachers to be investigated in this thesis. During teacher education, they became members through engagement, imagination and alignment (especially Jenny).

\[35\] In the teacher education the respondents' are to graduate from January 2009 the courses in mathematics education have been located in 2006 and/or 2007.
Before graduation, they are still participating in the community, mainly by imagination. How this membership develops and if, and then how, it influences their professional identity development as primary school mathematics teachers will be one focus of the chronological results in chapter five.

4.5.2 Striving towards or away from? The designated identity of the respondents at the time of graduation

Even though all of the respondents appear to be members of the above objectified community of reform mathematics teaching, they talk differently about teaching mathematics in the present and the future. This will be made visible in this section by using the notions of current and designated identity from the conceptual framework. As mentioned before, these terms are objectifications and not something that the respondents “have”, rather, they are a way of describing how the respondents talk about the present and the future. As such, the terms should not be seen as separated but as part of the same stories but focusing on different periods of time. Current identity is used for identity stories regarding the present and designated identity for stories regarding the future. Both current identity and designated identity are parts of the patterns of participation of the respondents at the time of graduation. Changes in these stories can be interpreted as identity development.

The respondents were interviewed once each (except for two interviews with Nina) before graduation, why changes are not yet visible. However, by making identity stories of current and designated identity visible at the time of graduation, it becomes possible to describe the respondents’ future visions and also to make coming changes visible.

When analysing the respondents’ stories focusing on current and designated identity, a question emerged regarding whether they, in their designated identities, are striving towards or away from? When related to Ragin’s (1998) cross-tabulation of cases, the category striving towards or away from constitutes a specific case construction as theoretical construct implying a category has emerged from the empirical material.

In their current identities, the respondents express themselves as being, more or less, fully qualified teachers and, through their membership in the community of reform mathematics teaching, they, in their current identity, have a clear picture of how they want to teach mathematics. In their designated identity they imagine a continued and more active membership in the community of reform mathematics teaching.

Both the current and designated identities of the respondents seem to strive away from and not towards their former experiences of mathematics teaching. They all stress that they want to teach mathematics differently to the teachers they have had in school and the ones they have met during their practice periods. The mathematics teaching they want to perform (the left side of the dichotomy) differs from the mathematics teaching they have experienced (the right side of the dichotomy). As mentioned, their focus is on how and why and not on what and why. It seems like the future students of the respondents are to be taught the same mathematics content as the respondents did in school but in a new way and, therefore, they will also experience the mathematics teaching differently to how the respondents experienced it.
I believe confidence is important. That the students should be able to keep theirs. [...] I have had that feeling myself many times, that now everything crumbled, exactly everything I knew. Now I suddenly don’t understand anything. It is a very frightening feeling. (Gunilla)

Not just saying ‘now we are going to work this out’ because you know yourself, so many times, ‘now we are going to do this but why are we doing this?’ and you don’t get an answer [...] (Nina)

I believe there are really many different ways today. When we went to school, you were just allowed to work one way. Today there are different ways. (Barbro)

The citations above are examples of the respondents’ position away from their own experiences. Even Camilla, who experienced mathematics as fun in school, wants to teach differently.

I thought it was one of the funniest things when my sister and my mother did more routine tasks for me. I wasn’t bothered that they were the same tasks or that I knew them, I thought it was just as much fun even if there was no challenge. But, for many children I believe, it is not fun if you aren’t challenged and learn new things. (Camilla)

Even though Camilla had positive experiences of mathematics in school, her membership in the community of reform mathematics teaching has influenced her in the same direction as the other respondents.

The position away from also regards the mathematics teaching the respondents have experienced during their practice periods and the stories of “they” seem to be part of the shared repertoire in the community of reform mathematics teaching. The respondents make a distinction between themselves and the teachers they have had in school and met during practice periods.

Sadly, I think you often meet. Often in practice periods, it is this working with weekly contracts. You are to do this or that many pages; you work in the text book. A lot of individual work in the text book. I think that is what you most often encounter. Then sometimes, you meet a diamond36. (Gunilla)

[…] that the teacher is very locked to the text book, the mathematics text book. And is very locked in the whole teaching with students sitting and working on their own and it is the text book that decides when there’s group work and such things. […] I almost think that all teachers should review text books as we are to do and actually look into different views about it. How you learn. (Malin)

I can come up with a lot of ideas but they might say ‘What are you doing now?’ Or ‘What’s happening? We don’t work like that’. (Jenny)

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36 To meet “a diamond” is an expression implying situations that are unusual but very positive when they happen.
Only Helena has met what she calls a good mathematics teacher and that was in the municipality adult education. Otherwise the respondents lack role models in their designated identity.

*I can’t think of anyone because I don’t think I have met anyone who, as I see it, is a really good mathematics teacher. There are mathematics teachers who have good knowledge of mathematics, but that doesn’t mean that they can teach mathematics.* (Barbro)

Above, Barbro talks about mathematics knowledge and, because of her time in secondary school teacher education, Barbro has taken courses in pure mathematics. However, instead of emphasising the importance of content knowledge, she says that such knowledge does not mean that you can teach mathematics. The thing that makes a mathematics teacher good, according to Barbro, is not their knowledge in mathematics but how they teach mathematics.

*[…] you are that closely tied to the textbook that you don’t dare leave it. Maybe I had both the advantage and disadvantage of having a very experienced placement supervisor who had been at the same school for forty years and who probably had been teaching the same way these forty years. So she was very controlled by the textbook.* (Barbro)

Barbro says that there were both advantages and disadvantages to her doing her practice period with a “very experienced placement supervisor”. When Helena talks about experienced teachers, she talks about the importance of their knowledge, even if she does not want to teach like them.

*I wish there was time. If I could make a wish, then I would wish for an additional teacher in a class. To be able to acquire the knowledge and wisdom that the experienced teacher often has. And I feel that if you remove them when they retire and put in a novice teacher, a lot of knowledge is lost.* (Helena)

Related to Helena’s and the other respondents’ stories about mathematics teaching and their future teaching in mathematics, the knowledge and wisdom Helena talks about does not seem to be about mathematics teaching but rather about being a teacher in more general terms. While the respondents identify within the community of reform mathematics teaching, they also identify through a non-membership by separating themselves from mathematics teachers in school. They are to become, and want to become, teachers. Some of them already call themselves teachers when being interviewed. But they separate themselves from mathematics teachers in school.

Maybe this strive away from is one explanation for why mathematics content is almost absent in the respondents’ stories about mathematics teaching (both regarding the good and the less good). In their stories, the focus is on the new and different, based on their own experiences. Maybe they do not perceive the mathematics content as new and different, but just the way of teaching, and, consequently, also learning, mathematics.
4.5.3 Frames for mathematics teaching

When analysing the respondents’ stories focusing on towards or away from, a new question emerged regarding the respondents’ views on their possibility to teach mathematics according to their designated identity. While the respondents strive away from their own schooling and the mathematics teaching in schools, at the same time, they talk about elements that will limit their possibilities to teach mathematics in line with the left side of the dichotomy, that is, limitations to reaching designated identity. Before graduation, Nina talks about the risk of being “craven” and Barbro talks about “daring to teach outside of the fairly strict frames” that she says exist in some schools. These are examples of how the respondents express that it may not be easy to reach their designated identity. The question that emerged was which limitations they expressed when talking about their future mathematics teaching? When related to Ragin’s (1998) cross-tabulation of cases, this category, called frames for mathematics teaching, constitutes a specific case construction as theoretical construct, implying a category has emerged from the empirical material. The word “frames” is chosen based on the respondents’ use of this word.

As mentioned before, all respondents before graduation have an idea of how they want to teach mathematics, an idea influenced by their membership in the community of reform mathematics teaching. This membership is visible in both their current and their designated identity. In their designated identity, they give themselves the role of a reformer who is to change mathematics teaching. This change can be described as a movement from the right side of the dichotomy to the left side. In their stories before graduation, the respondents express factors that, according to them, will limit their possibilities to teach mathematics in line with the left side of the dichotomy, in line with their designated identity.

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

37 Parts of these results have been presented at the Madif-Conference (Palmér, 2010a) and in an article (Palmér, 2010b).
and sneak in, you can show your ideas and what you can do and we want to take part in that but then, then you ought to stay in your place. It is not, and then sure I believe that some workplaces are like a paradise, where you can lead and show initiative. [...] That's the kind of workplace I hope you will get to. (Jenny)

Society and media are mentioned as those who want the old out; this can be seen as the mission to reform coming from outside. However, the respondents most often talk in term of “I” when they talk about and motivate their future mathematics teaching. If related to the community of reform mathematics teaching and the respondent’s mode of belonging, there is a possibility that Jenny (whose primary mode of belonging was alignment) emphasises the mission from external sources more explicitly than the other respondents (whose primary mode of belonging was imagination).

The limitations mentioned by the respondents can be divided into internal and external limitations. Internal limitations are connected to the respondents’ own abilities while the external limitations are to be found in the schools.

The internal limitations mentioned by the respondents are lack of knowledge and experience. Knowledge is mentioned as something they need to have and further develop to “have backing” for what they want. They also express insecurity regarding the “right order” of the mathematics content.

And how to organise it in the right order to get the best for the students. [...] I have got a really lot of ideas so that's not the thing [...] But just that to get, to catch the students in the right order [...] and to become accepted where you end up, so to say. (Jenny)

I guess the hardest thing will be, you come in with very little experience, and maybe you don't really know what you are doing, if you can say so. [...] It takes a while before you know what works or not. Then if you fail, perhaps it is easy to go back to what was working before at the school. Perhaps you fall back and get stuck in the text book ... structure. (Barbro)

External limitations mentioned by the respondents are traditions, lack of teaching jobs, other teachers, lesson patterns, lack of time, local goals, lack of material, lack of resources and text books. These external limitations will, according to the respondents, limit their possibilities to teach in line with the left side of the dichotomy. The respondents have a view of what is and is not possible for novice teachers and what they say they want to do is not what they will be able to do.

However, the respondents express that different workplaces will probably vary regarding many of the external limitations and regarding accepting the “new” mathematics teaching. Barbro’s expression “fall back” above can imply either falling back on the mathematics teaching that existed in schools before, or falling back as a degradation regarding the quality. Both implications can be related to the shared repertoire regarding good mathematics teaching in the community of reform mathematics teaching.

That the respondents talk about these limitations does not mean that they exist, however, the respondents graduate with this view of their future possibilities. The expressions of these limitations may be a part of the shared repertoire of the
community of reform mathematics teaching. Either or, the feeling of lacking knowledge and experience and the expectation of meeting external limitations are part of the current identity of the respondents at the time of graduation and they are also visible in their expressed strategies to reach designated identity.

One scenario is that there are no limitations and that, after graduation, the respondents can teach mathematics in line with their designated identity without problems. Another scenario is that their designated identity changes after graduation and the limitations expressed before graduation are no longer perceived as limitations. A third scenario is that the respondents find strategies to overcome the limitations. A fourth possibility is that the limitations are an expression of insecurity. By picturing external limitations that will prevent reforming and teaching in line with the left side of the dichotomy, the respondents do not have to challenge themselves but can, instead, teach mathematics in line with the, according to them, existing mathematics teaching in schools. As such, they would be able to teach in line with the right side of the dichotomy without losing their image of good mathematics teaching within their designated identity.

However, there is a difference in how the respondents talk about teaching in the near and distant future, a kind of near and distant designated identity. They talk differently about how they will teach mathematics directly after graduation and then later on.

*But I feel that when you start work as a completely new teacher a tremendous amount is new. It might be nice to have something to lean on like a text book can be.* (Gunilla)

*Especially as a new teacher, I, however, believe that you will hold on pretty hard to the text book and have it as support. Just to not miss [...] simply not missing important parts [...] (Camilla)*

Similarly, Helena says that she “will lean on” the text book when she starts teaching mathematics after graduation since “as a new teacher you can’t cope with reforming the world”. When she feels secure she will start trying new things. These expressions can be connected to the above mentioned expressed lack of experience as an internal limitation. They say that they will start to teach in line with the right side of the dichotomy and then, gradually, change direction to teach in line with its left side. The right side of the dichotomy, especially the text book and its well-known structure, seems to connote security for the respondent. The text book seems to offer security to the respondents regardless of what they say about it in relation to their examples of good and less good mathematics teaching. This security can mean a lot of different things. The mathematics teaching on the right of the dichotomy is the one the respondents have experienced themselves as students and because of that they have a lot of experience of it. Maybe the respondents do not want to be different to the other teachers in school but to fit in. Further, mathematics teaching in line with the left side of the dichotomy is expressed as difficult and time consuming. And, the text book seems to offer security regarding covering all the content and not “missing important parts”.

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4.6 The starting position of the respondents at the time of graduation

In the stories of the respondents before graduation, there is an ongoing negotiation regarding good and less good mathematics teaching which can be illustrated as a dichotomy. The dichotomy is an objectification, made by me, based on the respondents’ stories. Their negotiation regards the teacher, the teaching and the students in the mathematics lessons; the mathematics content is seldom focused on.

The dichotomy can be viewed as a shared repertoire in a community of practice based on mutual engagement, joint enterprise and this shared repertoire. Based on the respondents’ use of the word “reform”, this community of practice is named the community of reform mathematics teaching. The respondents have become members of it during their teacher education and are still members at the time of graduation, mainly by imagination and alignment. This membership is part of both their current and their designated identities. In their designated identities, they are to teach mathematics differently to the mathematics teaching that they themselves experienced in school and during practice periods. They say that they are to reform mathematics teaching. As such, they strive away from their own experiences.

However, being a reformer of mathematics teaching is not expressed as an easy job and, at the same time as the respondents strives away from their own schooling and the mathematics teaching in schools they express elements that will come to limit their possibilities of teaching mathematics in line with the left side of the dichotomy, that is, limitations to reaching designated identity. The limitations mentioned by the respondents can be divided into internal and external limitations. Internal limitations are connected to the respondents’ own ability while the external limitations apply in the schools. Internal limitations mentioned by the respondents are lack of knowledge and experience. External limitations mentioned by the respondents are traditions, lack of teaching jobs, other teachers, lesson patterns, lack of time, local goals, lack of material, lack of resources and text books. These internal and external limitations will limit the possibilities of the respondents to teach in line with the left side of the dichotomy.

Talking about these limitations does not mean that they exist; however, the respondents graduate with this view of their future possibilities. Their feeling of a lack of knowledge and experience and their expectation of meeting the expressed external limitations are part of their current identity at the time of graduation and also in their expressed strategies to be able to reach their designated identity.

However, there is a difference in how they talk about teaching in the near and the distant future, as a kind of near and distant designated identities as mathematics teachers. When they start to work as teachers they will teach more in line with the right side of the dichotomy and then, gradually, change direction towards the left side. The right side of the dichotomy, especially the text book and its well-known structure, seems to connote security to the respondent even though they want to change it.

The results presented in this section can be regarded as the starting position of the respondents at the time of graduation based on their reifying and significant stories about their patterns of participation regarding mathematics teaching, in the present and the future, interpreted with a background in contemporary multiple communities of practice. Based on this starting position, questions can be asked about the future:
• What will happen to the respondents' membership in the community of reform mathematics teaching? Several of the studies presented in the first chapter indicate that teacher education does not change the way teacher students and novice teachers teach mathematics. Before graduation, the respondents in this study express wanting to change mathematics teaching in schools. Will this have any impact on their professional identity development as primary school mathematics teachers after graduation?

• When the respondents graduate and start work as primary school teachers, they may become members in other communities of practice. If they do, how will such new memberships affect their membership in the community of reform mathematics teaching, and, how will the new composition of contemporary multiple communities of practice influence, and be influenced by, the patterns of participation of the respondents?

• Before graduation, the respondents participate in the community of reform mathematics teaching mainly by imagination and alignment. Will these modes of belonging change after graduation and, if they do, will it influence the patterns of participation of the respondents? Do different modes of belonging (engagement, imagination, alignment) have different influences on the respondents' patterns of participation and their professional identity development as primary school mathematics teachers?

• Before graduation some of the respondents call themselves “teacher” while others do not. The respondents want to become teachers but not the kind of mathematics teachers they have met during their own schooling and practice periods. Will there be any communities of practice where the respondents can identify and negotiate in the direction of their designated identity after graduation? Will there be possibilities for the respondents to strive towards and not away from and still reach their designated identity after graduation?

• And, what about the expressed internal and external limitations for mathematics teaching. What will happen with them when the respondents start to work after graduation? Do they exist and, if they do, how will they influence the mathematics teaching and the professional identity development of the respondents?
5. THE RESPONDENTS’ FIRST TWO YEARS AFTER GRADUATION

In this chapter, Helena’s, Nina’s, Barbro’s and Jenny’s first two years after graduation are focused on chronologically as a continuation of their stories before graduation as presented in chapter four. As mentioned before, their cases as chronological cases; when related to Ragin’s (1998) cross-tabulation of cases, are specific case conceptions as empirical units. However, the four cases also show four various routes into, and out of, the teaching profession. The case of Helena is a case of professional identity development as a primary school mathematics teacher. Writing mathematics in italics is a reminder that mathematics is my focus while the professional identity development of Helena is about much more than just mathematics teaching. The case of Nina is a case of searching for a professional primary school teacher identity, with focus on mathematics teaching. The case of Barbro is a case of conflict within professional identity development, with focus on mathematics teaching. Finally, the case of Jenny is a case of absent professional identity development as a primary school mathematics teacher. Just like the case of Helena, the focus on mathematics in the three last cases is my focus. As cases illustrating four various routes into, and out of, the teaching profession, the cases, when related to Ragin’s (1998) cross-tabulation of cases, are specific case conceptions as theoretical constructs.

The presentation of the cases is divided into sections based on empirical material and sections based on analysis. The empirical material in the four cases is the transcribed complete empiricism (Aspers, 2007) implying all of the material (observations, interviews and self-recordings) constitute a whole on which the analysis is based. The sections based on empirical material constitute the summarised freezing of the process of professional identity development made at different times based on each case. Every freezing consist of empirical material of different kind gathered at several occasions in the earlier described intermittent way. In the case of Helena, the process is frozen six times followed by analysis, in the cases of Nina and Barbro the process is frozen four times and, in the case of Jenny, three times.

The foundations in the empirical material are, in line with the operationalisation of identity, the respondents’ reifying and significant stories about their patterns of participation regarding mathematics education, in the present and the future. These are interpreted by me with a background in contemporary multiple communities of practice. The respondents’ stories about their patterns of participation regarding mathematics education is them recognising themselves as “a kind of primary school mathematics teacher”, while the analysis, based on the conceptual framework, is me recognising them as “a kind of primary school mathematics teacher”.

The focus in the analysis is on the process of professional identity development, the respondents becoming as primary school mathematics teachers; therefore, mainly long-term patterns of participation are focused on. However, some ‘touch-downs’ in situations are made to illustrate how these long-term patterns of participation impact the mathematics teaching, that is, immediate patterns of participation. According to the conceptual framework, identity development is an individual’s learning trajectory

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38 Parts of the case of Helena have been presented at the MAVI-Conference in Helsinki, 2012 (in press).
39 And, of course, long-term and/or immediate are just notions used to describe the same wholeness of an ongoing process and not two separate objects.
through different communities of practice. That learning trajectory can be interpreted as changes in long-term patterns of participation and such changes are also visible in immediate patterns of participation. The individual’s patterns of participation influence and are influenced by the communities of practice of which the individual is, wants to or does not want to be a member and from which she is excluded, as well as what kind of membership she develops. To make identity development visible, the notions of current identity and designated identity will be used in the analysis.

It is important to keep the double participation of the respondents (communities of practice - settings) in mind simultaneously (figure 11).

![Diagram showing double participation in communities of practice and settings](image)

**Figure 11:** An illustration of the double participation of the respondent. The respondents participate in communities of practice and immediate situations (settings from the perspective of the individual) simultaneously.

The patterns of participation in focus is patterns regarding becoming a primary school mathematics teacher; however, to avoid repeating *regarding becoming a primary school mathematics teacher*, just patterns of participation will most often be used in the text.
5.1 The case of Helena: A case of professional identity development as a primary school mathematics teacher

Helena, two months after graduation (spring semester)

As presented in the previous chapter Helena is 41 years old when she graduates from teacher education and she became a teacher because she “thought it was a lot of fun working in school”. Helena starts working at Aldro School directly after graduation. The school is located in a small conurbation with approximately 1 500 inhabitants. At the school, there are approximately 150 students in grades one to six. When the students start grade seven they go by bus to a lower secondary school in a nearby city. Helena is working as a long run substitute class teacher of grade six and she describes the class as bothersome. Before my first visit, she writes in an e-mail:

*There is a sign on the door with a sun (the only thing that shines in this class). In all seriousness, the class has many different problems. Their regular class teacher was put on the sick list this autumn and she was not the first. The class has not been functional since they started preschool class and every day without a fight is a victory!* 

Since the class is bothersome, several other teachers work in it with Helena. The working climate between them and Helena is positive. The same goes for the teachers’ staff room and the schoolyard. The teachers talk about organisational matters, e.g. who is going to supervise the schoolyard during breaks and who is going to fill in for sick colleagues. The teachers also talk about private matters but seldom about teaching.

Helena refers to herself as a “new teacher”. She says that she is pleased with her teacher education but that she lacks knowledge about the “right order” of the mathematics contents.

*Certainly, you can take a math book and see that it is divided into eight chapters making four chapters per half semester and then look at the weeks and run it like that.*

She says that she has acquired different tools from her teacher education for explaining mathematics to students. Her education has made her aware of how students can think differently and that it does not help to repeat the same explanation to a student who does not understand the first time.

During the math lessons, the class is split into two groups\(^{40}\). Helena works with a small group of students together with a remedial teacher. The small group consists of students who have not reached the national goals in mathematics for grade five\(^{41}\). The planning of the mathematics lessons is done by the remedial teacher and Helena does not know these plans in advance. According to Helena, the remedial teacher “rules

\(^{40}\) The split of the students were decided by the remedial teacher before Helena started.

\(^{41}\) In Sweden, during the time of this study, national tests in mathematics were taken in grades five and nine.
the teaching with a rod of iron. [...] There is no chance of me taking over that work. [...] laboratory material and such stuff, they have nothing." There is seldom any dialogue between Helena and the remedial teacher during the mathematics lessons. The children in the small group do not sit beside each other in the classroom since they not are to interfere with each other’s work. Helena walks around in the classroom and helps all of the children in the group, while the remedial teacher only helps half of them, the ones sitting on the right-hand side of the classroom. The reason for this is that the remedial teacher has decided that they are to split the students between them. However, Helena does not believe that this works, so she helps all of the students in the classroom, even those in the wrong half. During mathematics lessons, the students work with handouts copied from a grade five textbook. The goal of the mathematics teaching in the group is for the students to reach the goals set for grade five mathematics before the end of grade six.

Helena’s mathematics teaching two months after graduation do not include planning the mathematics lessons but participating during them and interacting with the students. Except on a few occasions, the remedial teacher plans the lessons, however, when Helena plans, she performs activities that she encountered during her teacher education. Helena does not like the mathematics lessons. “I feel it is a shame. You could do a lot of other stuff, fun stuff.” She tells about one good mathematics lesson she taught, without the remedial teacher. During that lesson, the students solved magic squares. “They liked it a lot.” Helena had acquired the material she used in that lesson during her teacher education. On another occasion, when I am visiting, Helena interrupts a lesson held by the remedial teacher. Ten minutes before break, she introduces a dice game focusing on multiplication. The students are playing in pairs and Helena has acquired also this game during her teacher education. The remedial teacher stays in the classroom but does not comment on the playing or help the students. Afterwards, Helena says that she believes it is really important that the students know their multiplication tables.

Otherwise, the talk between Helena and the students during the math lessons mostly regards encouragement, organisation and reprimands - “[a] lot of rigidity is needed to make it work” - but she also helps to solve tasks when the students raise their hands, for instance (fig. 12).

<table>
<thead>
<tr>
<th>Task:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mattias’s mom is having lunch in a restaurant with some of her friends. It costs 240 crowns in total. Everyone pays 40 crowns. How many people are having lunch?</td>
</tr>
</tbody>
</table>

**Figure 12:** Example of a task from the copied handouts (from a chapter in a text book focusing on division) used in the class.

*Helena* Can you read the task? *(The student reads the task)*

*Helena* It costs 240 crowns for them all to eat.
Student  Then it is minus
Helena  Wait a little. Everyone pays 40 crowns each.
Student  Yes
Helena  How many are eating? Everyone pays 40 crowns. You know the
sum they pay together. And you know what everyone pays. But
you don’t know how many there are. That is what we will find
out.
Student  How do you solve that?
Helena  How many stacks? Everyone pays 40 crowns.
Student  Then you can take 40 times…40.
Helena  Hold on a little. We will make stacks with 40 crowns in every
stack so that we each 240 crowns and then count the stacks.
Student  Yes
Helena  So, we are to divide 240 crowns into 40 crown stacks.
Student  Yes
Helena  What operation is it we going to use then?
Student  Divided by
Helena  Yes, divided by.
Student  So then it becomes 240 divided by 40.
Helena  Yes, OK.

This dialogue is characteristic of Helena’s dialogues with the students during the mathematics lessons. After the lesson, I ask her about this dialogue and she says that she guides the student but that she has no other choice since the tasks the remedial teacher has given the student are too hard. Afterwards, I e-mail her a transcript of the dialogue and again she gives a similar explanation:

This is a student who, more often than not, takes a chance on which operation
is to be used. Because of that, I let her read the task aloud to herself so that she’ll
be able to easier think of what it is that they are asking for. After she has read
the task, it still needs clarification since she is quick to take a chance on
subtraction. I have tried to get the students to think about what information
they get in a task and what’s being asked. But this student just “grasps”
something out of the air and hopes it will be right. If I had been the one to
decide from the beginning, I would never have let this student work with these
kinds of tasks as she hasn’t get enough basic knowledge to calculate in several
steps. I have to guide her forward to the question and even be as clear as to say
that we are to divide 240 into 40 crown stacks. After that, I still have to ask
what operation we should use.

Analysis, Helena two months after graduation (spring semester 2009)

The dialogue above between Helena and the student is a typical example of her
interactions with the students during mathematics lessons. When she helps the
student, she rejects the idea of subtraction, both in direct relation to the lesson and later when responding to the transcript. However, repeated subtraction would have been a possible way of solving the task and maybe that was the student’s thought which Helena did not let her continue with. From Helena’s perspective, the task is too difficult for the student and, therefore, she has to guide her through the strategy she thinks suitable for solving the task. The task was copied from a chapter named **Division**, which may be why Helena’s chooses that strategy. Another possibility is that she did not see the potential in the student’s suggestion. Guidance when helping students solve mathematics tasks has, no matter how, become a part of her mathematics teaching.

Two months after graduation, two communities of practice are visible in Helena’s patterns of participation regarding (mathematics) teaching. One is the earlier presented community of reform mathematics teaching and the other is a community of teachers working at Aldro School. However, the shared repertoire in the community of teachers at Aldro School does not regard mathematics or teaching but Helena’s membership in it influences how she recognises herself as a primary school teacher.

![Diagram](image-url)

**Figure 13**

The communities of practice visible in Helena’s patterns of participation regarding (mathematics) teaching two months after graduation. The shared repertoire in the community of teachers at Aldro School does not regard teaching mathematics why mathematics is between brackets in the picture. However, Helena’s membership in it influences how she recognises herself as a primary school teacher.

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42 Figures will not be used in every analysis but just when illustrating changes and examples of merger between communities of practice. The size of the circles is not to be related to the size of the communities of practice.
The mutual engagement in the community of teachers working at Aldro School is not mathematics teaching, or teaching of any other subject. Rather, the mutual engagement deals with how to organise the day-to-day work at the school. The negotiated joint enterprise and the shared repertoire concern the organisation, not the teaching, and there is no visible negotiation regarding teaching. Helena participates in this community through engagement and alignment and she reifies herself as “new”. Maybe she also participates through imagination, by calling herself “new”. Using “new” indicates that there are more central positions in the community of teachers at Aldro School. In relation to the community of teachers working at the school, she identifies herself as new.

Even though Helena is not in charge of the mathematics teaching, her membership in the community of reform mathematics teaching is visible. It is visible in her distancing herself from the remedial teacher’s teaching, e.g. regarding her giving the students tasks that are too hard. It is also visible in her focus on fun, e.g. when saying “I feel it is a shame. You could do a lot of other stuff, fun stuff.” she is talking in the community of reform mathematics teaching. Another visible sign is her introduction of games, games from her teacher education. As such, she participates by both engagement and imagination. Even though the remedial teacher plans the mathematics lessons, the community of reform mathematics teaching could be more visible in Helena’s patterns of participation than it is. The example above, when she rejects the idea of subtraction, could have been developed into a situation where different solutions to a problem and different ways of thinking were used to connect components (left side of the dichotomy) but, instead, it develops into a situation where one way of thinking is made visible (Helena’s) and components are dealt with separately (right side of the dichotomy).

No other communities of practice are visible in Helena’s patterns of participation regarding being a primary school mathematics teacher at Aldro School two months after graduation. One, which could have been realised, is a community of mathematics teaching with the remedial teacher. However, neither that teacher’s nor Helena’s patterns regarding mathematics teaching indicate that such a community will emerge. There is no mutual engagement, shared repertoire or joint enterprise regarding mathematics teaching between them and no negotiation indicating it will appear in the near future.

In her current identity, Helena reifies herself as a “new teacher” teaching mathematics in mathematics lessons she dislikes. However, she resists somewhat and tries to make changes in the direction of her designated identity, which is still in line with the community of reform mathematics teaching and the left side of the dichotomy.

Helena, six months after graduation (spring semester 2009)

Helena continues to work at the same school with the same class for the rest of the semester. The remedial teacher continues to plan most of the mathematics lessons, but Helena is now responsible for mathematics homework in which she focuses on the students training the multiplication table. The division of the students in the classroom that the remedial teacher had decided on, but which Helena did not follow, has gone. Now, the remedial teacher also helps all of the students in the group. The students also play more games at the end of the lessons, “We try to add
more games”. The games are mainly different dice games that Helena acquired during her teacher education. Helena marks the students’ work after every lesson and keeps a record of their work. She says she needs to do this to “have backing”. When talking, she still emphasises the importance of trying to understand how students think and basing explanations on their understanding, and on being able to explain in different ways. During the semester, Helena’s mathematics teaching becomes more focused on keeping the students quiet during lessons. The conversations Helena has with the students during the math lessons are still mostly about encouragement, organisation and reprimands. Also the guidance when helping students solve mathematics is still visible but not much of the kind of mathematics teaching she talked about before graduation. That may partly be explained by the fact that she is seldom the one who plans the mathematics lessons and partly by the acting out in the class. The students’ acting out makes Helena focus on order and quiet instead of variety, discussion and cooperation.

Helena lacks laboratory material “[e]ven though they need it.” Instead, she collects pencils stubs to divide into piles when teaching division. If she could change the lessons planned by the remedial teacher, she would use “money and stuff”. She would also add more multiplication tables training and problem solving with students working in pairs.

On one occasion, when Helena has planned a mathematics lesson, the students work with problem solving in groups of four. Helena uses a material that she got in teacher education. Helena starts the lesson by saying “today I thought that we would do something different in the mathematics lesson”. She tells the students that they are to be working in groups of four and splits the eight students into two groups. The start of the lesson and the organisation of the groups take about six minutes. The students are never totally quiet, not during the grouping and not either later when Helena explains what they are going to do.

_They have worked with math cards like this in the big math group. And it is like that, listen carefully now so that you know. The idea is you in the groups solving the tasks together. You get four cards, one each. (Helena stands quiet for a while since the students are talking aloud.) With help of the information on these cards you are to come up with an answer. (Again Helena stands quiet for a while since the students are talking aloud.) Many times when you are counting we say “think of, think of writing down what you know. On a paper. Or draw. And that is a very good trick to use also now. To think about what do I know and what do they ask for? Try to think like that and maybe draw sometimes if it is needed._

During the lesson, the two groups solve four problems. When Helena distributes the first set of cards she says that the students are to work together with all four clues. The remedial teacher is in the classroom but she is passive during the activity. One student leaves his group and starts to work with other math tasks on his own and is praised for this by the remedial teacher. After solving each problem, the students demonstrate their solutions on the board; they like writing on the board and they ask if they may do it again. When the students are about to start the third problem (figure 14), Helena says that it is a little trickier.
Task:
How many marbles are in the bag?

Clue 1: Two stone-marbles cost 4 crowns.
Clue 2: One shiny marble costs 5 crowns.
Clue 3: There are three kinds of marbles in the bag. Together, they cost 19 crowns.
Clue 4: One big glass-marble costs 3 crowns.

Figure 14: An example of a task used in the lesson.

Helena tells the students that the task has three possible solutions (assuming that you can buy one stone marble for two crowns) and the groups work for about twenty minutes before they demonstrate different solutions. Helena walks around and helps the groups, for example:

*Helena*  Now you are to think like this. The marbles cost different amounts of money. There are three different kinds of marbles in the bag and together they cost 19 crowns.

*Student*  Then they cost six and twenty.

*Helena*  Now you have to think like this also. Stone-marbles. Two stone-marbles cost four. One shiny costs five. One big glass-marble costs three. They cost different amount of money.

*Student*  Then it is just to take two of each.

*Helena*  Try with that and see where you end up.

Finally, together, the groups have found three solutions and Helena says that they have been thinking differently but that they all got it right. When evaluating the mathematics lessons, the example above and other lessons, Helena does not talk about the content, but, about the students’ behaviour. One day, when I ask Helena to tell me something positive about the mathematics lessons, she tells me about a student who showed initiative by working alone with his math books in a group room so as to find some quiet.

*The lessons are very different. Sometimes they are all quiet and work without commenting on each other. Today, some of the students were running and talking before calming down. Sometimes it is quiet from the beginning, sometimes it is not. Sometimes it never gets quiet.*

Analysis, Helena six months after graduation (spring semester 2009)

Helena’s patterns of participation during mathematics lessons can be understood in terms of memberships in two communities of practice (figure 15). One is the community of reform mathematics teaching and one is the grade six community at
Aldro School. (She is still a member in the community of teachers at Aston School but that does not seem to influence her mathematics teaching.)

![Diagram showing communities of practice]

**Figure 15**: The communities of practice visible in Helena’s patterns of participation regarding mathematics teaching six months after graduation.

The marble-task and her talk about “more games” are based on the shared repertoire in the community of reform mathematics teaching while the focus on quiet and silence is based on the shared repertoire in the grade six community at Aldro School. Helena met the marble-task in teacher education and one possible reason for her using it might be that she thinks of me as a member of the community of reform mathematics teaching and, therefore, wants to and/or feels encouraged to use them when I am visiting. However, when evaluating that lesson, she focuses on the behaviour of the students and not the mathematics content. Also the guidance when helping students solve mathematics tasks seems to be a part of the grade six community at Aldro School. Guidance is Helena’s strategy when helping the students and it is what the students’ expect from her.

Some would argue that a teacher and a class cannot be a community of practice. However, based on the interpretation of communities of practice in this thesis⁴⁴, it is

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⁴⁴ Similar interpretations are made by Wiliam, Bartholomew and Reyg (2004), Bohl and Van Zoonen (2003) and Van Zoonen and Bohl (2005). A class may be one community of practice of a part of a larger community of practice, for example, a community of mathematics where the teacher by his or her teaching offers the students membership. In this study, one such community is the community of reform mathematics teaching but, as seen, Helena’s membership in it does not imply that it is that community of practice that the students are offered membership in by the mathematics teaching. Bohl and Van Zoonen (2003) and Van Zoonen and Bohl (2005) emphasise the different roles the teacher plays in a community of practice with a class compared with, for example, a membership in a community of teachers. In the classroom, teachers are the “architects” (2005, p.320)
possible and a classroom is an example of a possible community of practice given by Wenger (1998). A community of practice is developed from a shared repertoire, joint enterprise and mutual engagement, but the roles within and the modes of belonging may vary. In the community of grade six at Aldro School, Helena, together with the other teachers in the class, has a core role. The shared repertoire is quiet, silence and behaviour. Helena is a member through engagement and imagination (imagining something she wants to achieve). Her engagement is visible in the classroom where her mathematics teaching is dominated by controlling the students acting out, and not by their learning. It is the teachers who have negotiated the shared repertoire and the joint enterprise in the community. Now, they are working hard to make the students members by alignment. They do this by promoting and rewarding the actions of the students who are in line with the shared repertoire of the community.

In Helena’s mathematics teaching, the community of grade six at Aldro School is more visible than the community of reform mathematics teaching. Her membership in the community of reform mathematics teaching is mostly imaginary (except for some engagement through activities in sporadic mathematics lessons) when talking about wanting to change the mathematics lessons, the importance of students understanding and the importance of teachers using different explanations. When Helena talks about “games” and “laboratory material” the words do not refer to any special games or laboratory material but instead the words seems to be reifications, in line with the dichotomy as the shared repertoire in the community of reform mathematics teaching. Games and laboratory material seems to have a value on their own as a way of working without connection to any specific mathematics content or learning goal. Helena’s engagement in the community of reform mathematics teaching is also through her talking with me about the mathematics teaching in the class.

Even though the two communities of practice are separated they become connected through Helena who is a member of both. The students are not members of the community of reform mathematics teaching but they have a central role in Helena’s imagined membership of how she would like to teach. However, to be able to make the students active members, it seems as if they must first become members of the community of grade six at Aldro School. To be able to cooperate, the students must first learn to work alone; and to be able to discuss mathematics; they must first learn to be quiet.

Even though the remedial teacher plans most of the mathematics teaching, which Helena dislikes, Helena has started to use “we”. This can be understood as the remedial teacher also being a member in the community of grade six at Aldro School. Gradually, Helena is taking over parts of the mathematics teaching. This can be understood as Helena introducing parts of the shared repertoire of the community of reform mathematics teaching. During this semester, Helena also starts talking about keeping a record of the students’ work to “have backing” but she does not mention

of the community that develops in the classroom. In the classroom, the teacher is responsible for the development of the regimes of accountability within which students function, rather than, as in other communities, an equal co-participant.
backing against what or whom. Keeping records of the students’ work becomes one part of her mathematics teaching.

In her current identity, Helena is a teacher and she is showing more initiative, which may be interpreted, as her moving towards a more central membership in the community of teachers at Aldro School. The initiative she shows in mathematics teaching is in line with the community of reform mathematics teaching within which she is a member by engagement and imagination. The mathematics teaching to the left of the dichotomy is the mathematics teaching Helena talks about in her designated identity, and her more central membership in the community of teachers at Aldro School and the students’ successive alignment in the community of grade six at Aldro School may make it possible for her to change the direction of the mathematics teaching towards her designated identity.

Helena, ten months after graduation (November, autumn semester 2009)

Helena is still working at Aldro School but now as a teacher assistant in the new grade six class. Many of the students in the class have problems reaching goals in several subjects including mathematics and there is a lot of talking and walking around in the classroom during the lessons. Helena is gradually taking over the teaching in the class and the class teacher is happy about this as he wants to leave his job. By mid autumn, Helena is responsible for mathematics teaching in the class. The headmaster has decided to make Helena the class teacher, starting after the winter break. Helena still calls herself “new” but says that no one at the school treats her like that any longer.

A new remedial teacher has started working in the school. Helena likes her and sometimes they talk about teaching. Occasionally, Helena also talks about teaching with Karin, the new grade five class teacher. Karin has been working at Aldro School longer than Helena but she has not taught at upper primary school before and she and Helena exchange experiences. “You talk a little with each other, give each other some tips. Borrow things from each other […]”. The things Helena lends out are often material that she acquired during her teacher education.

During the autumn, Helena also works with teachers from other schools in the municipality, creating common goals in science\textsuperscript{44}. Since most of the teachers in the group also teach mathematics, they often discuss mathematics teaching. Together, they have created schedules for the goals in subjects from grade one to grade nine. Helena says that these schedules will help her to know what to do and when to do it in her mathematics teaching. In the group, they have talked about the importance of all of the children in upper primary school being acquainted with the mathematics content of grade six. The teachers from lower secondary school (grades seven-nine) in the group complain that students who have not reached the goals of grade five have to spend the whole of grade six working to accomplish them and, as a consequence, miss the mathematics content of grade six. The teachers in the group have also talked about the importance of students knowing their multiplication tables. Helena says that it felt good hearing that, since the previous remedial teacher did not like Helena’s wish to work with multiplication tables last semester. Helena says that she

\textsuperscript{44} This is a work initiated by the municipality where all teachers in the municipality are divided into subjects groups.
now understands that they focused on the wrong things in the mathematics teaching last semester when they worked with the grade five goals.

Helena’s mathematics teaching is still focused on organisation in the classroom and keeping the students quiet during lessons but also on preparing the students for lower secondary school. The last part comprises showing the students how to find solutions to their problems by using the examples in the textbook and writing neatly with units, not their understanding of the mathematics content. Helena has bought new text books for “her class”. She says that she nagged herself money from the headmaster for the new text books since she thought that the old ones were too bad. The new text book is one that Helena is familiar with from teacher education since she then reviewed it as a part of an examination. The mathematics teaching is planned based on how the students are to complete the two new text books before the end of the school year. The chapters regulate what is going to happen and when it happens in lessons.

*The plan is for them to reach the diagnostic tests this week so we can get further and start with fractions before Christmas. My plan is to do another Diamond test with them this week to check them a little.*

She has explained to the students that they have not done enough mathematics in grade four and five and that is why they now have to work much more. In the mathematics lessons, the students work in their text books while Helena goes round helping those who raise their hands. Her conversations with the students focus mostly on strategies that will help them to find solutions to their problems by using the examples in the textbook. She says that the students need to learn such strategies before starting secondary school. Helena emphasises to the students the need to work “neatly” in their text books. All answers are to be written in units. Otherwise, she will mark them as wrong as “that’s how it works in secondary school.” After the mathematics lessons, she checks all of the students’ work since, as a new teacher, she wants to be in control. “[...] I ought to have control. Maybe it is because you are new and a little insecure and want to know you have control of what you are doing.” In addition to the text book, Helena has the students take diagnostic tests as she wants to know their prior knowledge.

*Yesterday [...] we had a little test in mathematics. I am testing them with tests from Diamond. And we have been working with sequences of numbers and simple shapes. And that result was really good which felt very good. [...] I believe it feels quite nice.*

When performing evaluations, Helena often equates the students’ results with understanding, e.g. “most of them have understood what it is about” or “test how much of it they understand now”.

*Yesterday [...] we had planned to split the class in two halves during the mathematics lesson. [...] After the lesson, I actually felt that most of them*  

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45 In the math book, every chapter starts with an introduction to the mathematical content in that chapter. The introduction is followed by a diagnostic test of that content. Based on their result in the diagnostic test, the students then continue working at different levels of difficulty.

46 The Diamond test is diagnostic test material provided by the National Agency for Education in Sweden.
understood. They worked and when I looked through their papers it felt good because most of them have understood what it is about.

Analysis, Helena ten months after graduation (November, autumn semester 2009)

Now, almost one year after graduation, four communities of practice are visible in Helena’s patterns of participation regarding mathematics teaching (figure 16): the community of reform mathematics teaching, the community of teachers at Aldro School, a community of teachers working with common goals in science and a community of practice with the students in the class. The first two are the same communities of practice that were visible earlier.

![Diagram showing communities of practice](image)

**Figure 16:** The communities of practice visible in Helena’s patterns of participation regarding mathematics teaching six months after graduation. Parts of the shared repertoires in the community of practice with the students in the class and the community of science overlap.

When Helena, the new remedial teacher and the grade five teacher talk about teaching, they may be regarded as members of the community of teachers at the Aldro School who are starting to develop a mutual engagement regarding teaching. To some extent, this mutual engagement also regards teaching mathematics. The interchange of ideas and experiences indicates the beginning of a shared repertoire that is negotiated between the three. That negotiation may lead to a joint enterprise.

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47 This community of practice will in the continuation be given the shortened name *community of science.*
This is the first time Helena mentions talking about and cooperating in teaching since finishing teacher education. As the one with experience of teaching at upper primary school level, she may have a central role in this cooperation, and there are overlaps regarding the shared repertoire in this community and the community of reform mathematics teaching. This can for example be seen in the choice of material that Helena gives to Karin. One interpretation is that a new community of practice, with overlaps, is emerging, with mathematics teaching as part of the mutual engagement, comprising the three members mentioned above. Another interpretation is that the community of reform mathematics teaching is getting new members. However, the community of reform mathematics teaching is seldom visible in Helena’s mathematics lessons. One thing visible is her wanting to know the students’ prior knowledge by using diagnostic tests. Otherwise, her mathematics teaching is more in line with the teaching she described as less good before graduating and she no longer talks as often as she did earlier about wanting to change this teaching. Nor does she plan her mathematics teaching based on the diagnostic tests but based on when to finish the next chapter in the text book.

One new community of practice is the community of science. This community seems to be important to Helena. She was chosen for the group by her headmaster, which may influence her feeling of being selected based on her education. This negotiation of this community has led to a joint enterprise and mutual engagement regarding how mathematics and science teaching is best performed. The shared repertoire involves the importance of all students becoming acquainted with all parts of the text book. The membership in this community has changed Helena’s way of talking about last semester’s mathematics teaching. She is still critical, but the earlier criticism was based on her membership in the community of reform mathematics teaching. Then she said that the mathematics teaching was not fun and that some tasks were too hard. Now, her criticism is based on her new membership in the community of science and is directed at the focus on the goals of grade five. The students should become acquainted with all parts of the grade six text book to enable them to recognise the content later in grade seven. Helena is getting positive feedback from the other members for wanting the students to master multiplication. The schedules made in the groups are reifications of their negotiation and they have also helped Helena to get a grip on “the right order of the contents” in the subject, something she missed in her teacher education. The community of science has thus fulfilled some of Helena’s needs regarding mathematics teaching. This is a community of practice that Helena has been participating in through its advent and development. However, she does not seem to be a core member in the negotiation of its shared repertoire since it is different from how she has talked about mathematics before (except from the multiplication table) and she also expresses that she “now understands” when she changes her evaluation of the mathematics teaching last semester. Helena is adapting her mathematics teaching towards its shared repertoire. Her membership in the community of science seems to be in forms of engagement, imagination and alignment.

Helena’s purchase and use of the new text book is a merge of the shared repertoires in the community of reform mathematics teaching and the community of science. The book was selected based on the shared repertoire of the first while the use of the text book in the classroom is based on the second. Similarly, her emphasis on the students working “neatly” in their text books and that they write their answers in units are part of that community.
The fourth community of practice visible in Helena’s patterns of participation is a community comprising her and the students in the class. Their shared repertoire includes study skills and finishing two text books before the end of the school year. This shared repertoire seems to be a transfer from the community of science and it is established by Helena and now it is not negotiable. Helena is a core member in the community through her commitment to something she believes in and imagining something she wants to achieve. Through her commitment, she wants the students to align with the shared repertoire in the community.

In her current identity, Helena is a “new teacher” Even though she is still formally employed as a teacher assistant; her patterns of participation make her recognise herself as “a kind of primary school teacher”. Her patterns of participation give her feedback in that direction, both from herself and from others. However, she expresses some insecurity, saying that because she is “new and a little insecure” she wants to have control of what she is doing. She gets this control by using diagnostic tests. Her expression “[a]nd that result was really good which felt very good. […] I believe it feels quite nice” can be seen as confirmation of her teaching being good. In her designated identity, Helena is the formal class teacher, and her successive takeover of the teaching is in this direction. The shared repertoire in the community of reform mathematics teaching is not as visible in her designated identity as before.

Helena, fourteen months after graduation (March, spring semester 2010)

After winter break, Helena formally becomes the class teacher. The previous class teacher has left but because there are many problems in the class, there are almost always two teachers in the classroom, which means Helena works with three other teachers. Helena teaches more hours than she is supposed to and seldom has time to plan with the other three teachers before lessons. Instead, they talk during lessons. She corrects the students’ work at home in the evenings and at weekends. She “tries to avoid working on Friday evenings […] but works for a while on Saturday or Sunday”. She says that maybe it is because she is new that the planning takes so long and she misses being able to reflect on her own teaching. Helena says that the workload is perhaps extra demanding in upper primary school. That is something she and the other teachers in upper primary school at Aldro School have talked about. Besides working with the other three teachers in the class which, as previously mentioned, mainly takes place during lesson time, Helena also continues to talk about teaching with the remedial teacher and Karin. “You give each other tips […] borrow stuff from each other”. Helena likes her job even though she would like to “shape a class from the beginning”.

Helena is still in the group of teachers working with common goals in science. She often mentions, as in the previous semester, that the teachers in grade seven have said that the biggest problem is students starting grade seven who have only finished the grade five text book.

*And then I thought, well, you’ve got to think like that. The most important thing is making the students see all of the parts you work with. If they have missed the goals of year five, well, you have to try to work with that but you cannot skip the contents of year six. […] And then I thought, help, that’s exactly what we did last semester.*
An ordinary mathematics lesson starts with Helena demonstrating something on the board and then the students work in their text books. When the students work in their text books Helena helps individual students to solve tasks and she often asks them to find solutions to their problems by using the examples in the text book. Also guidance when helping students solve mathematics is still visible. A good lesson, according to Helena, is when she can reconnect to something the class has done before. The students also work with multiplication tables for a while during every lesson. Helena emphasises the importance of the students writing units in their solutions and she still marks the text books after every lesson. It is quiet during the mathematics lessons and Helena whispers when talking to the students. Most of her conversations with the students regard their study skills but also solutions to tasks. Helena often asks the students if they have read the task and if they have looked at the examples in the text books. Those examples form a central part in the mathematics lessons.

When you calculate an area, what did you do then? Well, you took the base times the height. The base is six. The height is nine. And then you divide it in two.

On one occasion, Helena shows me an example from the text book saying “it is as obvious as it can be”. On another occasion, the class works with tangrams because Helena wants to show them that mathematics is not just the text book. Afterwards, she tells another teacher about it in the coffee room saying that it could have been chaos but that it was not. Otherwise, Helena says that “it is possible to do more fun stuff with younger children”.

To keep up with the plan of finishing two math books before the end of the school year, the class has mathematics lessons every day.

A basic course is around ten pages and then a red or blue course is about six pages. After every second chapter, there is a test. Preferably two to two and a half weeks for every chapter. It is about that. Sadly, I feel we will have to cut the problem-solving part. In the text books. I would like to work more with discussions but we will not have time for that.

The goal is to acquaint all of the students with all parts in the text books before the end of the school year. Helena says that she is really stressed and that she would “like to do this at a much slower pace” with more practical work and tasks where the students can demonstrate their solutions on the board and discuss them together.

Not all students manage to complete all tasks in time. [...] But we start on a new chapter anyhow and you simply have to skip what is left. And then we move on. [...] And you try to remind them that now there is only one more lesson. Now you have to focus during this lesson also. You need this time and we are here for you.

The plan to finish two text books before the end of the school year is visible, for instance, when Helena is planning the upcoming work with statistics.
It is not such a gigantic area, statistics. [...] They [the chapters in the text book] are usually about ten pages [...] but there are quite a lot of pictures, fairly large pictures so there are not so many tasks. [...] This chapter is not really that big.

The day before the introduction to statistics, Helena asks the students to cut statistics out of magazines when they are finished with another task. However, none of the students finish and, therefore, Helena cuts examples of statistics from a newspaper during the break before the lesson. At the start of the lesson, Helena asks the students where statistics are to be found in a newspaper. None of the students raise their hand. Helena asks them again, encouraging them to “think” about what statistics are needed for and why you “need to know.” One student says “the weather pages” and Helena answers approvingly that statistics are good if, for example, you want to know the amount of snow. Then she puts up the cuttings she arranged during the break, one at a time. The first shows a line chart of changes in energy prices and Helena says that it is important information for everyone who owns a house. Then a discussion about energy prices and saving electricity starts and continues for about five minutes. The next cutting shows a bar chart of the number of people who are sick during different months of the year. The third cutting is another line chart but this time regarding mortgage interest rates and, since the students do not know what that is, a new, quite long, discussion follows. Then the last two cuttings are put up, one is a bar chart of crimes and the other is a sports chart. After the last cutting, Helena says that “[t]his with statistics is not just something that exists in your text book but all around us. Also on the TV news.” Then she says that the students have a little time to work in their text books.

Now, start at page 96, remember to read the examples very carefully. What do they say? Give yourself time to understand.

The students start to work in their text books but after five minutes Helena interrupts them by saying that, unfortunately, they have to finish as the lesson is at an end. In an interview after the lesson, she says that it was a pity that the students did not have time to “get started working.”

After every second chapter in the text book, there is a test; and Helena keeps records of the students’ results. Helena is happy because all of the students have said that math has become more fun since she started. Helena often talks, both with me and her students, about the curriculum and the importance of students reaching their goals. However, there are few signs of her using the results from the different evaluations when planning and performing her mathematics teaching. Instead, the text book and the Diamond diagnostic test together frame her mathematics teaching. When students are not learning, Helena emphasises different possible reasons for that. E.g. one time, when three students failed the above mentioned test in the text book, Helena explains that two of them have mathematics action programs and that the third was about to get one and that “he should have already had one in grade four”.

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Analysis, Helena fourteen months after graduation (March spring semester 2010)

In Helena’s patterns of participation, the same four communities of practices are visible as the previous semester but changes have occurred regarding her memberships in them. As a consequence of these changes, her patterns of participation regarding teaching mathematics also changes.

Most of Helena’s mathematics teaching is in line with the shared repertoire in the community of science. The central part is making the students acquainted with all parts of the text book and not the learning of those parts. The mathematics lessons are based on the number of pages in the text book. Helena’s talk about understanding has changed; she still emphasises understanding but now as a result of the students’ study skills, not as a result of her teaching. In the community of reform mathematics teaching, students’ understanding is the responsibility of the teacher. If a student does not understand, it is up to the teacher to explain in a new way. Now, Helena tells the students to give themselves time to understand by reading the examples in the text book. Telling them that is part of the shared repertoire in the community of science.

The shared repertoire in the community of [mathematics in] the class partially overlaps with the shared repertoire of the community of science. All students are to become acquainted with all of the contents of the text book. The aim of mathematics teaching in grade six seems to be to prepare the students for grade seven, however, not regarding knowledge, but regarding study skills, e.g. writing in units and reading the examples in the text book. Helena is engaged in getting the students to align with this shared repertoire. She does this in her talk, in notes on the blackboard and through homework. Almost all of her meetings with the students focus on this. These two are the communities in which she participates the most when teaching mathematics.

The community of reform mathematics teaching is less noticeable. Helena says that she would like to do “this” but at a slower pace with more practical work and tasks where the students can demonstrate their solutions on the board and discuss them together. Sometimes, she introduces activities in line with the left side of the dichotomy but most often her teaching is in line with the right side.

The introduction of statistics is not an ordinary lesson (which is a lesson where Helena first demonstrates something on the board and then the students work in their text books) but it is containing elements from both the community of reform mathematics teaching, the community of science and the community of [mathematics in] the class (figure 17). The overall view of the area is based on the amount of pages about statistics in the text book. The text book is central in the community of science. The cuttings from the newspaper are a way of making the teaching reality-related and Helena also says to the students that statistics do not only exist in their text book. Both these expressions are in line with the shared repertoire in the community of reform mathematics teaching. It is questionable if energy prices and mortgage interest rates really are the reality of twelve year olds but the cuttings engage them in long discussions. Similarly, mathematics discussions are part of the shared repertoire in the community of reform mathematics teaching. However, the discussions during the statistics lesson are not really about the mathematics content and it is dubious if statistics are made visible in the introduction. For example, the different kinds of graphs are not discussed, nor are their role in the cuttings. After all the cuttings have been put up and the students start to work in their text books Helena tells them to
read the examples carefully and, according to Helena’s saying after the lesson, it is not until the students start work in their text books they start to “work”.

As such, the lesson in statistics is an example of Helena’s merged patterns of participation regarding mathematics teaching where the community of reform mathematics teaching (reality-related, discussions), the community of science (the basis in and the focus on “work” in the text book) and the community of [mathematics in] the class (students reading the examples carefully, finishing the text book) are visible.

![Diagram](image)

**Figure 17:** The imprints from different communities of practice in the introduction of statistics.

The fourth community of practice visible in Helena’s patterns of participation, the community of teachers at Aldro School, does not seem to influence Helena’s mathematics teaching. She is still a member of it which makes her reify herself as a teacher and she sometimes talks about teaching with the new remedial teacher and the grade five teacher. However, they seldom talk about mathematics teaching.

In Helena’s current identity she is still a primary school teacher, now also formally. Her talk about being new is a reification in identifying herself as a new teacher. Her talk about being new may be related to the stress she feels regarding planning her teaching and correcting the students’ work. She still expresses the need for control and the need of confirmation of students learning. In her designated identity, Helena is a primary school teacher teaching mathematics similarly to now but at a slower pace with more practical work and tasks where the students can demonstrate their solutions on the board and discuss them together. She also wants to have the opportunity to “shape a class from the beginning”.

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Helena, one and a half year after graduation (the end of spring semester 2010)

Helena continues to work as a class teacher in the present class throughout the spring semester with the same mathematics teaching layout implying the students working in their text books at “two hundred kilometres per hour”.

This because I think that you can’t start the seventh grade without having tried to calculate percentages. […] we have to get through this […] the vast majority will get enough knowledge. […] there are those who won’t have a clue of what we have been doing in sixth grade.

Helena’s goal for mathematics teaching one and a half years after graduation is for the students to finish the text book before the end of the semester and her mathematics teaching is dominated by this. During the mathematics lessons, as before, she often guides, and she often asks the students to find the solutions to their problems by using the examples in the text book. Her strategy seems to be the same regardless of the individual student’s problem with a task. She wants them to use the strategies shown in the examples in the book. On one occasion, a student uses another strategy than the one shown in the text book and Helena says that it is very likely that it will be wrong. After a while, she returns to the student.

Task:
How long is it from 10.20 am to 2.50 pm?

Figure 18: A task in the students’ text book.

| Helena | Now, what did you think there? From ten twenty to eleven. How many minutes is that? |
| Student | Forty |
| Helena | Yes. And from eleven to two? |
| Student | Three |
| Helena | How many more minutes? |
| Student | Fifty |
| Helena | Yes, then we have ninety minutes. How many whole hours can we get out of ninety? |
| Student | One |
| Helena | Yes. Four (Helena writes down the answer in the text book) It was a bad strategy you chose, wasn’t it? Do as we have said and it will be correct. |

Helena says that it is “frustrating” not having time to help all of the students who need help. She misses having “a remedial teacher with more experience” in the class. She has problems finding time to prepare her teaching and she feels limited by the
lack of material in the school and sometimes also by the students. Otherwise, she is free to teach “as I want to”.

Helena has had a lot of positive feedback from parents during the personal development dialogues. which “feels positive” and “[a]ll of the students think that mathematics has become more fun”. She does not know anything yet about her working situation after the summer break but she feels like “one of the gang” and says that almost everyone wants her to stay on at the school next semester.

_ I know that the headmaster is also fighting to keep me somehow. That feels good. It feels like you belong in that way. Definitely. In the beginning, you felt like a new teacher. But that, no, I don’t think I feel like that. I can feel that, yes, people come and ask me things. Yes. And I ask people things._

There are several other long run substitute teachers working at the school and they talk with each other about different possibilities regarding the future. Helena wonders if it is “easier in lower secondary school” with more motivated and self-driven students. She says that there is a science and mathematics teaching job available at a lower secondary school in the municipality that she maybe will apply for. At Aldro School, grade one will need a new teacher next semester but Helena does not feel competent to work in grade one. She says that being forced to work as a short run substitute teacher would be “a step backwards” as much of the work she does today, for instance, planning and following-up, would disappear.

**Analysis, Helena one and a half year after graduation (end of spring semester)**

In Helena’s patterns of participation, the same four communities of practices are visible as earlier the same semester: the community of science, the community of [mathematics in] the class, the community of reform mathematics teaching and the community of teachers at Aldro School. If we only look at Helena at the time of graduation and now, one and a half years later, it is hard to explain her mathematics teaching. But if following the process of the mutual influence between her merged patterns of participation and her memberships in different communities of practice, her development appears consistent. Two such developments can be seen regarding good mathematics teaching and understanding.

At the time of graduation, Helena describes good mathematics teaching as varied, laboratory-based, reality-related and problem-orientated. One and a half years later, a good mathematics lesson has become a calm, quiet lesson where the students work in their text books. At the time of graduation, Helena says that students’ understanding is her responsibility as a teacher. If students do not understand, it is her duty to explain in a different way. One and a half years later, she tells the students to carefully read the examples in the text book and give themselves time to understand. Now that the student is responsible, the focus is more on how the students will find help to solve tasks. Looking at Helena during this period of time through the conceptual framework, you can see how Helena’s talk about mathematics teaching before graduation was strongly influenced by the shared repertoire in the community of reform mathematics teaching. The changes that have occurred in Helena’s mathematics teaching regarding students’ understanding and good mathematics
teaching can be understood in relation to the changes in her memberships in communities of practice where her membership in the community of reform mathematics teaching has become peripheral mainly in the mode of imagination, while the membership in the community of science has become central to Helena through her membership by engagement, imagination and alignment.

In the shared repertoire of the community of science, understanding and learning do not seem to be the main focus, rather, writing units, reading examples and becoming acquainted with all parts of the text book seem to be the most important. Even if Helena tries to engage in the community of reform mathematics teaching (for example by her use of games), she gets no positive feedback for doing this. In the community of science, Helena has the opportunity to engage and she receives positive feedback for acquainting all of the students with all of the parts in the text book, which may be the first time she receives positive feedback for her mathematics teaching from other teachers after teacher education. She has also got positive feedback from students and parents and that feedback is based on her mathematics teaching which is in line with the shared repertoire in the community of science.

Control is not something Helena talks about at the time of graduation but when starting to work she experiences that she does not know when to do what in her mathematics teaching. When to do what is not part of the shared repertoire in the community of reform mathematics teaching, Helena requests control over when to do what and what the students have worked with. She expresses needing “backing”. The shared repertoire in the community of science provides this. In that community, schedules of what and when to work with different parts in mathematics are drawn up. As such, the community offers Helena both physical membership with positive feedback and fills a gap in her mathematics teaching. Related to this need of control is also her requested confirmation of students’ learning that Helena gets from different assessments she has the students to carry out. As such, the assessments are used both as control and as confirmation of her own teaching.

According to Wenger (1998), identity formation is a dual process in which one half is the identification in communities of practice and the other half is negotiation of the meaning (negotiation about the mutual engagement, joint enterprise and shared repertoire) in those communities of practice. Identification can be achieved through engagement, imagination and/or alignment. Negotiation requires some kind of interaction. According to Wenger (1998) identification without negotiation is powerless, vulnerable, narrow and marginal. This may be one explanation for why Helena’s merged patterns of participation are more visibly affected by the communities where she is a member through engagement including interaction. Those memberships offer both identification and negotiation. One and a half years after graduation, Helena is a member of the community of reform mathematics teaching only by imagination, an imagination that is becoming weaker and weaker. This weakening can be explained by the absence of half of the dualistic process of identity.

The different kinds of membership can also be connected to Gee’s (2000-2001) being recognised as a kind of person. Being recognised also means getting feedback. Being recognised as a mathematics teacher by others will make them treat you as one and your recognition of yourself as a mathematics teacher will increase from that feedback. In Helena’s case, she is getting positive feedback from the members in the community of science when she teaches according to its shared repertoire and she also gets positive feedback from the students and their parents. Feedback from others is difficult to get in a community of practice where you are a member through
imagination, as feedback requires interaction, though not necessarily physical interaction. Helena does not get any explicit positive feedback when teaching mathematics in line with the shared repertoire of the community of reform mathematics teaching. When you are a member through imagination, others in the community of practice may not know about your membership but in communities where you are a member through engagement or alignment, other members are aware of your membership. Either you are engaged with them or they are the ones making you align. Whichever is the case, their awareness of your membership makes feedback from others possible and that feedback you get from others affects how you recognise yourself as a kind of person.

In her current identity, Helena is a teacher (not new any longer) and her membership in the community of teachers at Aldro School is strong. She has had a lot of positive feedback regarding her mathematics teaching, from assessments, students and parents. Likewise, in her designated identity, Helena is a (primary school) teacher, willingly at Aldro School but, otherwise, in lower secondary school. She doesn’t talk about wanting to change anything in particular in her mathematics teaching but she does not want to work as a short run substitute teacher because then she would not be able to plan or follow-up on her own teaching which would be a step backwards in relation to her current identity.

Helena, two years after graduation (autumn semester 2010)

Just before the summer break, Helena receives and accepts an offer to become class teacher in the new grade four class at Aldro School. It was not an obvious choice as she was also offered the job she talked about in lower secondary school. However, by continuing to work at Aldro School, she will get a permanent contract with the municipality. She says that sometimes “the head must rule the heart”. However, she is thinking of complementing her competence in mathematics to become qualified to teach in lower secondary school and she will “try to find out what’s possible to do through distance learning to become qualified to teach lower secondary school”.

Her new class four is a class with “some worried souls” and she asks me to wait a few weeks before visiting them. Instead, we decide that I will visit her after school one Friday afternoon three weeks into the semester. She is working in the same classroom as the semester before and when I arrive she is in the classroom together with Gun, who I know is the preparatory class teacher. Helena says that Gun has started to work as an assistant in her class and calls her a “lifeline”. Yet another assistant has started in the class the same week. Helena is telling Gun the plans for the next week and before they finish the headmaster comes into the classroom and the three talk together about the situation in the class. Helena says that she does not know how to manage planning a teaching that will work with the assistants and that she has already worked twenty hours overtime during the first three weeks of the semester.

When Gun and the headmaster leave I ask Helena to tell me about her work in the class. Then she starts to laugh and cry at the same time saying that she “probably will begin to cry a little [...] I have done that a lot these weeks because it has been too bloody”. She says that she was alone in the class at first but that “failed totally” after four days. The students displayed “berserk rage” and it was decided that Helena was
not to be alone in the class. However, it is not just the students acting out that worries Helena but also their lack of knowledge.

[…] there are twenty-three students. Fifteen of them have not reached the goals of mathematics in grade three and seven of them haven’t reached the goals in Swedish for grade three. […] And that is not strange. Because it has been tumultuous.

Before she met the students, Helena “felt wow, this will be a challenge” but now she regrets not choosing the job at lower secondary school.

[…] if one starts the next follows and that is it. Then they run the gauntlet around here. And it is impossible to catch someone almost bigger than you, to hold him and put him down on a chair. And someone bites you in the arm instead and kicks at you. […] School it is, no.

There are more teachers than Helena having problems with their classes at Aldro School and Helena says that “it feels a little despondent” with “too heavy a workload on everybody”. She is “a little pissed off” since she did not receive better conditions from the beginning. “They knew that it would go to hell”.

Before the semester started, Helena collected mathematics material on a special “mathematics shelf” in the classroom but since the students started she has not done anything more with it. She planned to have “a folder with math games” and laboratory material on the shelf and she is still planning to finish it. She says that it will be a challenge to teach mathematics as she wants to because of having these students who are not “self-motivated” in any way. By giving the students practical homework, Helena has tried to introduce “thoughts of mathematics not just being in text books but that mathematics is everywhere around us and that we need it a lot”.

For instance, for homework, the students have asked their parents when they use mathematics at home and at work and they have played dice-games. Helena’s plan is that the mathematics teaching will contain something practical every week.

Because many of the students have not reached the goals of grade three in mathematics Helena has started to test them with diagnostic tests from Diamond. Besides that, they are using the text book from the same serial that the text book Helena bought the year before. She says that, in spite of everything, mathematics is the subject “that works best in this group” and she thinks that is because she experiences mathematics as “great fun” and “after all, mathematics has the best structure”.

However, the situation in the class does not get better and I am never able to visit her during school time; instead, we meet in the afternoons. Helena has got help from specially trained teachers working in the municipality but still nothing gets better. At the end of November, Helena gets put on the sick-list half time and in December she resigns.

[…] I think it is really fun being a teacher and I think it is really fun to teach. But then it must be conditions that make it work. […] And we feel that we lack the competence. We lack support from those who have the competence.
Helena does not know what she will do after the winter break but she says that the job she applied for at the lower secondary school is still available. She says that she can also work as a short run substitute teacher.

*I don’t care if I’m a short run substitute teacher. It doesn’t matter. [...] Anything is better than what I’m going through right now.*

**Analysis, Helena two years after graduation (autumn semester 2010)**

The fourth semester as a teacher Helena gets the opportunity to “shape a class from the beginning” expressed as a wish previously in her designated identity. But it doesn’t turn out that way and instead she cannot teach as she wants because of the students acting out. Helena doesn’t think that the job she is doing is in line with being a teacher and she does not feel competent to work in the class. The negative feedback she receives from the students acting out affects how she recognises herself as a kind of primary school teacher.

Two communities of practice are visible in Helena’s patterns of participation this semester: the community of teachers at Aldro School and the community of reform mathematics teaching. These are the same two communities of practice that were visible two months after graduation but the shared repertoire in the community of teachers working at the Aldro School seems to have been re-negotiated. In that community the mood is dejected and Helena uses “we” when she says that “we” lack the competence to work with the class and she talks about other teachers also having problems with their classes. A new central part of the shared repertoire in the community of teachers at Aldro School seems to be handling the problematic situations in the classes, and a mood of dejection.

The mathematics teaching Helena talks about this semester is more in line with her designated identity at the time of graduation than the semester before. The “mathematics shelf” is a physical reification of the community of reform mathematics teaching and other reifications that were used frequently after graduation are now used again, for example practical tasks and dice-games. Also her emphasis on goals and expressing the students’ lack of knowledge as “a challenge” is in line with community of reform mathematics teaching, where students learning are a responsibility of the teacher. However, to be able to perform this mathematics teaching, other criteria must first be fulfilled, for instance, the students being “self-motivated”.

In previous semesters, Helena, on her own or together with other teachers, has developed a community of practice with the students in the class with a shared repertoire regarding how to behave and work. She then tried to make the students become members of this community of practice by alignment. This semester “we”, however, do not succeed in developing a community of practice like this, not even with the external help. This is because “competence” is lacking.

That the community of science is not visible this semester does not infer that Helena is no longer a member. One possibility is that she is as engaged as the previous semester and thinks that all students should be acquainted with all parts of the text book but now the pressure of time is not the the same and therefore she doesn’t talk about finishing the books in the same way. It is also possible that the shared repertoire in that community is more important when the students are closer
to starting lower secondary school. Another possibility is that because she does not meet the other members in the community of science this semester (they have finished their common work) she has lost the possibility to engage and to get feedback and thereby her membership is weaker or absent.

Helena’s current identity regarding teaching mathematics is in some parts in line with her earlier designated identity but her current identity is not in line with her image of a primary school teacher. Even though she talks about mathematics teaching similarly to how she talked about it at the time of graduation, she does not feel that the work she does is in line with being a primary school teacher. Both her current identity and her designated identity of what it is to be a primary school teacher causes her to resign. Her designated identity, as before, contains the idea of teaching mathematics to older students but she is also willing to accept work as a short run substitute teacher.

A summary of the case of Helena: A case of professional identity development as a primary school mathematics teacher

This was a chronological presentation of the professional identity development of Helena the first two years after her graduation. Even if it ends negatively, it is a case of professional identity development as a primary school mathematics teacher. (Again, the italics is to remind that mathematics is my focus and that Helena’s professional identity development regards a lot more than teaching mathematics.) During the first three semesters, Helena develops a professional identity as a primary school mathematics teacher and she develops memberships in several communities of practice and receives feedback, from herself and others, in line with being a primary school mathematics teacher. This professional teacher identity is what she then compares to the work she does the fourth semester, which causes her to resign.

By looking at the mutual influence between patterns of participation and communities of practice, Helena’s professional identity development during the two years after graduation appears consistent. None of the communities of practice has mathematics content as a visible part of its shared repertoire. The community of reform mathematics teaching is focused on how and why, not what and why. Neither the communities of science, classes or teachers seems to have mathematics content as part of their shared repertoires. In the community of science one part of the shared repertoire is the students’ getting acquainted with mathematics content but which content is decided by the textbook. As such, Helena during these two years is the mathematics teacher in different classes without participating in any community of practice with mathematics content as the (or as part of the) shared repertoire.
5.2 The case of Nina: A case of searching for a professional primary school teacher identity

Nina, the semester after graduation (autumn semester 2009)

As presented in the previous chapter Nina is 24 years old when she graduates from teacher education and she became a teacher because she “wanted to work with people, above all children and young people”. After an extra semester at university, Nina moves back to her hometown to work as a teacher assistant at Aston School for John, a boy in grade one, who has attention deficit hyperactivity disorder. The school is quite large with three classes in every grade from preschool class up to grade six. She starts to work part time, 75%, and she spends all day with John, during school time and after school at the community youth centre48. When Nina got the job, it was decided that she was to have responsibility for reading and writing in the class. However, that did not happen because she was not given any time for planning. At first, Nina says that it is nice not to have any responsibility for teaching but quite soon she says that she would like to “paddle her own canoe and have her own class”.

That is the only thing I see as a challenge now and, hopefully, sometime in the future, I will find a job where I can be a class teacher.

Nina likes Aston School but her work as a teacher assistant (spending all day with John) prevents her from joining the fellowship of the other teachers. She is disappointed that the headmaster has not spoken to her since she started at the school. She says that the class teacher in John’s class, Diana, is as a “tutor” for her.

It feels quite nice to have started as a teacher. Even though I have no responsibility for a class, John and I work a lot in the classroom. So, I’m as much a teacher for the students as Diana is. And I help with all the correcting and I walk around in the classroom and help them and you really feel that you are ready to do this. And that you are prepared. So I like the job a lot. The only thing is that I don’t have time for planning and therefore I never attend any meetings with the other teachers, conferences about students or anything. Because of that, I don’t really belong to any staff group.

Nina says that she would like to have some time for planning and that she feels alone sometimes, “I am outside”. Since she never attends meetings and gets all information through Diana, she lacks the possibility to influence.

That [the possibility to influence] is something I feel I miss. Partly I would like to have some time for planning and to take some more responsibility and partly I feel that it would be fun to attend meetings and feel an increased fellowship.

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48 This is located at the school. The leisure time pedagogues who work there also work in the school during the day.
Even if she likes the school and everyone is nice to her, she “would like to belong to something”. As it is now, she is with Diana in the classroom and with the leisure time pedagogues in the afternoon but she describes herself as “the lonely one in the school”. Nina gets really happy the times when other teachers in the school show appreciation for her work.

*Today a teacher came around and said “Hello Nina with the enormous patience”. And then I thought ‘what?’ And she said that she thought I did such a good job. [...] And this felt really great; of course it warmed my heart hearing that. I took it as praise. [...] actually nobody else has confirmed that “yes, we also believe it’s working out fine”. Therefore, it felt extra good to hear something. After all, you are a little insecure and want people to appreciate what you are doing.*

Even if she likes Aston School, Nina is not completely positive about all of the other teachers. She says that many of them have been there a long time and that they complain a lot. She says that “everything would be fine” if they let some of the old teachers retire and employed more novice teachers.

Through working in the class, Nina has discovered that it is difficult to teach young children. She says that it is good that they are two adults in the classroom, she and Diana “since after all I’m an educated teacher”. Because they are two teachers in the classroom, it is possible for them to “see every child”. Nina says that, during her teacher education, she thought of school as knowledge but that she now sees that “the social” is as important, if not more important. And, as she had forgotten about the social part, she is happy to be with John at the community youth centre in the afternoons.

In relation to the mathematics teaching in the class, Nina says “our mathematics teaching” and “our class”. The mathematics lessons are based on a text book that Nina likes. She emphasises group work and practical work as positive things in the text book. She says that “we had thought of working a little more practically but since all the students were so eager and wanted to work when they had just received their text books, we actually let them do that”. In addition to the text book, “we” work with “extra material” such as handouts, laboratory material and games containing mathematics.

*Maybe the children do not really see the mathematics in it, but there is Yatzi, there are different card-games, Sudoku, Monopoly, yes, and different kind of games where mathematics is included anyway.*

At the end of the autumn semester, Aston School gets extra funding and it is decided that Nina is to work full time and be given time for planning which makes her really happy. The time for planning is to be used for taking care of a mathematics group\(^\text{49}\). Nina will either be the teacher of one of the smaller groups or she and Diana will share a larger group.

*Today, I am really happy because the principal came to me. [...] today, the principal actually came to me and asked if I could work full time. The school*

\(^{49}\) At Aston School, the students are divided into ability groups in the different subjects.
budget had money left and she thought it was important for me to have more time. And that felt great because now it suddenly feels as if she cares about me. They want to keep me on. [...] And that feels really fun because I will have my own group. I have been given some time for planning it. [...] And it feels really fun because they have figured out that they can use me in a better way. [...] It is really fun for me to take on that responsibility. Because sometimes, as I have said, this feels a little like a prolonged practice period [...] 

Analysis, Nina the semester after graduation (autumn semester 2009)

During the semester, Nina develops a professional identity in the boundary area between being a primary school teacher and not being a primary school teacher. Sometimes she replicates herself as a primary school teacher (feels quite nice to have started as a teacher), some of her job assignments are in line with being a primary school teacher (helping students in the classroom, correcting students’ work) but she lacks other parts (planning time, staff meetings). As such, her long-term patterns of participation does not make her recognise herself as a primary school teacher even though some activities during lessons do (helping students in the classroom, correcting students’ work). The parts of her job that is in line with being a primary school teacher, gives her feedback in that direction but the things she lacks give her the opposite feedback. The feedback from colleagues is not in line with her being a primary school teacher, rather with her being a teacher assistant.

Three communities of practice are visible in Nina’s patterns of participation (figure 19). One is the earlier presented community of reform mathematics teaching. The other two are the grade one community at Aston School and a community of teachers at Aston School. There may also be a fourth, comprising Nina and the leisure time pedagogues she works with in the afternoons, but that has not become visible in her patterns of participation.
Figure 19: The communities of practice visible in Nina’s patterns of participation the semester after graduation. The community of teachers at Aston School and the grade one community at Aston School partly overlap regarding the members and the shared repertoires. However, Nina is just a member in the grade one community at Aston School.

The members in the grade one community at Aston School are “we”, as in Nina, Diana and the students. Mathematics teaching is a part of its shared repertoire. Even if Nina is not involved in the planning of the mathematics teaching, she talks about “we” in relation to it. Diana is the core member in the community through planning and shaping its shared repertoire. She is also the one who owns the information that Nina wants to access. Nina participates by engagement; however, at the same time, she expresses this engagement as a “prolonged practice period” indicating her membership as not being central. The time for planning offered to Nina at the end of the semester is maybe an opening for her to influence the shared repertoire of the community indicating the possibility for an inbound learning trajectory. As for this semester, Nina can identify with the grade one community at Aston School (“I’m as much a teacher for the students as Diana is”) but she cannot negotiate, which makes only half of the process of identity development possible. According to Wenger (1998) identification without negotiation is powerless, vulnerbul, narrow and marginal.

In the mathematics teaching of “we”, the text book is the core. Nina talks about it as being a good text book using words in line with the left side of the dichotomy. She also talks about games where the children do “not really see the mathematics” and about “seeing every child”. This indicates that she is still a member in the community of reform mathematics teaching. But as she does not plan any mathematics teaching, her membership by engagement is mostly through the stories she tells me.

Diana is a member in the community of teachers working at Aston School, a community of practice where Nina does not feel like a member. This first semester, Nina often expresses her lack of belonging to the teaching staff and she talks about the other teachers as “they”. This can be understood as her having involuntarily non-participation in the community of teachers working at Aston School. This non-participation affects how she recognises herself as a kind of not being a primary school teacher. When she receives notice through the extra work time and time for planning which will enable her to start teaching, she says that “they have figured out that they can use me in a better way”. This can be understood both as her alienation and as feedback of “them” having realised that she can be a resource as a teacher.

Nina’s current and designated professional identities are influenced and influence her participation (and non-participation) in the different communities of practice mentioned above. In her stories of current identity, Nina says that it “feels quite nice to have started as a teacher”. In that expression, teacher is not something you are but something you do. Even though she does not have a job as a teacher, in the classroom, she is “as much a teacher for the students as Diana is”. In her stories of current identity, there is an awareness of her, by graduating, being a primary school teacher and that some of the things she does are in line with being a primary school teacher while some are not. In her designated identity, she is a primary school class teacher with responsibility for the teaching and a member of a staff team. It is not the absence of possible communities of practice to be a member of that hinders Nina’s professional identity development towards her designated identity, rather the layout of her job. However, at the end of the semester, a possibility arises (extended working
time including time for planning) making it possible for Nina to approach her designated identity.

Nina, nine months after graduation (spring semester 2010)

After the winter break John changes his medication and gets a harder time at school. As a result he needs more of Nina’s time and because of that she does not get her own mathematics group or any time for planning. She continues to spend all day with John, now full time. This semester, Nina seldom talks about mathematics or any other subjects if not directly asked. Just before John’s medication was changed, Nina and the leisure time pedagogues had planned and started a science project. This was the result of a new organisation where Nina and the two leisure time pedagogues were to plan the lessons in science and social subjects and the three class teachers in grade one were to plan mathematics and Swedish.

When Nina talks about her working situation, she says “I think I feel mostly like a resource [...] I am an assistant to a boy”.

Nina | I am always an extra teacher. Even if I haven’t planned and decided what we are to do, I am always an extra teacher. [...]
The only thing I feel is tiresome is never having any time for planning. I can never attend any meetings. But all my time, that is the eight hours a day that I work, are spent in the group of children, always, always.

Hanna | Is it hard to be a part of the collegium?
Nina | Yes, I feel so, yes, a little on the outside, you can say. [...] I can miss that. And that you are not, neither does it become possible for me to take part and influence as I never attend any meetings.

However, Nina says that she is “very close to” the class teacher and the leisure time pedagogues she works with in the afternoons and that these people feel like her colleagues. As mentioned above, she started planning with the leisure time pedagogues before John changed his medication. She says that the different backgrounds of her and the leisure time pedagogues made them focus on different things when planning. Nina also says that the leisure time pedagogues are sometimes irritated at the teachers as they give them work that really is not theirs to do.

Maybe I was a little more like ‘maybe we ought to work with this and this’ while they had maybe more creative thinking of ‘can’t we do this and that’ [...] I get along really well with the leisure time pedagogues. So it was fun. While it lasted.

Nina is looking for teaching jobs but there are none. There are assignments at preschools but Nina says that “then she is better off staying”. However, she does not know if she will be allowed to stay on next semester since her job is decided six months at a time. But since John still has his problems, she feels quite sure of being able to stay on as a teacher assistant next semester, if she wants to.
But I want to have a teacher assignment. And for her [Diana], we get along very well. For her, I provide a lot of security as it works with John. It will be really hard for her to suddenly have someone new. [...] So I can understand her situation.

She feels bad in relation to Diana who knows that Nina is looking for a teaching job. Diana often says that Nina will be given more responsibility and do more of the teaching in the class when John does better by himself. Nina knows that teachers will be needed at the Aston School in three years’ time when several teachers retire but she does not want to wait three years to get a teaching job. She is not sure either if it is an advantage for her to be working as a teacher assistant at the school when it is time to hire new teachers.

[...] I’m a little afraid that as long as they get resource money, even if I am a trained teacher and have been working for a long time, it is easier for them to have me to stay with John and hire a new teacher.

Analysis, Nina nine months after graduation (spring semester 2010)

During the semester, Nina becomes more focused on becoming a “real teacher”. She still lacks a sense of belonging, time for planning and the opportunity to attend meetings and reifies herself as “an assistant”. The communities of practice visible this semester are the grade one community at Aston School, the community of leisure time pedagogues and the community of teachers at Aston School (figure 20). The community of reform mathematics teaching is no longer visible in Nina’s patterns of participation. That does not mean that Nina is no longer a member but it seems to be peripheral and, unless asked, Nina seldom mentions mathematics or mathematics teaching.
Figure 20: The communities of practice visible in Nina’s patterns of participation nine months after graduation.

In the grade one community at Aston School; Nina participates by engagement and imagination as per the extended responsibility associated with teaching grade one which, according to Diana, she will be given. Nina and Diana have different roles in the community. Diana is still the core member who plans the shared repertoire while Nina performs some, decided by Diana, activities. Through her membership, Nina does activities that influence her (mostly immediate) patterns of participation in the direction of “a kind of primary school teacher”. As such, like last semester she identifies with the grade one community at Aston School but do not negotiate its shared repertoire.

In the community of leisure time pedagogues, almost the opposite applies. Nina can negotiate its shared repertoire (both during the short time spent planning science and in the afternoons) but she does not identify with it since she wants to become a teacher, not a leisure time pedagogue. Negotiation without identification is according to Wenger (1998) empty and meaningless. Nina is engaged with the leisure time pedagogues but she emphasises their differences and she does not want to become a core member; instead, she wants to become a member of the community of teachers at Aston School. Nina’s membership in the community of leisure time pedagogues is by engagement, but also by alignment based on her job at the school.

Both Diana and the leisure time pedagogues are Nina’s colleagues which raises the question if they all belong to one community of practice. However, Diana and the leisure time pedagogues do not work together and Nina talks about them as separate (“it is me and Diana and it is me and the leisure time pedagogues”) and Nina is the overlap between them. Regarding the community of teachers at Aston School, Nina still expresses an unchanged involuntarily non-participation.

Nina’s current and designated identities this semester are similar to the semester before. In her current identity, some of her long-term patterns of participation are in line with being a primary school teacher but mostly she talks about herself as a teacher assistant. In her designated identity, the focus is on becoming a primary school class teacher. At the end of the previous semester, Nina was to be given time for planning which would have made it possible for her to get closer to her designated identity. But the time for planning had hardly become part of her current identity before it was taken away and, once again, became a part of her designated identity. Nina does not focus on mathematics teaching, neither in her current identity nor in her designated identity. This does not imply that she is no longer a member of the community of reform mathematics teaching; however, if she is, the membership does not seem to be central either in her current or designated identity.

Nina, one year and four months after graduation (mid autumn semester 2010)

Nina continues to work as a teacher assistant at Aston School for a third semester working with John, who is now in grade two. Diana is still the class teacher and, as before, Nina spends all her working time with John. She says that it would probably
be hard for her to change from working as a teacher assistant to working as a class teacher at Aston School as now she is known by the children as a teacher assistant.

Otherwise, I don’t have any planning of my own this semester either, but all my time is in children’s group. So I can’t influence that much which feels a little boring. […] I, for instance, think that it would be difficult to become a real teacher for these children because one minute they see me as a kind of teacher making decisions and the next I am the game leader playing football […]

Nina has a good relationship with Diana and the leisure time pedagogues she works with during the afternoons. She is happy because the new headmaster at the school appreciates her work. However, regardless of this, she wants a teaching job and she has been for a job interview. It is the second interview at the same school; she did not get the first job. She hopes it will turn out better this time. “If everything goes well, I will be a real teacher in a month. Exciting but very nervous”. If she gets the job, she will start work at another school six weeks before the Christmas break. She has been worried about what Diana would say if she quit in the middle of the semester but Diana has said that it does not matter when they change assistant for John which has calmed Nina.

I will apply for all the jobs there are and my, yes, my hope is that in the near future, I will have my own class, a real teaching job. Because that is what I want to have. This is okay as I actually am in a school. I get to see a lot. I learn a lot from watching what others do. […] I’m quite bored with just being here. I want to have my own time for planning, fixing and actually being the one teaching. That is why I trained to be a teacher. […] I will give it, six months. […] If I don’t get a job by then, I will do something else.

At Aston School, they are working with the children in ability groups to meet all childrens needs. Nina says that this organisation works out fine.

Since the children are at very different levels, the mathematics lessons focus on totally different things. The group containing the slightly weaker students’ moves along very slowly, they do very simply tasks […] Then the groups with students who are good and interested in mathematics, if you can say it like that, they work faster, moving forward. They don’t have to keep the group together; everyone works in their own direction. Everyone does different tasks [in the text book]. You are simply left to work at your own pace and to become good at what you want.

A negative aspect of the groups she says is that the students cannot learn from each other as they do in a normal class system. She also says that a student can be less good in one area of mathematics but good in another; however, when working with ability groups, the students can get stuck in an ability group in one subject. During “our mathematics lessons”, John and Nina are in Diana’s group, a group for good students. Diana takes a lot of responsibility for John and Nina works as an “extra teacher for the other students”. They work a lot with the text book but they also, for instance, measure using water when working with volume and building their own sequences when working with patterns. They are using the same text book as last semester and
Nina likes both the text book and its teacher manual. As good, she stresses that every chapter starts with the goals for that chapter followed by a “math lab” where the students work with “practical material” in pairs “showing what they have done and draw from each other’s solutions”. According to Nina, this is good because the students “are to see how differently they think and that it can be right irrespectively of how they have done it”. Another positive thing about the text book that Nina stresses is that it follows the same pattern in every chapter and contains a lot of representations. One thing that Nina misses is having mathematics classes outdoors.

And the positive is that the whole text book follows the same pattern so it is easy for the children to understand it. [...] They demonstrate with blocks, demonstrate with money, and show what the children themselves are to draw. Yes, they give examples of how to do it in different ways. And I think that is positive since all children learn differently. [...] I think our lessons contain the most and cover a whole lot but, as I have said, I could imagine being more outdoors if I was teaching.

John is doing better and better at school which makes Nina happy but, at the same time, means she has less to do. For short periods, Nina leaves the classroom to let John be there on his own and she helps the other teachers with “copying, ordering and, yes, things that simply need to be done”. On one occasion during the semester, Nina takes part when a pedagogical plan for John is to be written and she says that “it actually felt like the first time I did something real, as a job”.

Analysis, Nina one year and four months after graduation (mid autumn semester 2010)

Also this semester Nina is focused on herself becoming a primary school teacher. Based on the job interview, this goal may be close which is visible in her current and designated identity. Four communities of practice are now visible in her patterns of participation (figure 21): in the grade two community at Aston School 50, the community of leisure time pedagogues, the community of teachers at Aston School and the community of reform mathematics teaching.

50The same members as in the grade one community at Aston School the previous semester.
Figure 21: The communities of practice visible in Nina's patterns of participation one year and four months after graduation.

Nina's long-term patterns of participation is a merger between her memberships in these communities of practice. Within the grade two community at Aston School, she identifies with the teaching work but she does not negotiate its shared repertoire; in the community of leisure time pedagogues, she negotiates the shared repertoire but she does not identify. In the community of teachers at Aston School, she still has an involuntarily non-participation. Finally, the community of reform mathematics teaching is visible in her evaluations of "our mathematics lessons".

Nina's participation in the grade two community at Aston School, the community of leisure time pedagogues and the community of teachers at Aston School have not really changed since the previous semester. However, she has started to talk about mathematics teaching again and that is when the community of reform mathematics teaching becomes visible. Maybe the job interview and the possibility to start work as a "real teacher" has made (mathematics) teaching a larger part of her current identity even though she still does not teach.

Nina's long-term patterns of participation regarding mathematics teaching seems to be a merger of the grade two community at Aston School and the community of reform mathematics teaching. The mathematics lessons are planned by Diana based on the shared repertoire the grade two community at Aston School. Nina evaluates these lessons based on both the shared repertoire in that community and the community of reform mathematics teaching. The text book has a core role in the mathematics lessons and Nina says that she "actually" likes it. This "actually" can be related to the placement of the text book in the dichotomy in the shared repertoire in the community of reform mathematics teaching. Before graduating, Nina also said that she would use the text book as it offers support to new teachers. However, now,
it is not the support that Nina emphasises as good but its content related to the left side of the dichotomy, for instance, practical work and group work.

The merger of the grade two community at Aston School and the community of reform mathematics teaching has changed how Nina evaluates mathematics teaching. Before graduating, she said that the repeated pattern of the text book was something less good, now she stresses it as something good since “it is easy for the children to understand”. This can be related to her previous discovery of the difficulties involved in teaching young children and getting them to understand what to do. Maybe this experience has made her appreciate that repeated patterns make students more self-driven. Another thing that has changed is how Nina talks about children’s different levels in mathematics. Before graduating, she talked about the importance of meeting every student on their level which is in line with the ability groups used at the school. However, before graduating, she stressed that students who are fast are not necessarily the good ones and that the good students need challenges other than working in the text book. Now, when she talks positively about the ability groups used at the school, the pace of working in the text book is central where the less good students work slowly and the good students work fast and individually in their text books. This merger is illustrated in figure 22.

![Diagram](image)

**Figure 22:** The merger between the grade two community at Aston School and the community of reform mathematics teaching when focusing on good mathematics students.

In Nina’s designated identity, two scenarios are visible. The first is that she gets a “real teaching job” and the second is that she leaves the teaching profession. Leaving the teaching profession is not something that she wants to do but she is so frustrated in her current identity that she cannot contemplate waiting much longer to reach her designated identity as a “real teacher”. A “real teacher” is a class teacher who plans, teaches, attends meetings and has influence over what is happening in the school. A “real teacher” does not, as Nina does, play football and organise games.

**Nina, one and a half year after graduation. (end of autumn semester 2010)**

To her great joy, Nina’s gets the teaching job she applied for, and six weeks before the Winter break she starts to work as a grade five class teacher at Edinham School. “Now it is settled. The papers are signed and I shall start my new real teaching job
Edinham School is located in a small town outside of the town where Nina lives and has been working up until now. In addition to being the grade five class teacher, Nina is also responsible for the mathematics teaching in grade two. Nina only meets the teacher she is to long run substitute for and the students one hour before she starts her new job. There is no teacher to welcome her on her first working day or to show her around at the school and there are no staff teams at the school.

I feel like I have drowned [...] It was handed over just like that. Well, I know that they have been working with bar charts because there is some hanging on the wall. And they have done some measuring because there are pieces of yarn measured in meters and decimetres.

Nina makes a lot of comparisons with Aston School regarding colleagues, organisation and students' work. She says the organisation of Edinham School is a “chock” where the teachers do not work in staff teams and there are a lot of students with problems. Nina expresses the lack of staff teams as lonely.

Everyone does their own thing. [...] I like my grade five and my students there. Grade two is horrible, if you are allowed to say so.

She compares this loneliness with how she felt at Aston School and says that it is different. She also lacks time for reflection which she had at Aston School and, when looking back, Nina expresses working as a teacher assistant as something positive.

Even if I did not attend meetings [...] I was a part of everything. And me and my class teacher talked a lot. [...] I was working alone a lot because all my eight hours were in the children's group. So I did not have anyone. I did not attend meetings, I did not attend planning [...] But everyone there was very welcoming. Both the class teacher and in the community youth centre. So I felt like they became my close colleagues. [...] But when I came to my new job it was a little special because I got there that first Monday and 'here is your class'.

Especially the mathematics teaching in grade two is expressed as difficult by Nina. There are 24 students in the class and “half of them can’t even sit on a chair”. Nina tries to follow the structure worked out by the previous teacher but thinks it is hard, partly because she does not like the text book and partly because the students use text books intended for three different grades. "I feel sick when they take out their text books because I think how they work is a disaster". Before meeting the students, her plan was to work using different mathematics content as themes but that didn’t become possible because of the three different text books. Nina says that the classroom situation and the lack of time for planning prevent her from teaching mathematics in grade two as she would like to do. She compares the students with the grade two she worked with at Aston School and says that she would have been able to teach mathematics as she wants to in that class but that these new students are not “self-determining” at all. This new class “needs to learn to sit on a chair” and “to listen to a simple instruction”. However, she tries to “vary” her teaching which takes a lot of time to plan.
Once a week, I have mathematics outdoors. And I try to do my own themes and be more practical. They use material that I have brought in or made myself. And they work with that. And they work with the text book once a week. Everybody works where they are. I think the teaching is very messy. I would like to have more coherent teaching but that you still are on your own level. [...] I feel that half of my time for planning is used for mathematics in grade two. Because you want to find good fun things all the time.

The mathematics teaching in grade five is organised similarly to the teaching in grade two but with a different text book and all of the students use the same text book.

Once a week, we usually do something related to the content we are working with. Maybe something practical or go outside or whatever. And then, once a week, I usually have, as I usually say, something extra fun. Maybe you play or do Sudoku or maybe you have problem solving in groups. Something beyond the regular teaching but still mathematics.

Nina also expresses being stressed by the students’ weakness in mathematics and she feels pressure to show that they are learning mathematics. She says that it would have been different if she had started work as a teacher at Aston School since there “everybody already knew who Nina was and that Nina did a good job”. Because of being new, she now has to “show who” she is which makes her “feel this pressure the whole time wanting my students to perform”. Nina wants to go back to Aston School but as a teacher.

My goal is to go back to the same school I was at before. I think I have a good chance of that if there’s an opening. [...] But you want to feel that you have something of your own and are allowed to frame it as you want to.

Analysis, Nina one and a half years after graduation (end of autumn semester 2010)

When starting to work at Edinham School, Nina’s long-term patterns of participation becomes in line with being a “real teacher”. This makes her receive feedback from herself and others (the students) as a teacher. Her focus on finding a “real teacher” job and the frustration she has expressed for almost one and a half year is at an end and is replaced by a new focus on planning teaching and experiencing pressure that the students must learn.

Three communities of practice are visible in Nina’s patterns of participation when working at Edinham School (figure 23): the grade two community at Aston School, the community of teachers at Aston School and the community of reform mathematics teaching. Two of these are located within Aston School and Nina wants to return there. Even though her membership in the community of teachers at Aston School was an involuntarily non-participation, that was better than non-participation in a non-existing teacher community at Edinham School. Even if she felt lonely at Aston School, everyone was nice to her. At Edinham School, everyone is “running their own race” and Nina feels even more alone.
When talking about teaching in general, and mathematics teaching in particular, Nina’s memberships in the grade two community at Aston School and the community of reform mathematics teaching are visible. When she evaluates the mathematics teaching at Edinham School as “a disaster” she bases her evaluation on these two communities. Nina compares the students at Edinham School with the students at Aston School (“my last class”) and is stressed by the low level of knowledge in mathematics of the students at Edinham School. Nina talks about “we” when she talks about Aston School and “they” when she talks about Edinham School. The grade two community at Aston School is something safe in the absence of a new community to become a member of at Edinham School. However, her membership in the grade two community at Aston School is now mainly by imagination. There are also several reifications visible from the community of reform mathematics teaching. Her mathematics teaching is focused on how to teach mathematics, not what mathematics to be taught. Even though the previous structure and the students give her problems her mathematics teaching is orientated towards the left side of the dichotomy, for instance she emphasises, fun, games, outdoors and problem solving in groups. As such, she is now participating in the community of reform mathematics teaching by engagement through the activities she does and by imagining what she wants to do more of.

In her current identity, Nina is now a “real teacher”, even if she is a frustrated one. Even if her current identity implies that she has reached her prior designated identity (primary school class teacher with her own class and time for planning), she does not teach mathematics, as she would like to. It is the earlier organisation of the mathematics teaching and the students that prevent her. It seems like mathematics teaching in line with the left side of the dichotomy requires a special kind of students. It seems like the students need to be able to focus on “their own”, “read instructions”
and work independently if mathematics teaching in line with the shared repertoire in the community of reform mathematics teaching is to be possible. In her designated identity, the mathematics teaching is different and is back at Aston School, but as a primary school class teacher. Before, being a “class teacher”, no matter where, was central in her designated identity. Now, as this has been achieved, a primary school class teacher at Aston School is her new designated identity. One part of that designated identity is that the mathematics teaching she would like to perform would work “really good” at Aston School.

A summary of the case of Nina: A case of searching for a professional primary school teacher identity

This was a chronological presentation of the professional identity development of Nina during the first one and a half years after her graduation. In her case it is visible that the focus on mathematics is my focus, and not hers. The primer in Nina’s designated identity is to become a “real teacher”, not the teaching in any specific subject. Nina’s designated identity regarding mathematics teaching, a “real teacher” who reforms mathematics teaching in line with the left side of the dichotomy, stays mainly the same during the time for this study. Due to the lack of teaching jobs and her work as a teacher assistant, she, in her current identity, does not get closer to her designated identity for a long time. While working as a teacher assistant, she receives no feedback, from herself or others, in line with being a primary school (mathematics) teacher. As such, her case is a case regarding the search for professional teacher identity as a primary school (mathematics) teacher. Without having reached a current identity as a “real teacher”, mathematics teaching is not focused on by Nina. Since the experiences of Nina’s after graduation are very common for primary school teachers in Sweden it offers important information regarding professional identity development as a primary school mathematics teacher, even though mathematics is not in the focus of the case. It seems like organisational factors first must make it possible to develop a professional identity development as a teacher before mathematics teaching becomes an issue at all.
5.3 The case of Barbro: A case of conflict within professional identity development

Barbro, the first semester after graduation (spring semester 2009)

As presented in the previous chapter Barbro is 34 years old when she graduates from teacher education and she had “wanted to become a teacher because [she] was little”. The semester after graduation, Barbro continues to work as a class teacher in the preparatory class where she started work before graduation. There are approximately eight\(^5\) students in grades four, five and six in the class. Next to Barbro’s classroom is the preparatory class for grades one, two and three. The name of their class teacher is Sara. These two preparatory classes are located in an outlying region of an older school, Jovik School, which has approximately one hundred students. Barbro teaches all of the subjects in her preparatory class except physical education and handicrafts. Even if the job means working alone a lot, Barbro says that she feels well received at the school.

(...) I was well received. Even if there is a lot of solo work getting started. There is nothing, nothing is finished here. There are no templates to follow, you have to search here. And there is no money to buy anything new either, so you have to search for stuff in what there is. [...] Of course, if you ask for help you receive it.

Barbro and Sara have started to develop a common thread for their work. Sara has worked at Jovik School for fourteen years, however, not always in a preparatory class. Barbro expresses their collaboration as a “close collaboration”.

(...) we have started to talk about how we want to organise things so there will be a common thread within the whole. The thought is that her third graders will come up, maybe come in here to me. And then you have to feel that you have an equivalent education because, otherwise, I might start teaching things that they have already done. [...] We are thinking of building a new system. Neither of us is pleased with the system as it is now.

Barbro does not collaborate with any of the other teachers but she sometimes receives requests from some of them regarding content that the integrated\(^5\) students need to work more on during their time in preparatory class. When new students arrive, Barbro evaluates their knowledge of Swedish and mathematics using a test that is already in use at the school. The mathematics test mostly regards arithmetic since the students cannot read Swedish.

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\(^5\) The number of students varies during the semester as new students arrive and students who are refused residence permits leave. During the semester, the number of students varies between six and ten.

\(^5\) During their time in the preparatory class, the students are also part of an ordinary class into which they are gradually integrated. For instance, a student can start learning one subject with the class and be in the preparatory class the rest of the time.
(...) it is the usual, arithmetic and if they have done fractions. Some of them know everything when they get here. They have had more mathematics than we have in Swedish schools.

When I ask her about how she challenges these students who “know everything” she says that “I have to be honest and say that I don’t”. Since the students say that “mathematics is fun” she has not felt any need to challenge them, “so far, the text books have been enough”. During mathematics lessons, the students work in different text books chosen based on their results in the test described above. The students work in text books intended for grades three to six.

I have one working with angles, and there is a lot of addition and subtraction, and one working a little more with multiplication. And division. And then I have one working with fractions.

It is very quiet in the classroom. The students whisper when they ask Barbro something and while they wait for her attention, they whisper with each other. Barbro says that she has problems with students who only want to show their answers and not their solutions to tasks. She has compromised so that the students write their solutions on loose sheets of paper which they keep in their text books until Barbro has seen them. She says that the students can use any strategy they want “as long as they show how they worked it out”. According to Barbro, they seldom have joint activities in mathematics as they are working on many different areas. The activities they have together regard mathematical concepts.

(...) largest and smallest (...) geometric figures and things like that. It is more things like that we do together. So as to increase their vocabulary.

During the semester after graduation, Barbro develops a teaching where the students’ learning Swedish is in the foreground in all teaching, even in mathematics teaching. The majority of the conversations between Barbro and the students during the mathematics lessons are about the language in the tasks. Many times when the students do not understand a word, Barbro shows them pictures using Google on a computer. Examples of words they Google are planks, line, labyrinth and lottery ticket. The children often know the mathematics in the tasks once Barbro has helped them with the words. Barbro says that she wishes there was a text book with a language adapted for these students.

I believe that Swedish is the most important; they get a lot of Swedish. Mathematics is secondary. But they are to have mathematics lessons every day, nevertheless. We try to have mathematics at least once a day. [...] The goal with mathematics is that they should, that they will, that they progress and broaden their knowledge of mathematics. Then the goal is also that they learn more Swedish. So there are two goals.

[^53]: The same edition but intended for different grades.
Barbro says that it is sad that there are no native language teachers at the school since they could help with translation. We talk about mathematics wordlists with translations between different languages but Barbro has not used any of those. One of the students speaks English as a second language very well and often asks questions in English during the mathematics lessons. When I ask Barbro if a textbook in English could have helped that student she says that it would but “then she wouldn’t learn Swedish”. Barbro describes her mathematics teaching as “traditional”.

*An ordinary mathematics lesson is a rather traditional mathematics lesson. It’s very much them working [...] individually in their textbooks at their level. And I walk around a lot and help them. [...] But often it is the Swedish in it that they don’t understand.*

It takes a very long time for her to answer when I ask her to tell me about a good mathematics lesson she has taught since graduating. After a long silence, she says “[h]aven’t I done anything good?”. Then she tells me how the students, when working with shapes, were to draw them, shape them with ropes and “stand together in the shape of a rectangle. I think that is the only thing I can think of just now”. Barbro says that the students’ insufficient knowledge of Swedish, lack of time, and lack of material limits her possibilities when teaching mathematics even if she is free to teach as she wants. The lack of time regards both the time used for planning as she has to develop much of the material herself, and the time needed for helping the students during the lessons. “[I]t is difficult to have time for everything as they need so much help”. The freedom she has regarding her teaching she expresses as both good and demanding. Demanding as in the insecurity regarding whether the students are learning anything and she says that it would have been good to have something to “follow [where] this is to be done, that they should know certain things after three months or something”.

*Since you don’t have any experience at all I can feel, okay, are they learning anything or is it just passing time? But sure, they learn, they do, so it is both good and demanding to have such freedom.*

Barbro would like to stay as the class teacher in the preparatory class next semester but does not know if she will be allowed as she is a long run substitute teacher. Even though she misses teaching science and thinks it is hard when students leave without prior warning she likes working with Swedish as a second language and she wants to develop her collaboration with Sara further. Barbro says that she “fell for it [Swedish as a second language] completely” in teacher education and that she only has one essay to write before being “totally qualified”.

*I think I fit as teacher for maybe a few, can you call them special students. [...] I think I have found my place.*

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54 In cases of refusal, the school does not get to know in advance; therefore, Barbro finds this out first when a student does not turn up for school.
Analysis, Barbro the first semester after graduation (spring semester 2009)

Two communities of practice are visible in Barbro’s long-term and immediate patterns of participation. One is the earlier presented community of reform mathematics teaching. The other is a community of teachers working in preparatory class.

![Diagram of communities of practice]

Figure 24: The communities of practice visible in Barbro’s patterns of participation the first semester after graduation.

One view of the community of teachers working in preparatory class is that it is developed, and is under further development, through the cooperation between Sara and Barbro. Together, they negotiate a shared repertoire, the “common thread” for their work. Barbro is participating by engagement and imagination by imagining the future collaboration and becoming totally qualified. Another way of viewing the community of teachers working in preparatory classes is that both Sara and Barbro are members in a larger community of practice regarding teaching Swedish as a second language. Barbro has taken courses in Swedish as a second language during her teacher education and says that she “fell for it completely”. It is possible that she became a member of a community of teaching Swedish as a second language during her teacher education similar like she became a member of the community of reform mathematics teaching. Barbro’s teaching and her talk about Swedish as a second language is in line with how Norén and Ramsfeldt (2010) describe that kind of teaching in Sweden. It is possible that both Sara and Barbro are members of such a larger community of teaching Swedish as a second language.

Barbro’s mathematics teaching is strongly influenced by the community of teachers working in preparatory classes/the community of teaching Swedish as a second language. Her participation is by engagement and also imagining becoming “totally qualified” by writing her essay. The mutual engagement in the community is
students learning Swedish which is a goal in all subjects including mathematics. Before graduating, Barbro said that it could be hard to change the mathematics teaching at a school if it was “old and deep-rooted”. As class teacher in the preparatory class, she has the freedom to teach mathematics as she wants but she does not teach in line with the left side of the dichotomy as the shared repertoire of the community of reform mathematics teaching. Barbro says that the students’ insufficient knowledge of Swedish, lack of time and lack of material limit her possibilities when teaching mathematics even if she is free to teach in whatever way she wants. However, her membership in the community of reform mathematics teaching is visible in how she talks about her own teaching as being “traditional” and her problems of finding something good in her own mathematics teaching. The “good” example she gives is in line with the left side of the dichotomy. Also her wish of students showing their solutions is in line with the community of reform mathematics teaching. Yet another visibility is that she doesn’t feel any need to change her text book based mathematics teaching since the students experience it as fun. Since the students experience the mathematics lessons as fun, Barbro says that it is okay to teach as she does. In her current identity, Barbro is a “traditional” primary school mathematics teacher and she is satisfied with that since it is the students’ language skills she is focused on and because the students say that mathematics is “fun”. In her designated identity, Barbro is a primary school teacher in the same preparatory class, hopefully “fully qualified”.

Barbro, the second semester after graduation (autumn semester 2010)

Barbro changes job after the summer break and starts work as a class teacher in a preschool class at Anglia School, a small private school. The school is located in a small town with about 500 residents. There is one class in each grade from preschool class up to grade six at the school. The new job is temporary for one semester but Barbro likes the school and her colleagues so she hopes that she will be able to stay.

*It would be nice to be able to develop something and then do it again next year. [...] it would be nice not to be new all the time.*

It is a couple of weeks into the semester when I visit Barbro for the first time as she needed “to get into the new a little first”. The teacher who worked in the preschool class the previous school year still works at the school in grades three and four. Barbro does not know why she changed but says that “she is also a science and mathematics teacher so maybe she wanted to do a little more”.

The preschool class is located in a classroom between the classrooms of grades one and two. Barbro says that she is free to do what she wants but that there are goals decided at the school. She does not collaborate with any of the other teachers but she says that everyone is nice and that she can ask anyone if she has a question. Contact with parents is new for her this semester and she says that she is nervous about personal development dialogues.

55Almost all Swedish children attend a preschool class one year before they start school.
Every school day except Tuesday starts with circle time on a big carpet in a corner of the classroom. Tuesdays are outdoor-days. During circle time, first a child checks the date on the calendar and says the date. After that the same child also moves one bead from the month can to the year can which is part of an activity that Barbro encountered during teacher education. Barbro tries to have “at least one circle time focusing on mathematics” every week. During one of these, she puts forward math bears saying “you have had these to play shop; today, we will do something different”. She puts forward some cards with bears standing in different patterns and the children are to help her continue these patterns. Barbro uses the word “pattern” several times and uses concepts as “small”, “big” and “little” when she talks about the bears. When the children suggest which bears are to be in a pattern, Barbro often asks “how were you thinking?” After a while, Barbro asks the children what a pattern is and they have different suggestions: “Like that (pointing at a card with bears)”, “It becomes like verges” and “different colours”. Barbro does not comment on their suggestions. The activity continues with Barbro giving one child at a time a card with bears in a pattern, asking them to continue the pattern. She accepts all solutions, even those which do not continue the pattern on the cards.

Besides having mathematics during circle time, Barbro tries to teach mathematics outdoors once a week. They also work with numbers and by the Winter break they have come to the number five. This work consists of talking about the number during circle time and working with handouts. On the handouts they draw the number and the number of things it represents. These handouts are kept in a folder together with similar handouts about the letters in the alphabet.

Analysis, Barbro the second semester after graduation (autumn semester 2010)

In Barbro’s mathematics teaching her participation in the community of reform mathematics teaching is visible, but the community of teachers working in preparatory classes from the last semester is not. Barbro says that it would “be nice to not be new all the time” which can imply a lack of participation in or a very new membership in a community of teachers working at Anglia School. Her talk about herself as new is also a reification. She plans her teaching by herself and even though all of the other teachers are nice, she does not collaborate with any of them. If there is a community of teachers at Anglia School, it is not visible in Barbro’s patterns of participation.

The community of reform mathematics teaching is visible in activities, for instance, the daily activity with the beads and the activity with the math bears. Both activities include parts of the shared repertoire in the community of reform mathematics teaching (for example, group work, practical, student-focused, revealing different ways of thinking) and Barbro has come into contact with them during teacher education. As mentioned in relation to the construction of the dichotomy, the shared repertoire in the community of reform mathematics teaching is focused on

56 Barbro has prepared twelve cans, one for every month, containing the same amount of beads as days in the month. The beads for different months have different colors. Every day, one bead is moved to a bigger can. The aim of the activity is to make visible time and the connection between days, months and a year.

57 The math bears is teaching material consisting of 40 plastic bears. The bears come in four different colours and three different sizes. Barbro has used these bears in teacher education.
how and not on what. This is visible in the math bears activity. Even if Barbro asks how every child thinks and what a pattern is, she does not follow up on their suggestions and she does not correct the children who fail to make a pattern. As such, the activity is in the spirit of the left side of the dichotomy and but the mathematics content is not put in the foreground.

In her current identity, Barbro is a class teacher in a preschool class teaching mathematics with elements of activities inspired by the shared repertoire in the community of reform mathematics teaching. Barbro does not express any visions for the future except wanting to stay at Anglia School. In her designated identity, she is still a preschool class teacher at Anglia School.

Barbro, the third semester after graduation (spring semester 2010)

At the start of the spring semester, Barbro continues to work in the preschool class at Anglia School teaching similarly to the semester before, with circle time focusing on mathematics once a week, outdoor days on Tuesdays and outdoor mathematics once a week. One outdoor-Tuesday, the children are to copy footmarks made in a pattern. There is a lot of snow and the children have put their rucksacks in a wind-break. Barbro gathers the children in a place where nobody has walked in the snow. The children stand in a long line and one child at the time is shown a laminated card with feet in a pattern. Every card shows five or six feet. One child at the time copies a pattern with their feet (with their shoes on) in the snow and it takes a long time before everyone is finished. The children who have made their pattern start to play in the snow. When the last child is finished, all of the others are playing in the snow. Barbro doesn’t gather the children in the end of the activity.

Barbro has been offered a permanent position at Anglia School but in the new preschool to be opened. She has accepted this offer and, therefore, leaves the preschool class in the middle of the semester and starts working at the new preschool. She says that “security was more important” and that a permanent position is worth more than continuing to work in school. She also says that it felt good to be asked to stay on and that the headmaster had said that “we would not have asked you if we hadn’t been so pleased”. In the preschool, Barbro will function as, what she calls, “team leader”. She will continue to work in the school part time, 20%, teaching Swedish as a second language. She says that she hopes that there will be a position for her at the school after the summer break and if so, she will take a leave of absence from the preschool to work in the school.

Analysis, Barbro the third semester after graduation (spring semester 2010)

During the first half of the third semester, Barbro’s long-term patterns of participation as mathematics teacher is similar to the semester before. The community of reform mathematics teaching is still visible. The activity with patterns in the snow is similar to the activity with the math bears; it is in line with the left side

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58 “track” is the word Barbro uses.
of the dichotomy and/but the mathematics content is not made visible. However, as I never asked, I do not know if Barbro considered the outdoor activity as an activity containing mathematics (patterns) or not. It is possible that the activity had another aim, but if so, that aim was not made visible either. Making mathematics visible is not a part of her (mathematics) teaching.

This semester, a community of teachers working at Anglia School is visible in Barbro’s patterns of participation. She is asked to apply for a permanent position as they want to keep her on and she is to become a “team leader”. The choice of the permanent position also means that she will not have to “be new all the time” enabling her, in one sense, to reach her designated identity as expressed the semester before. In her stories of current identity, Barbro changes from being a class teacher to becoming a “team leader” in the preschool. However, in her designated identity, she is again a primary school teacher (at Anglia School).

**Barbro, the fourth semester after graduation (autumn semester 2010)**

The fourth semester after graduation, Barbro splits her work days between preschool and teaching Swedish as a second language, both at Anglia School. At the beginning of the semester, Barbro works 80% in the preschool and 20% in the school, but during the semester, the time in school is extended to 40% since another teacher increases her assignment. When her time in school is extended, Barbro also starts to teach science.

> I think I would say that I am a teacher but that I work in preschool and in school. […] Since I don’t want to let go of school, it feels good to still be in there, to have one foot in the school. And it is better now because now I have two whole days. […]

She says that she is free to teach as she wants and since she works in several different classes in the school, she collaborates with different teachers. These collaborations regard what is to be done in Barbro’s lessons and sometimes the class teachers finish activities that have not been completed during Barbro’s lessons.

> I feel comfortable here at this school. Just because. It is nice being here since everyone supports you and you are allowed to have a bad day. On another day, maybe you have to support someone else. Then we also have a headmaster who works as a teacher and she is, she really has a lot of experience and knowledge and is really, really good […]

The two days Barbro is in school, she teaches science and Swedish as a second language. She teaches science in grades one, two, five and six. One day, when I visit her, she has science in grade one and grade two. The students are working with traffic and after they have finished a task they are to play a game (figure 25).
Figure 25: The game the students play during the science lesson.

The students are to role a dice and move their marker on a playing board made of circles numbered one to one hundred. On some of the circles, they have to wait until they have rolled an even number. As the students finish the first task at different times, they start to play the game at different times and no group finishes the game during the lesson. When talking about the game after the lesson, Barbro says that the game is about odd and even numbers, “there is a lot of mathematics in it”. Barbro says that she has discovered the usefulness of practical work and outdoor mathematics.

*Children learn in different ways, you really understand that. And, when working with the younger ones, I myself have discovered that they learn a lot by doing practical things. And that works out really well if you are outdoors. Outdoor mathematics works just because they get to experience mathematics from another angle. And that you then, maybe not always, talk about it being mathematics but instead continue to play with it. And then when you get inside, you can reconnect to what you did outside. So that they see that everything you do is mathematics. [...] You should dare then. No, but dare to challenge the traditional a little.*

Barbro says that mathematics is a very small part of her job right now. She says that there is mathematics around at the preschool all the time but that they seldom plan any mathematics. “You have math concepts the whole time with first and last, in the middle [...]”. The mathematics she has planned is the *math cans*\(^\text{59}\) which Barbro says she “got the others to purchase with her”. She also says that they usually count how many children and how many boys and girls there are at circle time.

\(^{59}\)The *math cans* is a material that Barbro saw and used during her teacher education. It consists of ten cans with varying numbers of items, from one to ten, in them. For each can, there are activities to do which are connected to the number of items in the can.
One day, when I visit Barbro in preschool, it is her day to arrange lunch. The food is delivered to the preschool but it has to be served in bowls and the tables are to be set. A boy helps Barbro to set the tables. Barbro has finished the plates and has put knives and forks (the correct amounts) on the kitchen worktop which the boy places beside the plates. When the boy is finished, she asks him if anything is missing and he answers “glasses”. Barbro asks him how many and he counts one table at a time by counting the chairs. After the first table he says “six glasses”, after the second table he says “six” and after the third table he says “seven”. Barbro gets the glasses from a kitchen cabinet without visibly counting them. She puts them on the kitchen worktop and the boy takes one or two at a time and puts them on the tables. When there are no more glasses on the kitchen worktop, the boy says that four are missing. There are only three glasses left in the kitchen cabinet and Barbro puts them out asking the boy if there are enough. The boy counts them and says that there is one missing. Barbro then gives him a glass of another, bigger kind and the boy says that one of the older children can have it.

Barbro says that she likes both the work at the school and the work at the preschool; however, at the preschool she wants to be with the older children. She calls herself “teacher” and says that she is still a “new teacher” but a “new teacher with some experience”. She says that she probably feels new as she has changed jobs so many times since graduation. However, at Anglia School she does not feel as new.

_Sometimes, you feel new, in some situations, I can feel. [...] since you have no experience and maybe haven’t done it before or like that. [...] it is a little different in different situations._

Even though Barbro likes her job at preschool, she would like to work more in school and she misses being a class teacher.

_That is what I miss, the teaching. I do. [...] I feel that it [the preschool class] is something for me. It suits me. [...] If I’m allowed to, I will stay a while at Anglia School._

Barbro says that she lacks some competence for the work at the preschool and during this semester she has taken a distance learning course at the university: _Swedish and mathematics at preschool_. She says that the course is really great since she had not “studied that” and she gets a lot of practical tips from more experienced preschool teachers in the course. She asks me what would be required for her teacher degree to be re-evaluated into a preschool teacher degree.

_The question is what it takes to count as a preschool teacher. [...] It is that, you want some more backing. Because the things you have with you possibly make it easier. [...] I’m pretty pleased with what I have now but I would like to spend a little more time in school. Then I don’t know what will happen. I can feel that I don’t always have the things with me that I would wish for being in preschool. But then it may be that you get into it more and more. Like how you become more and more secure in school you may become more and more secure in preschool. So I don’t really know. But from a longer perspective, it is in school I want to be. I want to, I see myself more in school than in preschool._

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Analysis, Barbro the fourth semester after graduation (autumn semester 2010)

During the fourth semester, Barbro’s professional identity is a mix of being a primary school teacher and being a preschool teacher. In school, she is not a class teacher and in preschool she lacks the competence a preschool teacher has. As such, her long-term patterns of participation do not make her recognise herself as a primary school teacher or a preschool teacher. In her current identity, she is a mixture, she is neither nor; in her designated identity, she is a primary school teacher.

Barbro’s mathematics teaching is similar in school and preschool. Her participation in the community of reform mathematics teaching is visible in activities, and when she talks about good mathematics teaching it is in line with its shared repertoire. She says that that part of this shared repertoire (practical work and outdoor mathematics) has been confirmed. The example when a child sets the table shows that even though Barbro says that mathematics is there all the time in preschool, she does not (always) make all that mathematics visible. However, it is still hard to tell if the mathematics is not made visible since Barbro does not see the possibilities herself. Mathematics being hidden is also part of the left side of the dichotomy where the students are to learn mathematics without noticing it.

Even if Barbro has a mixed professional identity, she feels secure in her profession. The security can be connected to her participation in the community of teachers at Anglia School. That she is someone who can both be supported and who can support others indicates that she is a central member. Barbro makes visible that you can be new in different ways and she is not new in relation to her colleagues at Anglia School. In the community of teachers working at Anglia School, Barbro negotiates the shared repertoire but mathematics teaching does not seem to be a part of it. Regarding identification she has two different professional roles but she wants to be a primary school teacher. As such, her membership is also in the form of imagining something she wants to become within that community of practice. Even though Barbro is teaching Swedish as a second language, as she did the first semester after graduation, the community of teaching Swedish as a second language is not visible in Barbro’s patterns of participation.

A summary of the case of Barbro: A case of conflict within professional identity development

This was a chronological presentation of the professional identity development of Barbro the first two years after graduation. Barbro becomes a primary school teacher in her current identity directly after graduation and her designated identity is focused on being able to stay as a primary school teacher at the same school she is at. However, when she starts work in a preschool, she, in her current identity, experiences a conflict of being neither a primary school teacher nor a preschool teacher. Her designated identity then changes to focus on being a primary school teacher again. When working as a class teacher in the preparatory class and the preschool class, she received feedback, from herself and others, in line with being a primary school mathematics teacher. Then, when starting to work in preschool and not having her own class in school she does not get feedback, from herself or others, in line with being either a primary school teacher or a preschool teacher. As such, her
case is a case of conflict within professional identity development as a primary school mathematics teacher. Mathematics teaching is not a primary focus of Barbro’s, neither when she is working as a primary school teacher nor when she is working as a preschool teacher. Barbro is the only one of the respondents who has taken courses in pure mathematics but that doesn’t seem to influence her mathematics teaching in direction to what to teach, she is quite the opposite focused on how to teach. If a subject was to be put in the foreground when describing Barbro’s professional identity development it would not be mathematics but science and/or Swedish as a second language.
5.4 The case of Jenny: A case of absence of professional identity development as a primary school mathematics teacher.

Jenny, eight weeks after graduation (spring semester 2009)

As presented in the previous chapter Jenny is 22 years old when she graduates from teacher education and she became a teacher because she likes to work with children. Since there are no teaching jobs available, Jenny has applied to the intermediate of substitute teachers. The intermediate mediates short run substitute teachers for schools in the municipality. This means that Jenny (if she is lucky) gets a call in the morning from the intermediate and gets to work as a short run substitute teacher at a school for one or more days. Jenny combines these temporary teaching jobs with temporary jobs of other kinds. During the first eight weeks after graduation, she has had many temporary teaching jobs at different schools in different grades, and she has taught different subjects, including mathematics. When I ask her if she feels like a teacher, she says:

*Yes, I’m a teacher. I have got into it more and more. It feels like, when I get my own class or when I can be a part of just one school, not just jumping around, then I will probably feel even more like a teacher because then I will have something stable.*

Jenny’s image before graduation that her ideas about good mathematics teaching would not be in line with the mathematics teaching out in the schools is verified when she starts work as a short run substitute teacher.

*It is just that, this updating. I am thinking about the teachers out there. […] And all the time [they] have that older version in their heads. It should look a specific way. So, they really need updating sometimes. And to really embrace it also and not just dig their heels into the old.*

Jenny explains that her situation as a short run substitute teacher has resulted in her not planning any mathematics teaching at all these eight weeks. Instead, she has taught mathematics as planned by other teachers.

*It is all about the text books. It is the text books all the time. I have to adjust to that right now, I have to. […] it is mostly the text books and I feel like that is not really me. As I probably said the last time, it’s more hands-on things, I want to pick and potter with and get them to understand in that way.*

Since she is working as a short run substitute teacher, Jenny is seldom able to prepare in advance. This as the planning of the lessons she is to teach is done by the ordinary
teachers. On one occasion when she is teaching in grade six a student working in a
text book intended for grade eight needs help and Jenny can’t help her.

[...] it was about circles, and there were two circles together and then there were
some normal ones. And I didn’t have a clue about what it was [...] and the rest
of the class also wanted my attention and I just [...] I don’t want it to be like
that. I’d rather go down a grade and know something there than stand still
somewhere where I can’t handle it. Because that feeling was a little tough.

The situation made Jenny think of the problem a class teacher can have with the
“differences in mathematics within the class” and how you, as a teacher, make
mathematics lessons fun for students like the one she spoke about. “[W]hen she is
finished with this, is she just supposed to go on to another text book and carry on?
That can’t really be that much fun?”

Even though her time in each school is brief, Jenny feels welcome. She has also
received positive feedback from students saying “you are much better than our
teacher”. This, she says, was “really fun to hear”. When Jenny talks about her own
competence as a teacher, she relates it to the subjects she studied during teacher
education. Mathematics and Swedish she feels “comfortable with since [she has]
them with [her] from the university”. She has just found out that she will substitute
at the same school for fifteen days teaching physical education and music. She is
really happy about this as she will be at one school the whole time and also plan the
teaching herself. She is a little insecure when it comes to teaching physical education
since she did not take that subject during teacher education.

Analysis, Jenny eight weeks after graduation. (Spring semester2009)

Jenny is not a member of any community of teachers. Not getting employment as a
primary school teacher is an obstacle to developing membership in a community of
teachers. She reifies herself as a primary school teacher but mentions belonging, to
a class or a school, as a criterion for really feeling like a primary school teacher. She
also gets reificated as a teacher by students saying “you are much better than our
teacher”. Jenny’s designated identity as a primary school teacher is a class teacher and
her expression of wanting to belong can be seen as a need to belong to a limited
community of practice of teachers at one school to be able to further develop her
teacher identity. Even if Jenny is formally a primary school teacher, she has not
reached her designated identity as a primary school (mathematics) class teacher. She
does not feel that she belongs to a community of teachers or to a community of a
class which both seem important for her to reach her designated identity. Her role as
a short run substitute teacher has also resulted in her not being able to deepen her
activities within the community of reform mathematics teaching, another part of her
designated identity. Instead, she is performing mathematics teaching which she
distances herself from and wants to reform. During these first weeks, Jenny’s
participation in the community of reform mathematics teaching is visible, not in the
teaching she performs, but in the evaluations she makes of it. Jenny has not changed
her ideas about good mathematics teaching, even if her situation as a short run
substitute teacher results in her not being able to teach that way. The community of
reform mathematics teaching is also visible when Jenny talks about the student she
could not help where she focuses more on how much “real fun” the student has rather than on what she learns.

Jenny, the first semester after graduation (spring semester 2009)

Jenny continues to work as a short run substitute teacher for the rest of the semester. Except for the fifteen days mentioned above, she doesn’t plan any teaching and she is critical of the teaching she performs.

*I want to be more practical than using the text book. And I still want to try to do that. [...] I believe it is difficult. Doing the things I want. It has to wait. It will be when my own class comes. Then I can start doing such things.*

Jenny says that it is lonely working as a short run substitute teacher since she does not get to know any of the other teachers in the schools. On some occasions, she has asked other teachers in the schools for help but, apart from that, her work has been lonely. In spite of this and in spite of her unpredictable working days, she says that working as a short run substitute teacher is a positive experience. The most difficult aspect of the job is not being able to plan her own time since she seldom knows the day before if and where she will work the next day. Similarly, insecurity regarding money is difficult.

*I jump, forwards and backwards between different schools, and different classes, and different grades, I think of that as a positive experience. You don’t always get the best class. The subjects also varies [...] you do not make any connections, like deep connections. [...] It is, it is lonely. You have to take care of yourself a lot.*

Even though she expresses it as a positive experience, Jenny does not want to work as a short run substitute teacher for another semester. As there are no teaching jobs to apply for, she has applied for a job as an au-pair in the USA. She visited the USA for three weeks during teacher education and says that the schools there were very good. At the end of the spring semester, she is prepared to leave and take a break from being a teacher. She hopes that there will be many teaching jobs available in a year when she comes back as “it is a teacher she wants to be”.

Analysis, Jenny the first semester after graduation (spring semester 2009)

Jenny’s work as a short run substitute teacher stops her from developing any membership in communities of practice where her patterns of participation can be influenced. The work as a short run substitute teacher leads to an involuntary non-participation in a community of teachers. According to Wenger (1998) such non-participation causes marginalisation. The work as a short run substitute teacher is lonely and she appreciates getting positive feedback from students. This feedback makes her feel like a (good) primary school teacher. Besides that, her mathematics
teaching this semester does not give her any feedback that enable her to recognise herself as the primary school teacher she wants to be in her designated identity, that is a class teacher (reforming mathematics teaching).

The community of reform mathematics teaching is visible in her patterns of participation, not in her teaching, but in her evaluations of the teaching she performs. Jenny has not changed her ideas about good mathematics teaching, even if her situation as a short run substitute teacher results in her not being able to teach that way. She mentions having “my own class” as a basis to being able to teach as she wishes.

In her current identity, Jenny is formally a primary school teacher but she does not plan any teaching and she does not teach mathematics in line with the left side of the dichotomy. In her designated identity, she is a member of a community of teachers and a community of a class, which, according to her, are both important for her to reach her designated identity. Jenny herself says that “it has to wait” until she has her own class. When that will happen is, however, something that she cannot influence herself. In her designated identity, Jenny is a primary school class teacher. As a class teacher, she reforms mathematics teaching in line with the shared repertoire in the community of reform mathematics teaching. However, between her current identity and her designated identity, Jenny, because of the lack of teaching jobs, envisions a year as an au-pair. Working as a short run substitute teacher does not bring her closer to her designated identity, even if she gains experience, and she hopes that there will be teaching jobs to apply for when she comes home. An assignment as a class teacher is a prerequisite for her to reach her designated identity as a primary school mathematics teacher.

Jenny, the third semester after graduation (spring semester 2010)

Jenny leaves to work as an au pair in October 2009. I meet her in May 2010 when she is home for a holiday. She is visiting home for ten days and will then go back to continue as an au pair until October. “Home” is where Jenny’s parents live, a town about fifteen kilometres from the university.

In the few days that Jenny has been home, she has looked for jobs at the job centre but there are still no teaching jobs to apply for. Based on a tip from a friend, she has been in contact with the intermediate of substitute teachers regarding a job in a preschool that will become available at the time of her return from the USA. “I’m not into short periods of substitute work […] I want to have longer periods so I get into it”. She does not want to work in a preschool, but, a new school is to be built in the same neighbourhood and Jenny says that working in that preschool may be a way in to the new school. She becomes enthusiastic when she talks about the possibility of working as a teacher in a new school.

Then I can take in everything and do my thing. […] But I don’t know how far they have got with the changes in the syllabuses and that part. I’m not really up to date there.

60 The syllabuses for primary school were changed in Sweden during this year. The changes came into force in 2011.
When I ask her what “do my thing” implies, she starts to talk about the American classroom. Working as an au-pair Jenny drives the two children in the family to primary school every day and she says that the American school is good. She says that their organisation is really good, where all material is available to the children and the children work with different things based on their own interests. She expresses this as being opposite of teachers teaching as “look at me, I’m the focus”. In the USA, Jenny works two hours a week at the Swedish School with students of three and four years of age. This is a way for her to maintain her teaching and she says that she will design her future teaching based on what she has seen in the USA.

There shall be so much material in this classroom so if anyone wonders about anything we will go and look it up together. If they want to sit and read a book then it is totally okay while I work with another group, which is doing this. And the next day, another group is doing this. In other words, you circle. There is no. Absolutely there is to be something to go back to, to get together around but I don’t want this “look at me”, I’m to be focused on, but it becomes more them. […] inspiring. No, but it feels like that would be a dream.

Jenny says that applying for a job and working as a primary school teacher when she comes home is a matter of course.

That is why I studied. I want to show that I can do this and if I let it go too much then, no, then it will not work. That’s why I have tried to keep it up also in the USA. And the thing with the Swedish School is perfect. Because they have, if you do mathematics, we do counting. Just counting numbers. Not addition, subtraction and things like that but easy, easy. […] And the teaching profession. I will not throw it away just because of being away for a year.

**Analysis, Jenny the third semester after graduation (spring semester 2010)**

In her current identity, Jenny works as a primary school teacher for only two hours a week and this is a side-line. In her designated identity, she is still a primary school class teacher which is visible as she actively searches for a teaching assignment for when she comes home and she works extra as a teacher to keep up her ability to teach.

Jenny is still participating in the community of reform mathematics teaching. She is mainly a member by imagining future teaching. She no longer expresses any alignment in the same way as she did before graduation. In her designated identity, Jenny is a primary school class teacher, a class teacher teaching mathematics (and other subjects\(^1\)) in line with the left side of the dichotomy. When talking about her future teaching, she says that she “can take in everything and do my thing” which is in line with her planning her own teaching. On some occasions, Jenny talks about mathematics but it does not seem to be in her foreground. Jenny is inspired by the teaching she encounters in the USA, which seems to be in line with the teaching she talked about before graduation. Before graduation, Jenny focused on organisation.

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\(^1\) In accordance with Jenny saying before graduation the way of teaching she describes applies to all subjects.
when she talked about mathematics teaching, organisation where the students could work with different things and where many different materials were available. She spent three weeks in the USA during her teacher education and maybe that inspired her. In any case, the teaching she encounters now in the USA seems to be a practical example of the organisation she talked about before graduation. Syllabuses are another recurrent theme in Jenny’s stories. Before graduation, they are expressed as a starting point for her teaching and now she says that she no longer is up to date. Even if she wants to teach as she said before graduation, she is unsure of what the changed syllabuses say.

Jenny, the fourth semester after graduation (spring semester 2010)

Jenny does not move back home in October but stays in the USA and she is still there at the time of writing this. However, she has not abandoned her thoughts of becoming a primary school teacher and writes to me in an e-mail.

Now I dream of my own class, but where in the world it will be; only the future can tell. I have started to research what I need to become a teacher in Boston. […] Life is an adventure, but I’m still on target to find my teacher position somewhere in the world.

A summary of the case of Jenny: A case of absence of professional identity development as a primary school mathematics teacher.

This was a chronological presentation of the professional identity development of Jenny, during the first two years after graduation. Even though Jenny reificates herself as a primary school teacher she mentions several factors (one school, own class, plan her own teaching) that would make her recognise herself “even more” like a teacher. Jenny’s designated identity, a primary school class teacher who reforms mathematics teaching in line with the left side of the dichotomy, is mainly the same during the two years. However, because of a lack of teaching assignments, in her current identity, even though it changes, she does not move closer to her designated identity. When working as a short run substitute teacher, she does not receive feedback, from herself and others, in line with being a primary school (mathematics) teacher. As such, her case is a case regarding absence of professional identity development as a primary school mathematics teacher. Once again the focus on mathematics is my focus. In the absence of professional identity development, mathematics is not something Jenny is focused on. She wants to plan lessons for a class of her own but does not talk about any special content that she would prefer to plan.
5.5 A summary of the four chronological presentations of the respondents’ two first years after graduation

The above were examples of how the conceptual framework provides explanations of the process of professional identity development as a primary school mathematics teacher. According to Wenger (1998), identity development is an individual’s learning trajectory through different communities of practice. That learning trajectory can be interpreted as changes in the individual’s long-term patterns of participation. These patterns of participation affect and are affected by the communities of practice of which the individual is, wants to or does not want to be a member of or from which she is excluded, as well as what kind of membership she develops. In the stories the respondent reified themselves as teachers or as non-teachers; for instance, when Jenny, before graduation, says “I as a teacher” and when Nina says “I am outside” and that she is “the lonely one in the school”.

The cases are examples of how the conceptual framework makes it possible to capture both the individual and the social as analytic units. Through looking at engagement, imagination and alignment, the individuals’ memberships in different communities of practice can be analysed. At the same time, the grounds for a community of practice can be analysed by looking at mutual engagement, joint enterprise and a shared repertoire. If one only investigated patterns of participation, descriptions could have been made of their teaching and a hypothesis could have been proposed as to how their teaching was affected by the social. However, through the coordination with communities of practice, explanations can be discovered as to how patterns of participation are the merged results of different kinds of memberships in different kinds of communities of practice.

In this study, patterns of participation are the starting point but the need for coordination goes in the opposite direction. If one only investigates communities of practice, interpretations can be made of the individuals’ memberships in them and a hypothesis can be proposed as to how the memberships influence the actions of the individuals. By coordinating with patterns of participation, as both a presumption of and as a result of communities of practice, explanations can be discovered as to how different kinds of memberships in different kinds of communities of practice merge into the different patterns of participation of individuals. Individuals’ patterns of participation become the unit of analysis when the individuals are in the foreground. If, instead, the collective is placed in the foreground, communities of practice, as overlapping constellations of participation, become the unit of analysis. Both parts are, however, needed if the purpose is to understand the process of professional identity development.

The four cases have made visible how the respondents’ patterns of participation are influenced by their memberships in communities of practice. As mentioned, the case of Helena is a case of professional identity development as a primary school mathematics teacher. The case of Nina is a case of searching for a professional primary school teacher identity, with focus on mathematics teaching. The case of Barbro is a case of conflict within professional identity development, focusing on mathematics teaching. Finally, the case of Jenny is a case of absent professional identity development as a primary school mathematics teacher. These different cases, these different types of professional identity development can be explained and understood by using the conceptual framework. It has become visible that the respondents’
patterns of participation regarding teaching mathematics change when they become members in new communities of practice with mathematics teaching as part of the shared repertoire. However, it has also become visible that the existence of such communities seems to be rare and the respondents’ different working conditions limit their possibilities of becoming members in those that exist. In the cases of Nina, Barbro and Jenny the focus on mathematics has been my focus while their focus has been on other things.

For almost one and a half years, Nina does not reificate herself as a “real teacher” as her job as a teacher assistant doesn’t make her recognise herself as “a kind of primary school teacher”. She gets some feedback as a primary school teacher from the students in the class but not from colleagues and seldom from herself. However, she is a member in a community in which mathematics is part of the shared repertoire (the grade one community at Aston School) and this influences her patterns of participation. Jenny experiences an unwanted non-participation in communities of practice regarding (mathematics) teaching except for her membership by imagination in the community of reform mathematics teaching, and no new influences are seen regarding mathematics teaching. Working as a short run substitute teacher (which is common for novice primary school teachers in Sweden) seems to be a way out of, and not in to, the teacher profession. To be able to recognise themselves as a primary school mathematics teachers the novice teachers need to perform what they recognise as the job of a primary school mathematics teacher. The influence on patterns of participation regarding mathematics teaching from memberships in new communities of practice is most visible in the case of Helena when she becomes a member in the community of science.

According to Wenger (1998), identity formation is a dual process in which one half is the identification in communities of practice and the other half is negotiation of the meaning (negotiation about the mutual engagement, joint enterprise and shared repertoire) in those communities of practice. Identification can be made through engagement, imagination and/or alignment. Negotiation can only be made through some kind of interaction. This can be one explanation of why the respondents’ are more visibly affected by the communities where they are members through engagement. Those memberships offer both parts of the dual process of identity, identification and negotiation. One and a half years after graduation, the respondents are members of the community of reform mathematics teaching mostly by imagination which doesn’t make it possible to negotiate its shared repertoire and half the dual process of identity development in that community of practice is lost. According to Wenger (1998) identification without negotiation is powerless, vulnerable, narrow and marginal.

The phenomenon that teacher education prepares teachers for working with and promoting reform in the practice of school mathematics worldwide exists (Sowder, 2007). A broker is, according to Wenger (1998), a member who brings elements from the shared repertoire in one community of practice to another. But that is a demanding mission, why the possibilities involved in promoting reform through novice teachers are debatable. Instead, one possibility is to expand the community of practice established in teacher education to outside teacher education in a form where membership through engagement is possible. If teacher education wants novice teachers to teach according to the shared repertoire in the community of reform mathematics, membership in that community through engagement must be possible also after graduation. (If teacher education wants novice teachers to teach in line with the shared repertoire in the community of reform mathematics teaching as described
in this thesis is, however, a different question not to be discussed here.) A primary school teacher in Sweden teaches many subjects. For the respondents in this study mathematics is not put in the foreground and the teacher educations' promotion of a reform in the practice of school mathematics through student teachers and novice teachers seems farfetched.

In three of the cases, new communities of practice emerge during the time of the study. This does not have to mean that these communities did not exist before, or that the respondents have not been members of them before. It means that they have not been visible before in the empirical material. Some of the communities have a starting date when they may have emerged, e.g. in relation to a specific school class or, as in the case of Helena, to the creation of common goals in science. A group created from the outside, however, does not cause the emergence of a community of practice. Most communities of practice do not have a name and do not issue membership cards (Wenger, 2009). Instead, communities of practice emerge from mutual engagement, a shared repertoire and joint enterprise, and the respondents' engagement, imagination and alignment are used to indicate the presence of different communities of practice.

According to Lester (2005), having a framework provides a structure within which the question “Why?” can be answered. Without a framework, the researcher can speculate at best or fail to offer any explanation. As shown above, the conceptual framework makes it possible to answer the questions raised is section 4.6. One and a half years after graduation, the respondents are members of the community of reform mathematics teaching mainly by imagination. Membership through imagination and alignment seems to influence the respondents less since they don’t offer possibilities to get feedback. However, the respondents’ membership in the community of reform mathematics teaching influences how they talk about and evaluate their own, and others’, teaching and it is visible in different activities they perform. As before graduation, the respondents mention limitations that prevent them from teaching mathematics, as they would like. Also some become members in new communities of practice, which influence their mathematics teaching. Some examples have been shown of how immediate patterns of participation become a merger between the respondents’ different memberships. It has become visible that the respondents’ patterns of participation regarding teaching mathematics changes when they become members in new communities of practice with mathematics teaching as part of the shared repertoire. But, it has also become visible that the existence of such communities seems to be rare and the respondents’ different working conditions limit their possibilities of becoming members in those that exist.

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62 These are further discussed in section 6.3
6. BECOMING A PRIMARY SCHOOL [MATHEMATICS] TEACHER

In chapter five, the conceptual framework was used to understand and describe the professional identity development of the respondents. That work provided new questions that were further investigated by using methods inspired by grounded theory. In this chapter those questions will be focused on. The results presented in this chapter derive from empirical material from all of the respondents except Malin. Malin did not get a teaching job after graduation, instead she started to work in another sector and during the time for the empirical work of this thesis she did not work as a teacher.

When related to Ragin’s (1998) cross-tabulation of cases, this chapter constitutes specific case constructions as theoretical constructs implying categories emerged from the empirical material. The categories to be presented are the image of a primary school [mathematics] teacher, identity development by feedback and frames for teaching mathematics. Even though these categories are developed through the analysis with methods inspired by grounded theory they will be connected to the conceptual framework. The goal with connecting these two kinds of results is to provide a coherent description of professional identity development as a primary school mathematics teacher.

6.1 The image of a primary school [mathematics] teacher

In the theory chapter, professional identity is described as an objectification of the process between patterns of participation and communities of practice. That objectification depends on how we, by ourselves and others, are recognised as a special “kind of person” (Gee, 2000-2001) in a given context. According to Morgan (2009), a professional mathematics teacher identity is to be seen by others and by oneself as a teacher of mathematics. As such, professional identity as a primary school mathematics teacher would imply being recognised, by oneself and others, as a kind of primary school mathematics teacher. When analysing the respondents professional identity development as described in chapter five, a question emerged regarding what it is that makes them recognise themselves as a kind of primary school mathematics teacher (or not).

Beginners in teaching face the fundamental question of whether they can see themselves as teachers, not only the reflections from colleagues and children in their schools, but also in the mirror that they hold up to themselves (McNally, Blake, Corbin & Gray, 2008, p.295).

Based on the question what it is that make the respondents recognise themselves as a kind of primary school mathematics teacher (or not) segments in the empirical material were labelled with the codes attribute, image, criteria and epithet. Then, through the writing of memos based on these codes the category the image of a primary school [mathematics] teacher emerged. This image is the similarities found in
the unique experiences and expressions of the respondents regarding what it implies
to be a primary school mathematics teacher. To recognise oneself as a primary school
mathematics teacher, the individual's patterns of participation have to be in line with
their image of the patterns of participation of a primary school mathematics teacher.
But, what are the patterns of participation of a primary school mathematics teacher?
The answer to that question is what will be focused on in this section as the image of a
primary school [mathematics] teacher.

The analysis of the empirical material shows that the respondents first (possibly)
recognise themselves as a kind of primary school teacher. Before they recognise
themselves as that, mathematics teaching is not something they focus on, and
therefore mathematics teaching will not be focused on in the first part of this section.
Instead, the image of a primary school teacher will be focused on.

As shown, it was difficult to get employment as a primary school teacher during
the two years after the respondents graduated. At times, this was experienced as a
problem for the study. However, thanks to the lack of teaching assignments for
several of the respondents the [ir] image of a primary school teacher was made visible. In
relation to this image, different criteria which made it possible for the respondents to
develop patterns of participation in line with the [ir] image of a primary school teacher
have been made visible.

The respondents' two years after graduation vary and, in this section, the image of a
primary school teacher will be built based on an interacting description of Nina's, Jenny's,
Barbro's and Helena's first two years after graduation. Their cases being interacting
imply that the aim is not to describe their individual professional identity
development as in chapter five, but to substantiate the image of a primary school teacher.
As mentioned, all of the respondents constitute the basis of the category, but the
presentation here will be built on these four cases as those are the ones which are
thoroughly described earlier and therefore easier to follow for the reader.

As described in chapter five, Nina stays at university an extra semester after
graduation as there are no teaching jobs and after that she starts work as a teacher
assistant, a job that she continues to do for almost one and a half years.

It feels quite nice to have started as a teacher. [...] The only thing is that I don't
have time for planning and therefore I never attend any meetings with the
other teachers, conferences about students or anything. Because of that, I don't
really belong to any staff group. [...] That [the possibility to influence] is
something I feel I miss. Partly I would like to have some time for planning and
to take some more responsibility and partly I feel that it would be fun to attend
meetings and feel an increased fellowship.

Even if Nina is formally a teacher, she does not recognise herself as "a kind of
primary school teacher". She calls herself "teacher assistant" or "resource teacher"63
and says that she wants to become a "real teacher", a "class teacher". She often talks
about the lack of time for planning and teaching and the lack of belonging. Working
as a "real teacher" is to be a class teacher for a class for which you plan and perform

63 A term for staff working in school based on the need of extra help, like a teacher assistant. The qualifications
of a "resource teacher" is based on the extra help needed in each case and does not necessary (seldom) include
teacher education.
the teaching and have contact with the parents. A “real teacher” also attends meetings and conferences and through that has influence.

Today, I am really happy because the headmaster came to me. [...] today the headmaster actually came to me and asked if I could work full time. The school budget had money left and she thought it was important for me to have more time. And that felt great because now it suddenly feels as if she cares about me. They want to keep me on. [...] And that feels really fun because I will have my own group. I have been given some time for planning it. [...] And it feels really fun because they have figured out that they can use me in a better way. [...] It is really fun for me to take on that responsibility. Because sometimes, as I have said, this feels a little like a prolonged practice period [...] 

However, as known from chapter five, there is never any time for planning for Nina and her job as a teacher assistant continues as before, resulting in her patterns of participation not generating feedback, from herself or others, of her being a kind of primary school teacher. Even though she is an educated primary school teacher and works at a school, with colleagues and students, she feels “outside” and as if she is on “a prolonged practice period”.

And my goal for the immediate future is to actually find a job where I can have my own class. [...] And I have talked to the headmaster and she has said that they will let me go when I need to. And that feels very nice looking towards the future because I feel trapped. Do I dare say yes to another semester or should I try finding something else. [...] But I guess there is a risk you won’t return to teaching if you start doing something else. And above all I feel that is what I want to do. Probably I will simply give it, well, six more months.

The case of Nina as a teacher assistant shows that education, knowledge and working at one school are not enough to recognise oneself as a kind of primary school teacher.

Jenny applies to the intermedium of substitute teachers directly after graduation and works as a short run substitute teacher the first semester. She is a little worried about her competence since she did not study all of the subjects during teacher education as “that primary school teacher she has before her eyes [...] who has a broad education, who has knowledge in all subjects”. That worry, however, does not regard teaching mathematics. During the first semester after graduation, Jenny has many temporary teaching jobs at different schools in different grades. She teaches different subjects, including mathematics.

Yes, I’m a teacher. I have come into it more and more. It feels like, when I get my own class or when I can be a part of just one school, not just jumping around, then I will probably feel even more like a teacher because then I will have something stable.

Except for fifteen days when she is at the same school, she does not plan any of the teaching but instead performs teaching planned by the teachers she substitutes for. She says that the teaching she performs underestimates her capabilities and she feels

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lonely, “you do not make any connections, like deep connections. [...] It is, it is lonely. You have to take care of yourself a lot”.

*I want to be more practical than using the text book. And I still want to try to do that. [...] I believe it is difficult. Doing the things I want. It has to wait. It will be when my own class comes. Then I can start doing such things.*

After one semester, Jenny is tired of working as a short run substitute teacher. She says that she wants her own class with her own planning and her own contact with parents. At the very least, she says, she wants to be at a school where she can feel like she belongs and become part of the teaching staff. Jenny does not recognise herself as a “real” primary school teacher. She doesn’t develop patterns of participation that generates feedback, from herself or others, of her being a kind of primary school teacher. Even though she is an educated primary school teacher and teaches almost every day, she feels lonely and wants to have colleagues and a class of her own whose teaching she plans herself. The case of Jenny as a short run substitute teacher shows that education, knowledge and teaching students are not enough to recognise oneself as a kind of primary school teacher.

Together, Nina’s and Jenny’s time after graduation show different criteria that are lacking for them to be able to recognise themselves as a kind of primary school teacher. They both call themselves “teachers” in their interviews before graduation. However, Jenny gets surprised by this, implying her current identity is on the boundary between student teacher and teacher. She then mentions two criteria, graduation and knowledge, required to count as a teacher. Similarly, Nina talks about knowledge but, while Jenny is a little worried about not having knowledge in all subjects, Nina says that she has got a lot of knowledge but not as much experience. Graduation and knowledge will here be called individual criteria since it is the individual him- or herself who has the “power” over them. In this study, in reality, these were entrance values in that all respondents were about to graduate as primary school teachers at the beginning of the study.

Both Nina and Jenny lack their own classes and permanent teacher employment. Nina is employed at one school but not as a class teacher and Jenny substitutes at a lot of different schools. They both mention a lack of the same things with the difference that Jenny expresses a wish to be at one school (which Nina is) but not to teach (which she does). With Nina, it is the opposite. These things will be called social criteria since the individual, him- or herself, does not have “power” over them.

Based on Nina’s and Jenny’s early days after graduation, the following picture (figure 26) can be drawn of what would be required for them to receive feedback, from themselves and others, as a primary school teacher, which, in turn, would make it possible for them to recognise themselves as a kind of primary school teacher.
Depending on which of the individual and social criteria are being fulfilled, Nina and Jenny receive different feedback from themselves and others. The different individual and social criteria affect which communities of practice they can become members of and therefore their possible patterns of participation. Both Nina and Jenny fulfil the individual criteria (even though Jenny is a little worried regarding teaching some subjects, though not mathematics). Jenny teaches but does not plan her own teaching and she does not develop any sense of belonging to the teaching staff. Neither does Nina develop a sense of belonging to the teaching staff, nor does she or Jenny plan any of their teaching by themselves. None of them receive feedback, from themselves or others, for being a kind of primary school teacher. This is illustrated below in figure 27 and 28.

Figure 26: Individual and social criteria making feedback, from oneself and others, in line with being a kind of primary school teacher possible.
Figure 27: The highlighted criteria are those fulfilled when Nina works as a teacher assistant making her receive almost no feedback, from oneself or others, in line with being a kind of primary school teacher.

Figure 28: The highlighted criteria are those fulfilled when Jenny works as a short run substitute teacher making her receive almost no feedback, from oneself or others, in line with being a kind of primary school teacher.
Barbro who works as a class teacher during the first year after graduation, first in a preparatory class and then in a preschool class, both plans and performs her own teaching in the two classes and she develops a sense of belonging to the schools. As such, both the individual and social criteria are fulfilled and she generates feedback, from herself and others, as a kind of primary school teacher. If it had not been for Nina and Jenny, the different criteria would not have been noticed as they, when they are fulfilled, are experienced as so obvious that they are not talked about by the individual. Then, when Barbro starts to work in a preschool, except for a few hours when she teaches Swedish as a second language in School, not all of the criteria are fulfilled and Barbro starts to talk about her role as a primary school teacher.

*I think I would say that I am a teacher but that I work in preschool and in school. [...] Since I don’t want to let go of school, it feels good to still be there, to have one foot in the school. And it is better now because now I have two whole days. [...]*

*I call myself a teacher [...] because that was what I educated myself to be [...] I can miss that, being a class teacher.*

Barbro did not graduate as a preschool teacher and she says that she has not got all the knowledge needed in preschool and, therefore, she begins a distance learning course focusing on Swedish and mathematics in preschool.

*The question is what it takes to count as a preschool teacher. [...] It is that, you want some more backing.*

Barbro researches what it takes for her to complement her primary school teaching degree into a preschool teaching degree and alternates between talking about doing that or trying to get her hours in the school extended.

*I would like to be a little more in school. I don’t know what will happen. I can feel that I don’t always have the things with me that I would wish for being in preschool. [...] in a longer perspective, it is in school I want to be. I want to, I see myself more in school than in preschool. [...] I miss teaching.*

During her second year after graduation Barbro does not generate feedback, from herself or others, for being a kind of primary school teacher or preschool teacher. This as, depending on which of them (primary school teacher – preschool teacher) she focuses on, different individual and/or social criteria are not fulfilled. This is illustrated in figure 29 and 30.
Figure 29: The highlighted criteria are those fulfilled when Barbro works in school making her receive some feedback, from herself or others, in line with being a kind of primary school teacher. Even though Barbro is teaching in the school for some hours every week she herself says that she “miss teaching.”

Figure 30: The highlighted criteria are those fulfilled when Barbro works in preschool making her receive some feedback, from oneself or others, in line with being a kind of preschool teacher.

In the cases of Nina and Jenny, who both experience the lack of social criteria after graduation, their wish to achieve the criteria is visible from the start. For Barbro, the
criteria were first fulfilled but then her working conditions changed making her express similar loss as Nina and Jenny.

**Helena**, who starts work as a primary school class teacher directly after graduation, fulfils all of the individual and social criteria making her receive feedback, from herself and others, as a kind of primary school teacher.

*I think I actually feel like one of the gang now. I definitely do. […]*

*It feels like you belong in that way. Definitely. In the beginning, you felt as a new teacher. But that, no, I don’t think I feel like that. I can feel that, yes, people come and ask me things. Yes. And I ask people things.*

Helena continues to work as a class teacher at the same school and in her last class, which she experiences as really bothersome, she says that every day is a struggle. Even though nothing visible changes externally regarding the individual and social criteria, Helena does not feel competent to work in the class. The negative feedback she receives from the classroom climate affects how she talks about herself as a kind of primary school teacher. She says that her competences are not in line with the students in the class (figure 31).

**Figure 31:** All individual and social criteria are fulfilled when Helena works as a class teacher at Aldro School but when she the fourth semester starts to work as a class teacher in grade four she experience that her competences are not in line with the need of the students in the class.

*[…] if one starts, the next follows and that is it. Then they run the gauntlet around here. And it is impossible to catch someone almost bigger than you, to*
hold him and put him down on a chair. And someone bites you on the arm instead and kicks at you. [...] School it is, no.

[...] I think it is really fun to be a teacher and I think it is really fun to teach. But then there must be conditions to make it work. [...] And we feel that we lack the competence. We lack support from those who have the competence. [...] And I have decided to resign. In time for Christmas. And look for other jobs as a short run substitute teacher.

As mentioned, the respondents first (possibly) recognise themselves as a kind of primary school teacher and only after that their professional identity development starts to regard more specific parts. In the case of Helena, such a specific part becomes the knowledge she has in relation to the needs of the class. As shown by the cases of Nina, Jenny and Barbro, fulfilling the social criteria is important but even when fulfilled, in the case of Helena; they are not in line with her individual criteria making her not receive feedback from herself as a kind of primary school teacher.

Professional identity is the part of an individual’s identity which is about identifying oneself as a perpetrator of a professional role (Heggen, 2008). The teaching profession is special in relation to several other professions as all student teachers, by their own schooling, have experience of the profession. Based on these experiences, individual images are developed regarding the teaching profession (Persson, 2009b). Similarly, Lindström Nilsson (2012) found in her survey of student teachers that they carried socially constructed expectations and images of schools and teachers, expectations and images that were not challenged during their teacher education but first confronted after graduation.

In the interviews before graduation, based on my questions, the respondents’ images of good and less good mathematics teaching became visible but not the[ir] image of a primary school teacher. This, unexpressed image was shown to influence what was needed for the respondents to recognise themselves as a kind of primary school teacher. The image of a primary school teacher influences both their current and designated identities.

According to Palmer (2010), establishing a professional identity is about “picking up” the codes and the language associated with that profession. The codes and the language associated with the primary school teaching profession are seldom connected to mathematics but, instead, to caring and motherhood. Since the beginning of the 1900s, teachers teaching younger children have been pictured as warm, protecting and responsible females, a picture that still remains in both politics and media.

Student teachers who are to work with younger children, construct their professional identity during their practice periods, but also in relation to expectations from parents, children, the media (TV and film etc.) and society at large. Also memories of being a child and youth are interwoven in the professional identity (Palmer, 2010, p.31 translated).

The image of a primary school teacher has been both unexpressed and obvious at the same time and became visible through the individual and social criteria. Of course, the respondents themselves did not tag them as individual and social criteria, but these criteria were important in the professional identity development of the
respondents. The individual and social criteria are their reification of being a primary school teacher. These criteria influence the feedback they receive from themselves and (want to receive from) others as a kind of primary school teacher. The individual and social criteria also influence the respondents’ possibilities of developing memberships in communities of practice in line with their *image of a primary school teacher* which, in turn, influences their possibilities of receiving feedback from others as a kind of primary school teacher.

According to Heggen (2008), identification with a profession mainly regards being accepted and valued as “one of us”. When the social criteria are fulfilled the respondents can become (don't automatically but the social criteria seems to be preconditions) members in communities of teachers, where the belonging that Jenny and Nina express they lack, can be reached. Through memberships in communities of teachers by engagement and/or alignment, the individual may also get feedback. For example, Nina’s work as a teacher assistant does not make her receive feedback, from herself or others, in line with being a kind of primary school teacher. She does not express being accepted and valued as “one of us” by the other primary school teachers at the school. To be able to be accepted and valued as “one of us” and to receive feedback, from herself and/or others, in line with being a kind of primary school teacher, the social criteria have to be acquired.

For the respondents to reach their designated identity as a kind of primary school teacher in line with their *image of a primary school teacher*, the criteria needed to become fulfilled. With another image of a primary school teacher, the criteria might have been others. As this study only focuses on the time after graduation, there are no empirics that might show how or when this image has developed; nonetheless, at the time of graduation, it is part of their current and designated identity. At that time, starting work as a teacher assistant or a short run substitute teacher is not in line with their designated identities. Below is an excerpt from a group interview made two years after the respondents’ graduation where Gunilla has just told the others about a teaching job she has had where she commuted one hour per journey to work every day.

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*Helena*  Are there no jobs here? Since you had to go so far?
*Gunilla*  Are there any jobs anywhere?
*Helena*  There is at home.
*Nina*  That’s unique for that place.
*Helena*  But it is like that. And there are absolutely no short run substitute teachers. You would be able to work as a short run substitute teacher full time without any problem.
*Gunilla*  But I don’t want to work as a short run substitute teacher.
*Helena*  No.
*Gunilla*  I was fed up with it after two months. Jumping back and forward. I don’t think you learn anything from it either. It feels like you just keep your nose above the water.
*Helena*  No, if you spend just one day here and one day there, but if you spend a week or so in one place. Then you learn something. You (turns to Nina) have probably had the best start of us all by being a teacher assistant. That is a fantastic job to have.

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Nina  You learn a lot but it doesn’t feel like that when you are there. But now when I have started, I realise that I’ve learned, or like that.

Helena, who has worked as a class teacher since graduation, resulting in both individual and social criteria being fulfilled in line with the image of a primary school teacher, but who has had difficulties with her class the last semester and resigned, expresses working as short run substitute teacher and teacher assistant as something positive. Just like in Barbro’s case, it may be that the image of a primary school teacher is obvious when you “fulfil it”; however, if or when you no longer fulfil the individual and/or social criteria, acquiring them becomes the focus in both current and designated identity. When Jenny, Gunilla and Nina work as short run substitute or teacher assistants, they are focused on becoming primary school class teachers and their focus is on the social criteria as such and not the substance within them. For example, their focus is not on what and/or how to teach but on teaching and, similarly, their focus is not on what and/or how to plan but on planning.

“Responsibility” is something that Nina says she lacks when working as a teacher assistant. Helena, who has not worked as a short run substitute teacher or a teacher assistant, sees these jobs as a possibility of getting experience of teaching without the responsibility associated with being a class teacher. This is a shift of hers since the last semester. Previously, she expressed short run substitute teaching as regression because she then would not be able to plan or follow-up on her own teaching. Now, on the contrary, after experiencing a problematic last semester, short run substitute teaching seems to be a good alternative, an alternative she has no experience of though.

At the time of the interview dialogue above, Nina has worked as a class teacher for six weeks and saying “now that I’ve started” indicates that she has now reached her designated identity as a primary school teacher. She has been working in a school for almost one and a half years but it is only in these six weeks that she has “started” to work in line with her image of a primary school teacher. If Helena, just some weeks earlier, had said to Nina that she had had “the best start” of them all, she probably would not have agreed as she was very frustrated over being “stuck” as a teacher assistant.

When the respondents introduce themselves at the group interviews completed two years after graduation, they all, without being asked to, say the orientation and specialisations they have in their teaching degree.

Barbro I graduated 2009. As an orientation, I took mathematics and science and then Swedish and Swedish as a second language as specialisations. I have been working since graduation.

When Gunilla tells the others that she teaches Swedish to adult immigrants, she is immediately asked by the others if she has “taken […] Swedish as a second language” within her teacher education. The courses taken within teacher education seem to be part of who you are as a kind of primary school teacher and the respondents seem to equate subjects within their teaching degree with knowledge64.

64 Doing that is in line with the teacher certificate that was introduced in Sweden 2012 but those discussions in the media started first at the end of the empirical period of this thesis.

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Both Barbro and Camilla\footnote{Camilla started to work in preschool directly after graduation as there were no teaching jobs. She has been working in different preschools since then.} are working at preschools, Barbro works part time and Camilla works full time, but they give different answers when asked what they work as.

<table>
<thead>
<tr>
<th>Researcher</th>
<th>If someone asks you what you work as, what do you answer?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camilla</td>
<td>Preschool teacher.</td>
</tr>
<tr>
<td>Researcher</td>
<td>Preschool teacher. Will you be able to get a preschool teacher certificate?</td>
</tr>
<tr>
<td>Camilla</td>
<td>That is discussed a lot. By rights, I will probably not.</td>
</tr>
<tr>
<td>[...]</td>
<td></td>
</tr>
<tr>
<td>Barbro</td>
<td>I call myself teacher.</td>
</tr>
<tr>
<td>Researcher</td>
<td>As a teacher. And you will get a teacher certificate now. When did you start to feel like a teacher? Did you feel that directly at graduation?</td>
</tr>
<tr>
<td>Barbro</td>
<td>Yes I did, because that was what I educated myself to be.</td>
</tr>
</tbody>
</table>

Both Barbro and Camilla have primary school teaching degrees and both work in preschools. Camilla calls herself a preschool teacher and Barbro calls herself a teacher. Barbro and Camilla had the same orientation in their teacher education but Camilla had a specialisation directed towards working in preschool. Camilla often refers to that course, which could be interpreted as her having the knowledge (individual criteria) that Barbro, on the other hand, says she lacks when working in preschool. Maybe the difference is also connected to their designated identities. Camilla can imagine continuing to work in preschool and she has not worked as a primary school teacher. Barbro has worked as a primary school teacher, and still works in school part time even though not as a class teacher, and it is probably more because of that than because a primary school teacher “was what she educated [her]self to be” that has made her feel like a kind of primary school teacher. Working as a primary school class teacher her first year after graduation made her receive feedback, from herself and others, in line with being a kind of primary school teacher. That has now changed but Barbro expresses the change as temporary and in her designated identity she is still a primary school teacher. Camilla has instead received feedback, from herself and others, in line with being a preschool teacher which also seems to be her designated identity.

The role of the image of a primary school teacher and the individual and social criteria in the professional identity development of the respondents is illustrated in figure 32 below.
Professional identity development aims at
the respondents’ designated identities as “a kind of primary school teacher” in line with their image of a primary school teacher.
is made possible by the individual and social criteria.

The individual can do the things "a kind of primary school teacher" does which enable feedback from self as a kind of primary school teacher. The individual and social criteria also influence the respondents’ possibilities to develop memberships in communities of practice in line with their image of a primary school teacher. These memberships influence the patterns of participation of the individual and their possibilities of receiving feedback from others as a kind of primary school teacher.

**Figure 32:** The respondents’ professional identity development aims at their image of a primary school teacher and is made possible by the individual and social criteria.

In the final group interviews, the respondents were asked if they felt like teachers⁶⁶ (or preschool teachers in cases where that was relevant) and, after that, if they felt like teachers of mathematics.

Helena [...] you still feel like new.
Researcher Yes. (turns to Nina) Does that apply for you too?
Nina Yes, I feel like really new.
Researcher But do you feel like a teacher?

⁶⁶ In the question, “teacher” was used, not “primary school teacher”.

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Nina referring to herself as “really new” mirrors her recent change of job which she “started” just six weeks earlier. She has been working in a school for almost one and a half years, but only the last six weeks have made her feel like a kind of primary school teacher, even though a “really new” one. Helena expresses herself as “new”, contrary to six months earlier when she said that she did not feel new. Maybe the problematic last six months when Helena experiences her competence as not being in line with her class has made her feel new again? Barbro does not feel like a new teacher but she says that the feeling of being new can be related to different situations.

There [Anglia School] I don’t feel new any longer. I don’t. Where I’m now, I have been there almost two67 years. Even though I have changed jobs a lot in that time. No. Sometimes you feel as, in some situations I can feel. […] since you have no experience and maybe haven’t done it before or like that. […] it is a little different in different situations. (Barbro)

Being “new” does not seem to be related to the time that has passed since graduation but to the time you have spent in an actual school or preschool. Also, one’s own role (for example being a “team leader”), the work tasks (for example planning and follow-up on teaching), accessoriness (for example participating at meetings) and responsibility (for example having one’s own class) influence whether the respondents feel new or not.

Researcher Do you still feel new?
Camilla No, I can’t say that I do because I have been to several different places so you have different experiences. Like now when we are setting up, we will get a totally new girl and you feel that you, you are not that new any longer. You’re to help buying new stuff and conducting interviews, who to hire, reading their personal records. Consequently, you are involved, so I can’t say that you are, but you are really a part of it.

As a preschool teacher, Camilla is “really a part of it” implying being able to influence (what to buy, who to hire) which makes her receive feedback from herself as not new. One aspect of feeling new or not seems to be if there are other staff members who are newer. Having a lot of influence and other staff members being newer than you, may if connected to the conceptual framework, be seen as Camilla having moved to a central membership mainly by engagement within a community of preschool teachers. This makes her have knowledge about and influence on the shared repertoire and there are other members being more peripheral members (or maybe they are not even members yet) than she is. Similar strong memberships in communities of practice can be seen in the cases of Barbro (“[t]here I don’t feel new any longer”) and Helena (I actually feel like one of the gang now). Acquiring the

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67 In reality she has not been at the school almost two years since she worked at another school the first semester, but one and a half year.
social criteria makes it possible to develop such memberships in communities of primary school teachers (or preschool teachers).

Based on the aim of this thesis, one important question is how mathematics and mathematics teaching is related to the respondents' image of a primary school teacher. Before graduation, based on their membership in the community of reform mathematics teaching, the respondents expressed a wish to become a primary school teacher who reformed the mathematics teaching in schools in line with the left side of the dichotomy. But, how is that related to the above described image of a primary school teacher?

When, two years after graduation, being asked if they felt like a mathematics teacher, the respondents all said no. That is a natural answer for some of them, for example, Gunilla who then taught Swedish as a second language to grownups. But nor have those who work as class teachers, teaching mathematics, developed a sense of themselves as a kind of mathematics teacher.

Gunilla  It's easy for me to answer that question. I don't feel like a teacher of mathematics.
Researcher  Have you felt like it at any time since graduation?
Gunilla  No
Researcher  Not even when you were teaching it?
Gunilla  No. [...] But no, I don't feel like a mathematicis teacher but I can absolutely see myself having a job as a class teacher within which teaching mathematics is a part.
Researcher  Nina?
Nina  [...] I have quite a lot mathematics right now but my biggest dilemma is that I came in like that, and have to practice mathematics teaching that's already been started. And I may not be one hundred per cent. I can feel like the next time I have mathematics, if I'm on my own and am to use a text book. I'll choose the text book I want to use, and how to use it.

A primary school teacher in Sweden teaches many subjects of which mathematics may be one. It does not seem to be enough to have a teaching degree including mathematics to develop a sense of yourself as a kind of primary school mathematics teacher. To develop this sense, you have to teach mathematics, but that does not seem to be enough either. Gunilla taught mathematics as a short run substitute teacher and Nina teaches mathematics as primary school teacher both in her own and another class but this does not make them feel like mathematics teachers. Nina indicates that you have to be able to decide you own mathematics teaching, which is in line with the above described development as a kind of primary school teacher. The mathematics teaching the respondents have done have not made them receive feedback, from themselves or others, in line with being a kind of primary school mathematics teacher. This may, similar to above regarding the image of a primary school teacher, depend on their image of a mathematics teacher.

Gunilla's expression "I don't feel like a mathematics teacher but I can absolutely see myself having a job as a class teacher within which teaching mathematics is a part."

68 The first semester after graduation Gunilla worked as a short run substitute teacher and then she, among other subjects, taught mathematics.
part" indicated that there are different degrees of being a mathematics teacher. Helena says that she would like to work more as a "subject teacher" and not have to bother about subjects she has not got in her teaching degree.

I would like to learn more about the history of mathematics. I would like to learn much more about why they discovered that it is like this and explanations to different things in that way. I don’t feel like a mathematics teacher as I don’t know that. (Helena)

To be able to feel like a mathematics teacher Helena says that she would need to know more about the history of mathematics. This can be seen as a lack of an individual criterion, knowledge, which stops Helena from developing a sense of herself as a kind of mathematics teacher.

There may be two different images of a teacher teaching mathematics where the image to the left (figure 33) is in line with the teaching degree of the respondents.

![Diagram](image)

**Figure 33:** Two different images of teachers teaching mathematics.

As mentioned, a primary school teacher in Sweden teaches many subjects but, at the same time they are the first teachers to teach mathematics to our school children. The thematic result regarding striving towards or away from presented in chapter four seems to regard the respondents’ image of a primary school mathematics teacher and not their image of a primary school teacher but, after graduation their designated identity seems to be a primary school teacher and not a primary school mathematics teacher. For the respondents in this study professional identity development as primary school mathematics teacher seems to be a two-step process where the first step is to focus on the image of a primary school teacher where the individual and social criteria are the pathway. After that, the next step (not done by all) to be focused on is the image of a primary school mathematics teacher. For the respondents to develop (and striving towards developing) a sense of themselves as a kind of primary school mathematics teacher; mathematics must become a part of their designated identity as primary school teachers and memberships in communities of practice containing mathematics must be possible after graduation. Mathematics must become a part of their image of a primary school teacher as an image of a primary school mathematics teacher, not as a two-step process but as an integrated whole.

In chapter one a primary school mathematics teacher was described as a primary school teacher who teaches mathematics. In the heading of this chapter and this section the word mathematics is encircled by brackets. The brackets are there to
indicate that even the respondents who, as primary school teachers, are teaching mathematics do not feel like mathematics teachers.

6.2 Identity development by feedback

In the section above, it was shown how the respondents first (possibly) develop a sense of themselves as a kind of primary school teacher and then (possibly) a sense as a kind of primary school [mathematics] teacher. When analysing the respondents’ identity development during the two years after graduation, a question emerged regarding what it was that made them recognise themselves as this (or not)? The individual and social criteria were one aspect but there seemed to be more involved in the process of professional identity development.

When coding the empirical material a pattern was discovered regarding expressions (words and/or actions) where the respondents made connections between their work in past and present (for example mathematics teaching) and/or utterances from colleagues, students and parents, where the latter were expressed as a positive confirmation of the former. These segments were coded as confirmation inferring on the respondent’s establishment of the correctness of their work (for example mathematics teaching). The segments within the code were sorted based on the source of the confirmation. By writing memos and developing and refining the codes, the category identity development by feedback was developed. When writing memos about confirmation, the connections to the need for feedback expressed by Gee (2000-2001) as making it possible to recognise ourselves and others, as a special kind of person became visible and that is why the word feedback, and not confirmation, is used to label the category. What kind of feedback, from oneself and/or others, is it that makes the respondents recognise themselves as a kind of primary school [mathematics] teacher (or not)?

The need of feedback from others was first noticed in the self-recordings made by Nina while she worked as a teacher assistant. In her work as a teacher assistant, Nina is lonely and in her self-recordings the major part is about being confirmed.

_Today a teacher came around and said “Hello Nina with the enormous patience”. And then I thought “what”? And she said that she thought I did such a good job. […] And this felt really great; of course it warmed my heart hearing that. I took it as praise. […] actually nobody else has confirmed that “yes, we also believe it’s working out fine”. Therefore, it felt extra good to hear something. After all, you are a little insecure and want people to appreciate what you are doing. (Nina) _

The feedback Nina gets from others is important but it does not make her develop a sense of herself as a kind of primary school [mathematics] teacher since the feedback is in line with her being a teacher assistant. At the beginning of her work as a teacher assistant, Nina is disappointed that the headmaster has not contacted her to confirm how she is doing.

69 When brackets are used it is to indicate that even the respondents who, as primary school teachers, are teaching mathematics do not feel like mathematics teachers.
[…] it would have felt good for me as completely new if she had told me that [that she is doing a good job] and been engaged. Showed that she cares about me. (Nina)

Later, when the headmaster does contact Nina, Nina becomes really happy since the headmaster has positive news giving Nina feedback that she is doing a good job.

Today, I am really happy because the headmaster came to me. […] today the headmaster actually came to me and asked if I could work full time. The school budget had money left and she thought it was important for me to have more time. And that felt great because now it suddenly feels as if she cares about me. They want to keep me on. (Nina)

Similarly, the other respondents express feedback from colleagues as important. In Helena’s case, feedback from colleagues becomes central to how she designs her mathematics teaching. In the community of science, she receives positive feedback for acquainting all of the students with all parts of the text book, which may be the first time she receives positive feedback for her mathematics teaching after teacher education. To get more of that feedback, Helena orientates her teaching in line with the shared repertoire in that community.

Both to themselves and to colleagues, the respondents want to show that they are good primary school [mathematics] teachers and feedback from themselves and colleagues becomes a part of their professional identity development. Also feedback from parents and students is important to the respondents.

All the personal development dialogues have been positive. All the students think that mathematics has become more fun. And that, that feels nice. […] I can feel that I have received a lot of positive feedback during the personal development dialogues. (Helena)

Yes, it was really fun. I received; during the lunch break the girls said that you are so much better than our teacher. (Jenny)

When talking about teaching and students learning, it is important for the respondents to show others, and through them, be confirmed as someone who knows how to teach (mathematics). The feedback in the first quotations above focusing on fun is in line with the left side of the dichotomy as feedback being a good mathematics teacher. The respondents also want to be sure that the students learn mathematics from their teaching and when students learn this brings about feedback in line with being a good primary school [mathematics] teacher.

I feel this pressure the whole time that I want my students to perform. (Nina)

I actually feel that you have quite a lot to prove; both to yourself and that I actually have to prove that I know this. I’m new but I know this. And I think that feeling is gone when you have twenty years of experience. (Gunilla)
One way of getting feedback from students learning is through assessment⁷⁰. As mentioned before, Helena changes students three times during the two years after graduation, but, independent of students or grade, she uses and talks about assessment in the same way throughout the two years. Mathematics lessons in her classes often start with a Diamond diagnostic test, an optional test provided by the Swedish National Agency for Education. Helena puts the students’ results together in different score tables which she often shows me.

Yesterday [...] we had a little test in mathematics. I am testing them with tests from Diamond. And we have been working with sequences of numbers and simple shapes. And that result was really good which felt very good. [...] I believe it feels quite nice. (Helena)

When using and talking about the Diamond diagnostic test, Helena does not emphasise how she is going to perform future teaching based on the results; instead, she emphasises how she feels and the assessments confirm her sense of self as a kind of primary school [mathematics] teacher. Assessment is primarily used by her to confirm her mathematics teaching, not to plan future teaching. In order to feel she is doing a good job, Helena keeps records (score tables) of the students’ learning. For Helena, the records of test results become feedback of students learning mathematics. Similarly, Nina expresses the importance of students learning mathematics from her teaching and that this learning are to be seen by others.

[...] everything you do is to result in knowledge [...] I will show that I know this and that I know how to teach. (Nina)

Assessment becomes a way of getting feedback from students learning mathematics and feedback from themselves and others of being a kind of person who can teach mathematics. Helena marks the students’ work after every mathematics class and keeps a record of their work. She says she needs to do this to “have backing”. After mathematics lessons, she checks all of the students’ work because, as a “new teacher”, she wants to be in control.

[...] I ought to have control. Maybe it is because you are new and a little insecure and want to know you have control of what you are doing. (Helena)

When performing different assessments, Helena often equates the students’ results with understanding, e.g. “most of them have understood what it is about” or “test how much of it they understand now”.

Yesterday [...] we had planned to split the class in two halves during the mathematics lesson. [...] After the lesson, I actually felt that most of them understood. They worked and when I looked through their papers it felt good because most of them have understood what it is about. (Helena)

⁷⁰Assessment is used here as an umbrella term for different kinds of written evaluations of students’ knowledge in mathematics. The respondents’ use of assessment was presented at the Maclif-Conference in Sweden, 2012 (in press).
In the quotation above, what also is interesting is what Helena does not say. She does not talk about the layout of the mathematics lesson (even though her saying that she has looked through “their papers” indicates that the students have written something connected to mathematics during the lesson) or about the mathematics content that the students had understood. What she singles out is that their understanding “felt good”.

Not all actions and/or utterances in the empirical material regarding assessment were labeled within the code confirmation by assessment. In situations like in the above quotation when students are not learning, Helena often emphasises different possible reasons for that.

[...] I cannot understand how they have been able to let him through fourth and fifth grade and half of grade six without reacting. [...] The action plan
actually states that him reaching the goals in every subject is not the vision right now. (Helena)

One time, when three students fail a test in the text book, Helena explains to me that two of them have action plans in mathematics and that the third was about to get one and that “he should have already had one in grade four.” In a way, such explanations absolve Helena from the responsibility for the students’ non-understanding and non-learning and enable her to focus on the confirmation of the students which indicates that they are learning mathematics. Similarly, when Nina starts to work as a class teacher in a new school, she becomes worried that the poor mathematics knowledge of the students will be associated with her.

I feel like I want to tell everybody that they are that weak now. [...] later, when I hand them over, I don’t want them to think, Nina, what was she doing? Consequently, I feel an enormous pressure. (Nina)

As such the respondents use assessment as feedback to get confirmation of students’ learning mathematics to develop a sense of self as a kind of primary school [mathematics] teacher. Assessment indicating students not learning are on the contrary not connected to their mathematics teaching but to other circumstances, for instance the mathematics teaching in lower grades.

Based on different steering documents in Sweden, assessments are intended to be used to evaluate and inform students, parents and headmasters about the knowledge development of the individual students, to provide fair judgment of students, to increase target achievement, to map the knowledge development of students and to provide material when planning lessons. The content in steering documents in Sweden may be seen as framing a shared repertoire in a document-based community of practice regarding assessments. Wiliam (2007) mentions evaluating the quality of educational programs as one purpose with assessment. In this study the respondents instead use assessments to evaluate their own teaching. To get confirmation of student learning mathematics they use assessments in mathematics that can bring about the wanted confirmation. Assessments (for example tests in text books and the Diamond diagnostic tests) designed for formative assessments (supporting learning)

71 In Sweden, action plans are to be written for children who are at risk of not reaching the goals in specific subject.
are used in a summative way (certifying the achievements or potential of individuals) as confirmation of students understanding and learning.

The respondents' use of assessments can be understood as a merger of the shared repertoire in a document-based community of assessment and the need for confirmation of student learning in the respondents' professional identity development as mathematics teacher. Also the community of reform mathematics is visible in the use of Diamond-diagnostic tests that the respondents became acquainted with during their teacher education. When talking about assessment in general, the respondents stick strictly to the curriculum, but, in their use of assessments; those aims are no longer their focus. They map the students' results but do not use them as material for planning lessons but, rather, as feedback of students learning indicating that they are doing a good job as (mathematics) teachers.

In one way, the respondents are able to determine their own feedback through assessment. They can choose when to test the students and on what. According to the situative perspective used in this thesis there is no linearly correlation between teaching and learning (Peressini et al, 2004) but even so, the respondents, by their teaching and choice of assessments, have a big influence on their own confirmation by assessment. In the classrooms the merged patterns of participation regarding assessment results in a lot of focus on assessments, both in talk and actions. The structures of the lessons are affected as they often start with, or end with, an assessment from the textbook or the Diamond diagnostic test. But, there are seldom visible actions in the mathematics teaching that can be connected to the results from these assessments.

Summarised, feedback from themselves and others appears to be a central part of the respondents becoming primary school [mathematics] teachers. As a result of different positions at different times, the respondents vary their focus concerning this feedback. The feedback the respondents receive from others is not always in line with their image of a primary school mathematics teacher and, therefore, does not always result in the respondent recognising themselves as such. One example of that is when Nina works as a teacher assistant and later as a primary school class teacher. As a teacher assistant, Nina has not got her own class, she does not attend any staff meetings and she calls herself “the lonely one at school”. Even though she enjoys the school and values her colleagues, she feels lonely in her position. Maybe, as a result of that, getting feedback being someone who is doing a good job becomes central for her. She also emphasises when she gets feedback in line with being a primary school teacher, e.g. when saying “I'm as much a teacher for the students as Diana is”. Later, as a class teacher, Nina experiences the parts she was missing as a primary school teacher assistant and, instead, in order to feel that she is doing a good job, wants feedback that the students are learning mathematics.

Memberships in communities of practice are one important part regarding the respondents' possibilities of getting feedback from others and the kind of feedback they may get. The respondents do not get any positive feedback when teaching mathematics in line with the shared repertoire of the community of reform mathematics teaching. Feedback from others is difficult to get in a community of practice where you are a member through imagination, as feedback requires some kind of interaction, though not necessarily physical interaction. When you are a member through imagination, others in the community of practice may not know about your membership. In communities where you are a member through engagement or alignment, other members are aware of your membership. Either we are engaged with them or they are the ones making us align. Whichever is the case,
their awareness of our membership makes feedback from others possible. The importance of memberships in communities of practice in relation to feedback also implies the importance of the individual and social criteria presented in the previous section. For example, it is difficult to get feedback from parents when not having one’s own class since contacts with parents seldom are included in the work of short run substitute teachers. When working as a teacher assistant, as Nina did the first year after graduation, the feedback from the parents is not in line with being a “real teacher”. Acquiring the social criteria makes it possible for the respondents to become members in communities of practice where a kind of primary school mathematics teacher is a member. Becoming that, influences the respondents’ possibilities to get feedback from themselves and others and also the kind of feedback they may get.

In a review of research about feedback, Hattie and Timperley (2007) propose a model of feedback that is to be used to identify the circumstances under which feedback has the greatest impact. Their focus is primarily on students learning but parallels can be drawn to the feedback in this thesis treating identity development as learning. According to Hattie and Timperley, feedback is a “consequence of performance” (p.81) as feedback is information provided by an agent regarding aspects of one’s performance or understanding. The feedback focused on in this thesis is the feedback being focused on by the respondents and, based on that, the agents have proven to be students, parents, colleagues and assessments. The feedback is both given by others (students, parents, colleagues) and sought by the respondents (assessments).

According to Hattie and Timperley, feedback has no effect in a vacuum and it has to be a learning context in which feedback is addressed. The learning context in this thesis is the process of professional identity development as a primary school mathematics teacher. Furthermore, feedback according to Hattie and Timperley, can be accepted, modified, or rejected. The feedback being accepted by the respondents is mainly the feedback in line with their image of a primary school mathematics teacher. Feedback in the form of students not succeeding when assessed is, on the contrary, rejected. According to Hattie and Timperley, some types of feedback are more powerful than others where they question if rewards should be thought of as feedback at all. The feedback the individuals in this thesis get from parents, students and colleagues is mostly rewards which are only occasionally connected to their ability to teach (mathematics). When Helena, for instance, says that the parents and students have said mathematics has become more fun since she started as a teacher that reward (that feedback) does not really refer to the quality of her mathematics teaching even though it (fun) can be connected to the left side of the dichotomy.

According to Hattie and Timperley, the “main purpose of feedback is to reduce discrepancies between current understanding and performance and goal” (p.86). Current understanding and performance and goal can be compared to the notions of current identity and designated identity. In their professional identity development, the respondents would need more feedback in line with their goal (their designated identity), in line with their image of a primary school [mathematics] teacher. During the time for this study, the respondents receive little feedback of that kind and they hardly receive any feedback for their performance as mathematics teachers. For example, Helena gets feedback related to mathematics teaching when she becomes a member in the community of science and her membership in that community has big influence on her mathematics teaching. Aside from that and a few other similar situations, the respondents have to provide themselves with feedback regarding their mathematics teaching and they do this, for example, through their use of assessment.
The figure below (figure 34) is a further development of figure 32 and summarises this and the previous section. To be able to recognise themselves as a kind of primary school mathematics teacher, the individual needs feedback, from oneself and others, of being a kind of primary school mathematics teacher. Such feedback is a part of the respondents’ becoming as primary school mathematics teachers, a part of their professional identity development. The feedback wanted is influenced by the image of a primary school mathematics teacher which is part of the respondent’s current and designated identities.

- Professional identity development aims at
  - the respondents’ designated identities as “a kind of primary school [mathematics] teacher” in line with their image of a primary school [mathematics] teacher.
  - is made possible by the individual and social criteria.

- The individual can do the things "a kind of primary school [mathematics] teacher" does which enable feedback from self as a kind of primary school [mathematics] teacher.
  - The feedback wanted is influenced by the current and designated identity of the respondents.
  - The individual and social criteria influence the respondents’ possibilities to develop memberships in communities of practice in line with their image of a primary school [mathematics] teacher.
  - These memberships influence the patterns of participation of the individual and their possibilities of receiving feedback from others as a kind of primary school mathematics teacher.
Figure 34: The respondents’ professional identity development aims at their image of a primary school [mathematics] teacher. This professional identity development is made possible by the individual and social criteria as they influence the respondents’ possibilities to become members in communities of practice and to receive feedback in line with their image of a primary school [mathematics] teacher.

6.3 Frames for teaching mathematics

At the time of graduation, the respondents talked about elements that would limit their possibilities of teaching mathematics in line with the left side of the dichotomy, limitations to reaching their designated identity as good primary school mathematics teachers. This was presented in section 4.5.3. In this section, those expressed limitations are focused on again but now based on the empirical material from the two years after the respondents’ graduation. Did the limitations exist? If they did, how were they handled by the respondents and how did they influence their professional identity development as primary school [mathematics] teachers?

Even though none of the respondents express themselves to feel like a mathematics teacher two years after graduation, they have a lot to say about mathematics teaching. All of them have taught mathematics, one way or another, in school and/or in preschool. When coding the empirical material first the words used by the respondents before graduation (knowledge, experience, traditions, lack of teaching jobs, other teachers, lesson patterns, lack of time, local goals, lack of material, lack of resources and text books) were focused on. Which of these limitations did the respondents express (words and/or actions) after graduation and what meaning were they labeled with now? Additionally, the dichotomy that was developed based on the interviews before the respondents graduation was shown to them to reflect on in the final group interviews two years after graduation. After that, a new coding was done (on the whole empirical material) focusing on segments where the respondents expressed (words and/or actions) obstacles, difficulties and/or resistance. Based on the memo-writings of these codes the category frames for teaching mathematics were developed.

In the final group interviews, the respondents were asked what they, two years after graduation, thought about their teacher education in general, and their teacher education in mathematics education in particular. Even though they are not completely happy with their teacher education as a whole, they spoke positively about the mathematics components it contained.

Gunilla  What I really wanted was to get some input into what you could do in math that was more fun than the math you experienced yourself in school. Sitting with the text book. Every single lesson. And I got that. Especially the practical math I had missed myself. (The others nod) That you felt a little pleasure in relation to mathematics and that you realised that it can really be fun. So I was pleased with the math education here.

Helena  Me too. […] the math was good. But I wanted to know some more about the history of things. I feel that.
Nina  I guess I also think the math was good here. You got a lot of concrete tips that you maybe hadn't been thinking about yourself. I guess you have calculated a lot in text books.

Gunilla  And also the possibility of receiving a lot of material.

Helena  I was about to say that. All the material you have at home. You look into that all the time, look and use and do things with it.

Nina  It is really great.

As before graduation, the respondents talk about having experienced another way of teaching mathematics in their teacher education. When being confronted with the dichotomy (as presented in figure 10) no one of the respondents comments on the division between the left and the right side saying that something needs to be changed, removed or added. Instead, they started to talk about the dichotomy in relation to the mathematics teaching they had experienced and performed in the two years after graduation and it becomes clear that they agree with the division and that the left side is still preferable. Camilla says that the left side of the dichotomy “feels a little like the modern teacher as it strives towards” while the right side “is more the old fashion way”. Gunilla says that she thinks that “a lot of teachers wish” they could work in line with the left side of the dichotomy but that “they feel unsure regarding [if they] getting everything in” and therefore they do not “dare fully”.

Will we reach our goals working like this? (points at the left side of the dichotomy) Do I dare step away from the text book, leaving this traditional and safe way of working? Or will I risk my students failing? (Gunilla)

Gunilla’s use of “we” seems to be aimed at teachers other than herself; we, as in the teachers teaching mathematics in line with the right side of the dichotomy. The respondents say that the left side of the dichotomy is more visible in lower primary school than later on and that the left side calls for an increased engagement from the teacher as it is easier to use the text book just saying what pages to work on. The respondents also talk about the difficulty in considering all students individually in groups of twenty-five to thirty students.

All in all, the respondents seem to agree with the dichotomy. Two years after graduation, they are still members in the community of reform mathematics teaching, though through different modes and at different degrees. Two years after graduation, their professional identities as primary school [mathematics] teachers are very different (and sometimes absent) but they still talk similarly about how they would like to teach mathematics. They do not express any objections towards the dichotomy but, instead, start to talk about why they and other teachers do not teach mathematics in line with the left side of the dichotomy. The text book seems to be both a resource and security for teachers and also necessary when working with some groups of students.

Nina  I can feel that the next time I teach math, if I am by myself and I'm to have a text book, I'll choose what book I want to use. And how to use it. […]

72 They were asked about if wanting to do this.
Helena  Somehow it is [the text book] something to lean on, being able to land in it provides security. And a bothersome class actually needs a text book.

Nina  I feel that. I need that structure because of them. This class needs to learn to sit on their chairs. They need to learn to listen to a simple instruction and then work by themselves. [...] And you plan really a lot and think that this will be good but it still becomes crap and then you feel like, no. Now I won’t put more time into this. Now they shall work in their text books.

Helena  Many times though, I experience that the students have a really hard time with taking responsibility in free teaching. It [the text book] gives the students security and a structure. Though it is like a frame to relate to. [...]"

In section 4.5.3 the limitations the respondents expressed regarding how they wanted to teach before graduation were described as internal and external limitations. Internal limitations were connected to the respondents’ own ability while the external limitations figured out in the schools. Internal limitations mentioned before graduation were lack of knowledge and experience while the external limitations mentioned were traditions, absence of teaching jobs, other teachers, lesson patterns, and text books, lack of time, local goals, lack of material and lack of recourses. Before graduation, traditions and other teachers were expressed as possible future limitations as the respondents wanted to teach mathematics differently to the mathematics teaching they expected to meet in schools. They said that they might have to adapt to the prevailing mathematics teaching so as to be accepted. Two years after graduation, other teachers are still expressed as a limitation, but not by preventing the respondents from teaching as they want, but by being absent.

*There is absolutely no organisation on the whole at the school. And no, it is a little different. Not different but everyone is running their own race. [...] nobody knows what I do. I can do what I want to because nobody. There are no goals and no matrixes. Nothing in common.* (Nina)

The respondents lack the opportunity to collaborate with and get support from other teachers. Helena says that nobody has been nasty but that everyone has too much to do and, therefore, do not have time for somebody else. Similarly, those who have worked as short run substitute teachers say they have been lonely even though everybody has been nice to them. They say that “new teachers” need to be taken care of in the beginning. To teach mathematics as they want is not easy because, as Gunilla says: “I can do what I want to do but what will I do then?” The worry the respondents expressed before graduation regarding being limited by traditions and other teachers has changed into a wish that other teachers would take more notice of them.

*I feel that the thing you need when you get out there is a mentor. [...] That is something I can miss sometimes because I did not have that the first year. [...] You would almost need to work as a trainee, if you say like that.* (Barbro)
The respondents' wish, that other teachers would take more notice of them, is in line with the previously discussed problems for them to get teacher jobs and becoming members in communities of practice where teaching (mathematics) is part of the shared repertoire, where they can get feedback in line with being a kind of primary school mathematics teacher.

One person who was not mentioned before graduation, but is mentioned both as a support and a limitation after graduation, is the headmaster. For Barbro, the headmaster at her second school has been a support while Nina says that the headmasters at her schools have been absent. For instance, Nina tells about her disappointment with a headmaster who had not talked to her since she started at the school. She says that it would have felt good for her as “completely new” if the headmaster had given some response, “[s]howed that she cared about me”.

Above, it was shown how the respondents talked about the text book as something necessary when working with some groups of students. Two years after graduation, students are expressed as what’s limiting the respondents the most. The respondents say that they have to adapt their teaching to the students as otherwise it “becomes total chaos”. The students are said to need a simple structure since they are not self-controlled. Students were only mentioned once as a possible limitation before graduation, by Helena, and then in relation to students’ unfamiliarity with mathematics teaching in line with the left side of the dichotomy. The students the respondents meet after graduation are described as lacking self-control and self-motivation which are expressed as preconditions for the respondents to teach in line with the left side of the dichotomy. To be able to collaborate, the students must first learn to work alone. To be able to discuss with each other, the students must first learn to be quiet. Contrary to the dichotomy, the respondents say that the students become comfortable when working “traditionally with the text book”. These two expressed comforts probably regards two different things, comfortable with what will happen during the lesson (right side of the dichotomy) or comfortable with mathematics (left side of the dichotomy).

The respondents express time as limiting and especially the time they have to deal with what they call “extra work”. This “extra work” is nurturing, conflicts, different staff meeting and calls from parents in the evenings. They say that they have discovered that being a teacher implies much more than teaching and that working as a teacher takes a lot more time than they thought it would. This is the same regardless of the kind of assignment the respondents have had during the two years and the workload was unexpected.

**Gunilla**  
I had expected that it would be a lot but not how much.

**Helena**  
Not that much. No

**Gunilla**  
And not that the focus was on something totally different to what I expected. I thought that the planning of lessons would take time and yearly planning and subject planning. That those things would take time. But it doesn’t feel like that is what you have spent the most time on. […]

**Helena**  
You could work yourself to death. Without a problem. Those bloody forty-five hours a week, they just sweep by. […] that was a clock. You had imagined that there would be a lot but not that there would to be that much. No.
According to the respondent the other teachers in schools also work a lot but with the difference that the respondents have to prepare everything for the first time and that they do not always know where to find the material they need at the schools.

*It was like now after Christmas. I’m starting to work with weights with my second graders. I was sitting at home planning. But then I suddenly, What kind of scales are there? How many are there? [...] Things that you might know after a while, But everything takes such a long time. [...] then I used them for one lesson and after that they’ve been lying on a shelf.* (Nina)

The lack of time and the heavy workload are expressed as limiting the respondents from teaching mathematics in line with the left side of the dichotomy because that teaching, according to them, requires more time for preparation and creativity from them.

* [...] it just becomes something in wild panic. Most often just something, take something from Lesson*73 *or something that someone else has done, just read through the part and go.* (Helena)

Both before and two years after graduation, **goals** are expressed as a limitation between the right and the left side of the dichotomy, this even though the left side is expressed as the desirable mathematics teaching. Including and working with all of the goals limits the respondents’ possibilities to design mathematics teaching as they would like to.

**Helena**

*There is so damn much that you have to keep up with. So incredibly many goals you have to look at. [...]*

**Nina**

*But I think that the ones who have been around a while they just, yeah yeah. They are not that controlled by the syllabus in the same way. But, on the other hand, I’m not saying that they are doing the right thing.*

Two years after graduation **parents** are mentioned as a limitation stopping the respondents from teaching mathematics as they would like to, something they were not two years earlier. Before graduation Jenny mentioned being worried about personal development dialogues but now other problems are focused on. The respondents talk about parents who do not help their children with their homework, parents who help their children with their homework but in the wrong way (for example, by doing the homework for them), parents who fight with each other (both within and between families), parents who do not take their children to school on time in the mornings, parents who interfere with their teaching and parents who call them at home in the evenings. Parents as a limitation is expressed as a surprise by the respondents as in teacher education, according to them, they had been taught about parents’ influence as something positive that they could use as a resource. Nina says that, before graduation, she thought that she would receive help from the parents but that “they take so much energy”. At the same time, as shown in the previous section,

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73 A nickname for a website where teachers can publish and download lesson plans.
positive feedback from parents is important for the respondents to develop a professional teacher identity. However, they say that there is more negative than positive feedback from parents and the lack of time, the problems with students and the problems with parents seem to be interrelated.

Finally the lack of material and poor economy (making it impossible to buy new material) are expressed as limitations two years after graduation, just as they were before. As shown earlier (section 6.1) knowledge and experience are also talked about after graduation but not as before. Before graduation knowledge and experience were talked about as limitations to being able to teach mathematics as they would like. After graduation knowledge and experience are talked about as individual criteria making it possible for the respondents to recognise themselves as a kind of primary school [mathematics] teacher.

Previously in figure 34 it was shown how the respondents need feedback, from themselves and others, of being a kind of primary school [mathematics] teacher to be able to recognise themselves as a kind of primary school [mathematics] teacher. Such feedback is a part of the respondents’ becoming as primary school mathematics teachers, a part of their professional identity development. The nature of the wanted feedback is influenced by the image of a primary school [mathematics] teacher and that image is part of the respondent’s current and designated identities. The limitations presented in this section, the frames for teaching mathematics, prevent the respondent from reaching their designated identity in line with their image of a good primary school mathematics teacher. The respondents’ experience of limitations is in line with an induction research overview by Feiman-Nemser et al. (1999) which shows that novice teachers most frequent and serious problems are classroom discipline, students’ motivation, dealing with individual differences, assessing student work and relating to parents. Regardless of how the respondents deal or do not deal with these limitations, two years after graduation they say that limitations exist preventing them from teaching mathematics in line with their designated identity as good primary school mathematics teachers.

6.4 A summary of professional identity development as a primary school mathematics teacher

Professional identity as a primary school mathematics teacher is to recognise oneself as a kind of primary school mathematics teacher. To be able to recognise oneself as that, the individual needs to develop patterns of participation which make possible such a recognition. But, what are the patterns of participation of a primary school mathematics teacher and how does an individual develop it?

To develop a sense of themselves as a kind of primary school mathematics teachers individuals needs to develop patterns of participation in line with their image of a primary school mathematics teacher. That image is part of the individual’s current and designated identity. In the study, the respondents’ image of a primary school teacher was very consistent and their professional identity development as a primary school mathematics teacher seems to be a two-step process. Their first step is to focus on the image of a primary school teacher where individual and social criteria are the pathway. Regarding the individual criteria (graduation and knowledge), the respondents have the “power”, while they are dependent on others regarding the
social criteria (one school, one’s own class, teaching, planning, colleagues). After the individual and social criteria are acquired, the next step (not done by all) is to focus on the image of a good primary school mathematics teacher.

The individual and social criteria make the process of professional identity development in line with the conceptual framework, by identification and negotiation, possible. According to Wenger (1998), identity development is an individual’s learning trajectory through different communities of practice. That learning trajectory can be interpreted as changes in an individual’s long-term patterns of participation. Long-term and immediate patterns of participation affect and are affected by the communities of practice the individual is, wants to or does not want to be a member or the one’s from which she is excluded, as well as what kind of membership she develops.

The four presented cases have made visible how the respondents’ patterns of participation are influenced by their memberships in communities of practices. It has become visible that the respondents’ patterns of participation regarding teaching mathematics changes when they become members of new communities of practice with mathematics teaching as part of the shared repertoire. But, it has also become visible that the existence of such communities seems to be rare and the respondents’ different working conditions limit their possibilities of becoming members in those that exist. The case of Helena is a case of professional identity development as a primary school [mathematics] teacher. The case of Nina is a case of searching for a professional primary school teacher identity. The case of Barbro is a case of conflict within the professional identity development. The case of Jenny is a case of absent professional identity development as a primary school mathematics teacher. These different cases, these different professional identity developments can be described and understood by using the conceptual framework. The cases are examples of how the conceptual framework makes it possible to capture both the individual and the social as unit of analysis. By looking at engagement, imagination and alignment, the individuals’ memberships in different communities of practice can be analysed. At the same time, the grounds for a community of practice can be analysed by looking at mutual engagement, joint enterprise and a shared repertoire. By coordinating patterns of participation and communities of practice, descriptions can be offered regarding how patterns of the individuals are the merged results of different kinds of participation in different kinds of communities of practices (figure 35).
The individual in the foreground

Professional identity as a primary school mathematics teacher implies doing the things a kind of primary school mathematics teacher does and by that develop a sense of being a kind of primary school mathematics teacher. That is, the individual develops long-term patterns of participation in line with their image of a primary school mathematics teacher. The image of a primary school mathematics teacher is part of both the current and designated identity of the individual. The individual’s patterns of participation influence the feedback the individual gets from oneself and others. Feedback in line with being a kind of primary school mathematics teacher influences the individual’s sense as a kind of primary school mathematics teacher.

The social in the foreground

Individual and social criteria are pathways to become member in communities of practice were a kind of primary school mathematics teacher is a member. Which communities of practice that is depends on the image of a primary school mathematics teacher. Changes in memberships in different communities of practice influence the patterns of participation of the individual. Different kinds of membership in different kinds of communities of practice influence the individual’s possibilities to identification and negotiation and the feedback the individual can get from self and others in line with being a kind of primary school mathematics teacher.

Figure 35: An illustration of the professional identity development as a primary school mathematics teacher with the individual and social in the foreground, respectively.

None of the respondents express that they feel like a mathematics teacher two years after graduation but they have, as they had before graduation, a lot to say about mathematics teaching. Before graduation the respondents were part of an ongoing negotiation regarding good and less good mathematics teaching which was objectified as a dichotomy. This dichotomy was describes as a shared repertoire in a community of reform mathematics teaching. The dichotomy was confirmed by the respondents two years after graduation and, similar to before graduation, the respondents talked about having experienced a new way of teaching mathematics, the left side of the dichotomy, in their teacher education. Two years after graduation, the respondents are still members in the community of reform mathematics teaching, although by different learning trajectories. Two years after graduation, the professional identity as primary school [mathematics] teacher of the respondents’ are very different (and sometimes absent) but they still talk similarly about how they would like to teach mathematics. Their image of a good mathematics teacher has not changed and is still a part of their current and designated identities. Even though the designated identity of the respondents regarding a good mathematics teacher has not
changed they two years after graduation express limitations (as they did at the time of graduation) which prevent them from teaching mathematics in line with the left side of the dichotomy. The individual and social criteria make it possible for the respondents to develop patterns of participation in line with their image of a primary school teacher. After that, the limitations, the frames for teaching mathematics (for example, students, lack of time, parents) prevent them from reaching their designated identity as a good primary school mathematics teacher.

Feedback from oneself and others appears to be a central part of becoming a primary school mathematics teacher. The feedback is both given by others (students, parents, colleagues) and sought by the respondents (assessments). As a result of different positions at different times, the respondents have different focuses concerning this feedback. The feedback the respondents receive from others is not always in line with their image of a primary school (mathematics) teacher, and therefore it does not always result in the respondents recognising themselves as such. Membership in communities of practice is one important part regarding the respondents' possibilities of getting feedback from others and the kind of feedback they may get. Feedback from others is difficult to get in a community of practice where you are a member through imagination as feedback requires interaction, though not necessarily physical interaction. The respondents do not get any positive feedback when teaching mathematics in line with the shared repertoire of the community of reform mathematics teaching. When you are a member through imagination, others in the community of practice may not know about your membership. In communities where you are a member through engagement or alignment, other members are aware of your membership. Either we are engaged with them or they are the ones making us align. Whichever is the case, their awareness of our participation makes feedback from others possible.

In their professional teacher identity development, the respondents would need more feedback in line with their image of a good primary school mathematics teacher. During the time for this study, the respondents hardly receive any feedback for their performance as mathematics teachers. If the individual and social criteria are fulfilled, the individual can become a member in communities of practice where a kind of primary school mathematics teachers are members and do things that a kind of primary school mathematics teachers do which makes feedback from oneself and others in line with being a primary school mathematics teacher possible. Mathematics is not the main aim (sometimes not the aim at all) in the professional identity development of the respondents. During this study none of the respondents are members in a community of practice with mathematics content as a primary part of the shared repertoire. The respondents do not seem to participate or negotiate in any community of mathematics which results in mathematics content being very little focused on when they talk about or teach mathematics. A primary school teacher in Sweden is a teacher of many subjects but they are the first mathematics teachers to teach our school children mathematics. For the respondents to develop a sense of themselves as a kind of primary school mathematic teacher, mathematics teaching has to become part of their designated teacher identities, and memberships in communities of practice with mathematics and mathematics teaching in the shared repertoire must be possible, both during teacher education and after graduation. For this to become possible, mathematics must become a part of the image of a primary school teacher as an image of a primary school mathematics teacher, not as a two-step identity development process but as an unified whole (figure 36).
To be a class teacher is to be a teacher of mathematics. When you as a primary school teacher teach mathematics you are a mathematics teacher.

Figure 36: An image of a primary school mathematics teacher as a unified whole.
7. DISCUSSION

In this chapter, the content of the thesis is discussed both retrospectively and progressively. The retrospective discussion focuses on the conceptual framework, the design and analysis of the empirical material and the results. After that, there is a progressive discussion regarding the implications of this study for future research. It is worth noting, however, based on the approach in the study that there are several connections between the different parts. Lastly, the quality of the study and the thesis as a whole is discussed.

7.1 Focusing on the conceptual framework

Using the conceptual framework, it has been shown that it is possible to understand and describe novice primary school mathematics teachers’ professional identity development. The conceptual framework was developed to include “the-teacher-in-the-learning-community-in-the-teacher” (Graven & Lerman, 2003) where this study has taken “the-teacher-in-the-learning-community” as its entry point but the conceptual framework also makes “the-learning-community-in-the-teacher” visible. Since the conceptual framework captures both the individual and the social, the results presented in this thesis have implications for both teacher education and schools that employ novice (mathematics) teachers after graduation (examples are given further on).

In this study, the respondents’ stories have been focused on with the purpose of understanding their experiences from their perspective. Ball, Lubienski and Mewborn (2001) stress the difference between talking about teaching and actually teaching, which is critical in relation to the operationalisation of the conceptual framework. However, based on the ethnographic direction and the analysis made using the conceptual framework as a lens, the stories of the respondents are included within the above described wholeness.

Some might argue that it was previously known that school culture and colleagues impact novice teachers. However, the results presented in this thesis enable an understanding of how and why such an impact occurs. Furthermore, these new understandings make it possible to reinterpret results from earlier studies regarding novice teachers’ regression after graduation. Instead of regression, those changes can be described as learning in communities of practice. The changes are not regression, but rather professional identity development in forms of learning as increased membership in new communities of practice. And, if novice teachers are to develop a professional teacher identity where teaching mathematics has a (core) role, memberships in communities of practice with mathematics teaching as part of the shared repertoire must be possible both during and after the teacher education.
7.2 Focusing on the design and analysis of empirical material

The aim of the design of the empirical material was to make both the individual and the social parts of professional identity development visible from the perspective of the respondents. In line with the ethnographic direction, interviews (formal and informal) and observation (participating and non-participating) were used and, based on practical circumstances, also self-recordings. These self-recordings were shown not only to contribute alternative empirical material but also empirical material with a character of its own. Field notes made by the respondents could have been an alternative to self-recordings; however, it is less time-consuming to talk than to write. The self-recordings also included components such as emphasis and feelings which are excluded when writing. The use of self-recordings was new to me and some reflections will be noted here in relation to using them in the future.

The number of self-recordings made by each respondent in the study is related to the amount of observation conducted with them. For example, Nina, who could not be observed when working as a teacher assistant, made a lot of self-recordings. In contrast, Helena, who was observed a lot, made fewer recordings. As the empirical material collected by observations and self-recordings differs in character, even though gathered based on the same aim, a more equal division would have been desirable. On a practical note, it would have been good to have asked the respondents to start every recording by saying the date. Regarding the self-recordings, I know in which weeks they were made but I do not know exactly how long it is between recordings. Another consideration relates to how many instructions to give in advance. Too many will hinder the perspective of the respondents, too few will risk getting recordings that have nothing at all to do with the topic. In all probability, there is no single answer as to how many instructions to give, which means that the aims of the research and the character of the requested data should determine the answer from case to case.

As previously mentioned, researchers will probably not know what their cases are until the research, including writing up the results, is completed since “what it [the case] is a case of coalesces gradually, sometimes catalytically, and the final realisation of the case’s nature may be the most important part of the interaction between ideas and evidence” (Ragin, 1992, p.6). This study has included several different cases and when related to Ragin’s cross tabulation, the cases represent three of four possible cases (figure 37).
<table>
<thead>
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<th>specific</th>
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<tr>
<td>The chronological cases in</td>
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<td>chapter five.</td>
<td>figures 34 and 35.</td>
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<td>chapter four and six.</td>
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Figure 37: Example of the different cases in this thesis as related to Ragin’s (1992) cross-tabulation.

7.3 Focusing on the results

In section 3.3 I discuss me as a researcher being part of the empirical material that has been created, foremost in observations but also in interviews and self-recordings. However, it is impossible to say if the respondents’ professional identity development would have become different without my presence. Central in this study is that the focus on mathematics has been my focus, not the respondents. I have asked about and focused on mathematics teaching and the respondents have known my focus. Because of that, mathematics may have been given increased significance in the respondents’ professional identity development in relation to what it would have got otherwise, even though its significance in the study is as limited as it is.

According to George (2009) some student teachers are not given the opportunity to renegotiate their mathematical identity and by that they bring psychic baggage from their own schooling into teaching. In a study by Gellert (2000), student teachers who remembered their own schooling in mathematics as frightening viewed as their mission as mathematics teachers to protect their students from similar experiences. Their strategy to do this was to keep the mathematics content in areas where they felt secure and to avoid abstraction. These student teachers viewed games and problem solving as methods of making mathematics more fun but without mathematical purpose. All of the respondents in this study except Camilla express experiences from the own schooling similar to those of the student teachers in Gellert’s study. All of the respondents in this study, also Camilla, strive away from their own schooling in mathematics and want their students to get different experiences.

The role of mathematics in the respondents’ professional identity development is related to their *image of a primary school teacher* and their *image of a mathematics teacher* which can be understood as context specific collective identities (Lindström Nilsson, 2012). As described in section 3.2.1 selection of respondents can be seen as a question
of how the respondents define themselves and just because different criteria are used it is not certain that the respondents place themselves within that group. This became visible in this study where the respondents did not place themselves within the group of mathematics teachers. When the criteria for sampling were presented in section 3.2.1, it was claimed that if novice teachers who have taken an orientation in mathematics, and some also written a final teacher education bachelor thesis on mathematics education, do not develop a professional identity as primary school mathematics teachers, neither probably will those who have not taken those courses. In one way the individual criteria (graduation and knowledge) presented in section 6.1 confirmed this claim. Graduation and knowledge are two important parts in the respondents’ image of a primary school teacher. But, at the same time mathematics doesn’t seem to be a part of the respondent image of a primary school teacher. Even if they are teaching mathematics they do not think of themselves as mathematics teachers.

In this study, there is no empirical material to show how the image of a primary school teacher has emerged. Lindström Nilsson (2012) studied student teachers from the same university during the same period of time as this study. According to her study, the student teachers retained the image they had of teachers when they started throughout their whole teacher education. Their image of a teacher was challenged first when they started to work. According to van Bommel (2012) student teachers who are to become primary school mathematics teachers need to shift from seeing themselves as general teachers to locking at themselves as mathematics teachers. Van Bommel studied primary school student teachers during a mathematics education course and the requested shift was not made by the student teachers and it was not addressed by the teacher educators. This is similar to other countries around the word where most primary school teachers are educated as generalists and most of the preparation they receive places low emphasis on mathematics content in relation to the overall programme (Tatto, Lerman & Novotná, 2009). However, according to Hodgen and Askew (2007) it is possible for primary school teachers to develop an identity as a teacher of mathematics but for this to happen the teacher has to “reconnect with mathematics whilst maintaining an identity as a primary teacher” (p.482).

Whether focusing on mathematics or not, teacher education according to Persson and Tallberg Broman (2002), does not prepare novice teachers for the changed profession that the teacher job is. Similar mismatch between intentions and expected performance and between ideal about good teaching and practice were found by Flores and Day (2006). Also Chong, Low and Goh (2011) write about the importance of teacher education preparing student teachers to deal with the realities of school culture so that the early years of teaching can be turned into a positive experience. According to Chong et al. (2011) student teachers tend to have a stereotypical view of teachers and teaching resulting in a mismatch between their expectations and the reality they are confronted with. Gustafson (2010) writes that in society there is an image of the teaching profession as consisting of teaching and pre- and after work and that that image is unfavourable as the complexity of a teacher’s job, the complexity of the changed profession, and its preconditions are kept hidden. However, the image of a good primary school mathematics teacher has unequivocally been a part of the teacher education of the respondents in this study. In their teacher education, they met a new kind of mathematics teaching and they strive away from their own experiences towards this new way of teaching mathematics. Based on the references above, teacher education does not challenge the image of a primary school
teacher of student teachers and based on the results in this study the image of a good primary school mathematics teacher, in teacher education, does not seem to have been united with the image of a primary school teacher. In teacher education the student teachers have worked a lot with the image of a good mathematics teacher but this image has not been connected to, and therefore not become a part of, their image of a primary school teacher.

For the respondents to develop a sense of themselves as a kind of primary school mathematics teacher, mathematics teaching has to become part of their designated primary school teacher identities, and memberships in communities of practice with mathematics in the shared repertoire must be possible, both during teacher education and after graduation. For this to become possible, mathematics must become a part of the image of a primary school teacher as an image of a primary school mathematics teacher. Not as a two-step identity development process but as a unified whole. Primary school teachers in Sweden teach many subjects but they are the first mathematics teachers of our students in primary schools and a part of their professional identity as primary school teachers ought to be mathematics teachers. The solution does not seem to be just increasing the amount of mathematics courses in teacher education but to connect mathematics to the image of a primary school teacher of the student teachers. If mathematics is taught in separate courses in teacher education and those courses fail to connect to the student teachers’ image of a primary school teacher, becoming a primary school mathematics teacher will not be their focus when starting to work.

Generalisation has been discussed in section 3.2.2, focusing on context similarity (similarities of the researched context and other contexts) and recognition of patterns (an individual’s patterns described in one study being recognised in new cases). Both of these generalisations should be made by the reader of the research based on the thick descriptions offered by the researcher and will, therefore, not be made here. However, one can wonder if the image of a good primary school mathematics teacher figures only among the respondents in this study or if it is part of a larger image? In this study, the dichotomy has been described as a shared repertoire in the community of reform mathematics teaching and that implies more than the respondents in this study being members. But, is it possible that the community of reform mathematics is a local community at this university?

One year after conducting the initial interviews in this study, a thesis by Persson (2009a) was published. Persson had followed Swedish student primary school mathematics teachers during teacher education and after graduation. Persson’s focus was on how the respondents talked about mathematics and mathematics education and how this talk changed throughout and after teacher education. Another similar Swedish study is Björneby Häll’s (2006), in which she followed student secondary school mathematics teachers, during and after teacher education focusing on their arguments for mathematics teaching. (Both these studies are presented in section 1.4.3.) The student teachers’ in Persson’s and Björneby Häll’s studies talk about mathematics teaching in a similar way to the respondents in this study. At the same time as the student teachers in Persson’s and Björneby Häll’s studies developed a new view of the right way to teach mathematics, they became critical of both their own schooling and the teachers they met during practice periods. According to Persson,

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74 As described in section 1.6 content knowledge was emphasised in the respondents’ teacher education at the expense of decreased practice periods.
her respondents focussed more on how-questions than on what-questions even though her questions to them were quite straightforward, for example what is mathematics for you and what do you think is mathematical knowledge? Even though the respondents in Persson’s, Björneby Hall’s and this study are from three different universities, they seem to be part of the same community of reform mathematics teaching.

As shown in chapter one, the reform is not something new, nonetheless, several studies point to the fact that there is little reform mathematics teaching in schools. In an article from 1990, Ball (1990) describes how an experienced primary school teacher talks about and teaches mathematics. The way the teacher talks about good mathematics teaching is very similar to how the respondents in this (and Persson’s and Björneby Hall’s) study talk. Almost twenty years have passed between the studies; nevertheless, the words used are the same. Ball found that even though the teacher taught and talked in line with the new curriculum, her conception of mathematics and knowing and learning mathematics was still rooted in the traditional epistemology of school mathematics. As such, no fundamental change had been made and Ball writes that to change the way in which students in schools encounter and learn mathematics requires changing views of what mathematics is, what it means to know and do mathematics, as well as changing assumptions about students and how they learn. These changes include a lot of what-questions which are not focused on by the respondents in this (or Persson’s and Björneby Hall’s) study. Based on this study and the studies of Björneby Hall and Persson there seems to be a large community of reform mathematics teaching in Swedish teacher educations, a community not focusing on what to teach but on how to teach. The absence of what differs from how the reform is presented in the NCTM (1991) documents. Another difference between the reform in the community of reform mathematics teaching and the reform as it is described in the NCTM documents is the (in)visibility of mathematics. On the left side of the dichotomy, mathematics being hidden in different activities is stressed as good which has no counterpart in the documents from NCTM. In those documents also the mathematical knowledge of the teacher is emphasised which is not the case by the respondents in this study.

Cavanagh and Prescott (2007, 2008) have studied student mathematics teachers before and after graduation and they describe teacher education and the mathematics teaching at schools as “two separate communities of practice that are, in many respects, at odds with each other” (Cavanagh & Prescott 2007, p.190). The student teachers in Cavanagh and Prescott’s study talk about avoiding a perceived conflict with other teachers after graduation by becoming a “textbook teacher (2007, p.188)” similar to the respondents in this study. Cavanagh and Prescott’s conclusion (2007 & 2008) is that novice teachers need skills to deal with the impact of the culture of schools. According to Fransson and Gustafsson (2008), novice teachers often receive help from colleagues but that help seldom regards content knowledge and pedagogical content knowledge or encourages novice teachers to question and challenge existing teaching. According to Gellert (2008), changes in teaching are done in phases where the situation in the classroom is initially more difficult than before, partly because old routines are removed. He describes a group of teachers, a community of teachers, who deliberately try to improve their mathematics teaching. In Gellert’s study, the teachers can support each other and the teacher group also needs support from the outside when it becomes uncertain and doubting. If Gellert’s experienced teachers experience the classroom situation as more difficult when changing their teaching, then novice teachers may experience the same thing as even
more difficult as they have no routines at all, and no memberships in communities of teachers with teaching as part of the shared repertoire. Actually, many novice teachers do not even have anything to change but just something to develop from scratch. Before graduation, the respondents in this study expressed several limitations for their future teaching and one limitation mentioned was colleagues. Before graduation, the respondents expressed misgivings regarding being limited in their mathematics teaching by colleagues, but, instead, two years after graduation they express a lack of colleagues as the limitation. Maybe the lack of colleagues is one explanation to the focus on feedback by assessment by the respondents in this study.

Similar to several of the studies presented in chapter one, the respondents in this study found the first years after graduation stressful, chaotic and emotionally draining. The phenomenon regarding the heavy work load, the time pressure and the impermanence of work do not seem to be a local national phenomenon. In their study Aspfors et al. (2011) among other things identified intensification, impermanence and enthusiasm as important factors in the first years of teaching. These factors are also visible in this study. Intensification regards the large work load besides teaching which make the novice teachers become pressured of time. Just like the respondents in this study the Finish novice teachers in Aspfors et al.’s study said that the heavy work load was not valid just for them but also for experienced teachers. Intensification and enthusiasm is not easy to combine and often novice teachers feel dissatisfied with their own work. Impermanence in the Finish study refers to the novice teachers having to change work place several times the first years after graduation which indeed is the case of the respondents in this study. However, in the Finish study the novice teachers at least seem to be working as teachers even though they change schools several times.

From 2012, entering the teaching profession as a novice teacher in Sweden will change as a year of probation is implemented. According to Chong and Low (2009) quality teacher induction programs are important to support novice teachers in coping and building up the positive professional identity they brought into the profession in the first place. At the same time, as several of the problems that the respondents in this study experienced when not getting jobs will disappear (or move a year forward in time) when probation is implemented, it seems to be important that the student teachers develop an image of a primary school (mathematics) teacher in line with the actual work of a primary school (mathematics) teacher. And, if novice teachers are to develop a professional identity where teaching mathematics has a core role, memberships in communities of practice with mathematics and mathematics teaching in the shared repertoire must be possible also after graduation.

As mentioned, the phenomenon that teacher education prepares teachers for working with and promoting reform in the practice of school mathematics worldwide exists (Sowder, 2007) giving novice teachers the role of brokers between existing communities of practices. Being a broker is, according to Wenger (1998), a demanding mission so the possibilities involved in promoting reform through novice teachers are debatable. Instead, one possibility is if communities of practice established in teacher education could be broadened outside teacher education in a form where membership through engagement is possible. Successful experiments designing such communities of practice have been done, for instance, by Goos and Bennison (2008) and Cuddapah and Clayton (2011). Cuddapah and Clayton arranged physical sessions with novice teachers led by an experienced educator, while Goos and Bennison developed web-based virtual communities of practice. The web-based communities were developed during teacher education and the initial physical
meeting was found to be important. After graduation, several of the novice teachers continued to work together in the virtual community but, in contrast to Cuddapah and Clayton, no support from university teachers was given after graduation. However, in both these communities of practice, the experienced colleagues of the novice teachers are missing. If novice teachers and experienced teachers are not members in the same communities of practice there is a risk that the negotiation and identification of novice teachers regarding mathematics teaching becomes between (we-them) these different communities of practice.

Several studies (for instance, Franke & Kazemi, 2001; Gellert, 2008) have focused on how to implement and develop reform mathematics teaching as part of the shared repertoire in communities of experienced teachers. That development has not focused on novice teachers but maybe that is the way to proceed. Novice teachers often receive help from experienced teachers but, as mentioned (Fransson & Gustafsson, 2008), that help seldom regards content knowledge and pedagogical content knowledge or encourages novice teachers to question and challenge existing teaching. Based on the high demands on brokers and the big influence from established communities of practice on novice teachers, one way to support them is not to focus on them directly but on the communities of practice that they possibly will become members of. The ideal would be if the shared repertoire in the community of mathematics teaching in teacher education and the communities of practice of primary school mathematics teachers outside the university were similar or even joint. In that case, the learning trajectory of novice mathematics teachers, their professional identity development as mathematics teachers after graduation, would not have to become a negotiation and identification between contrary communities of practice but, instead, negotiation and identification within a unified mathematics teaching community.

Such communities of primary school mathematics teachers could make possible the development of profound understanding as presented by Ma (1999) in her comparative study presented in the first chapter. This profound understanding was reached by the Chinese teachers first after teacher graduation through the collective and individual work with mathematics by the mathematics teachers in schools. That collective work can be considered a joint negotiation of the shared repertoire in a community of mathematics teachers where novice teachers successively become more experienced members. According to Ma, one problem in America is the working conditions of teachers with less time for preparation but with more to prepare (teaching several subjects). Because of such organisational factors, the time for developing the profound understanding that the Chinese teachers have after graduation does not exist for the American teachers. I would say that the same applies to Swedish teachers. Also, the Chinese teachers do not have different images of their teacher role as they are “solely” primary school mathematics teachers.

7.4 Focusing on future research

Lester (2005) presents a model of different kinds of research whereof this study can be described as basic research aiming at improve understanding. Based on that understanding a continuation of this study could focus on improvement by the use of applied research and/or developmental research. One possibility is to develop, and to do research of that development, communities of practices in line with those
described in section 7.3. The goal would be to develop communities of practices with mathematics and mathematics teaching in their shared repertoires where the members together could develop a profound understanding of mathematics as primary school mathematics teachers. If that succeeded, the negotiation and identification of novice teachers regarding mathematics teaching could be within communities of practice instead of between communities of practice.

Doing research is not just to focus on, but also to opt out. In this thesis the analysis of the empirical material have been focusing on long term patterns of participation as the learning trajectory constituting professional identity development. It has not been possible to also focus on immediate patterns of participation in the same amount even though some examples have been given. Focusing on immediate patterns of participation of the respondents is another story to tell, a story that can be explored in the future where the professional identity development of the respondents as presented in this thesis will supply as an important foundation. By investigating long-term patterns of participation the process of becoming a primary school mathematics teacher have been described and understood. That understanding can work as a foundation when investigating immediate patterns of participation. Within a study of immediate patterns of participation also feedback could be further elaborated. In this study, feedback has been identified as an important part of professional identity development as a primary school mathematics teacher. This feedback has been investigated from the perspective of the individuals, with focus on the feedback being focused on by them. In future research, feedback as a component of professional identity development could be investigated with focus on different kinds of feedback received in the classroom and how that feedback influence the mathematics teaching in the classroom.

One question that is not answered in this study is if becoming a mathematics teacher is different from becoming, for instance, a Swedish teacher. Differences between subjects, and as a consequence, not being able to teach or learn subjects in the same way, are expressed as the main idea of a subject’s didactics (Sjöholm, Kansanen, Hansén & Kroksmark, 2011). Do the same differences apply when learning to be a teacher? Mathematics is, at the moment, in focus for politicians and the media in Sweden and the respondents expressed that they have encountered a new way of teaching and learning mathematics in teacher education. Does this image of reform exist only in relation to mathematics teaching or does the same also apply for teaching other subjects? One possible direction of future research based on the results of this study is to study the development of the image of a primary school teacher and its connection (or non-connection) to the image of a good primary school mathematic teacher. If knowledge is received about how the image of a primary school teacher is developed then you can start to understand how to, if desired, change it.

7.5 Focusing on the quality of the thesis

In this section, the quality of this thesis is discussed. Quality can be focused on from two perspectives; the making of the study and the presentation of the study. Both are addressed in this section based on a structure from Lester and Lambdin (1998) supplemented by references to Charmaz (2006), Kvale and Brinkmann (2009) and Lincoln and Guba (1985).
Lester’s and Lambdin’s structure (1998) is based on seven quality criteria (worthwhileness, coherence, competence, openness, ethics, credibility, other qualities of good research reports) which are discussed below. First, they ask if the research is worth doing and if it adds something. There is a lot of research about teacher development and teacher change, but this study offers a new coordinated conceptual framework making it possible to have both the individual and the social as unit of analysis. Also, the perspective of the respondents offers new insights into the process of becoming a primary school mathematics teacher and new questions to be further investigated have been identified.

The next of Lester’s and Lambdin’s criteria is if there are connections between the research questions, methods and methodology. This study has been driven by its aim to understand and describe the professional identity development of novice primary school mathematics teachers. Based on that aim, the research questions rose throughout the thesis, and the line of argument between the aim, the questions, the methodology and the methods used is visible. The questions being raised throughout the thesis is in line with finding unknown unknowns. For instance the questions raised in section 6.1 (What it is that make the respondents recognise themselves as a kind of primary school mathematics teacher (or not)?) and in section 6.2 (What kind of feedback, from oneself and/or others, is it that makes the respondents recognise themselves as a kind of primary school [mathematics] teacher (or not)?) were not known as relevant questions at the beginning of the research process.

Lester and Lambdin also ask if the researcher is qualified enough and if he or she has done the study in a qualified way. The process of writing a thesis is part of an education. The quality gained in that education have, hopefully, increased the quality of this study. The eyes that read the literature in the first graduate courses and which made the first observations are not the same as the eyes looking at this thesis today. But as the PhD being an education that development, the increased possibilities to qualitative work, is a part to be and will hopefully also continue after the end of this study.

A fourth criterion by Lester and Lambdin is if the researcher openly reports the starting points, assumptions and preconceptions as well as reporting how the study has been conducted. Questions of openness are, according to Kvale and Brinkman (2009), connected to questions of clarity why those two questions are combined here. Clarity should permeate a written thesis and my vision has been to write as transparently and honestly as possible. I have tried to report the research process as accurately as possible and I have been open about my own background and possible influences caused by it. Extracts from field notes, interviews and self-recordings have been used to illustrate and provide evidence for the validity of the results. According to Kvale and Brinkman, clarity also occurs when competing interpretations and possibilities are discussed and when it is shown how the empirical material has been analysed, two parts also considered in this thesis.

Lester and Lambdin also have quality criteria regarding the ethics and the credibility of the research. Ethical questions are discussed earlier in chapter three. The credibility of this thesis will be discussed in relation to Lincoln and Guba’s (1985) quality criteria. According to them, there can be more than one description of the same phenomenon depending on the research perspective and on who is doing the analysis. One important step is, therefore, that the researcher presents a relatively large amount of the research process. That has already been discussed above.

Not believing in absolute truth in social science, Lincoln and Guba have elaborated on the criteria of trustworthiness and authenticity. Trustworthiness is
divided into credibility, transferability, dependability and confirmability, of which, 
transferability has been discussed in section 3.2.2. To acquire credibility, this research 
process has been described in detail and some of the results (the dichotomy and the 
frames) have been shown to and confirmed by the respondents. Another way to 
increase credibility is to use different methods to create data which has also been 
done in this study. One way of acquiring dependability is by a thorough description 
of the research process, as described above regarding the transparency of the research 
process. That the conceptual framework and parts of the results have been presented 
and discussed at different conferences\textsuperscript{25} and published in an article\textsuperscript{26} increases the 
dependability of this thesis. Finally, confirmability is about me confirming that my 
values have not biased my work and by me describing my background.

The other of Lincoln and Guba’s criteria, authenticity, is determined by giving a 
fair picture of the individuals studied and by increasing understanding of them. For 
the reader of this thesis, the results offer an increased understanding of both the 
respondents and other novice teachers. As such, the results are of interest to teacher 
educators and to schools who employ novice teachers. One additional aspect of 
authenticity is if the outcome of the research offers opportunities for change. 
Possibilities for change have been discussed in this thesis, for example, regarding 
primary school mathematics teachers and teacher cooperation with focus on subjects.

The last of Lester’s and Lambdin’s criteria is to give prominence to research 
reports that are lucid, clear, and well organised where they emphasise conciseness, 
directness and originality. As mentioned there is a lot of research about teacher 
development and teacher change, but this study offers a new coordinated conceptual 
framework making it possible to have both the individual and the social as unit of 
analysis. Also, the perspective of the respondents offers new insights into the process 
of becoming a primary school mathematics teacher and new questions to be further 
investigated have been identified. I have tried to make a well organised thesis and to 
find a balance between clear writing and a thick description of the research process.

The thematic results can also be evaluated using Charmaz (2006) criteria for 
grounded theory research, credibility, originality and usefulness of the results, of 
which, both credibility and usefulness have been discussed above. Regarding 
originality, the thematic results, the categories, offer new insights with accompanying 
increased understanding of the process of becoming a primary school mathematics 
teacher. As previously mentioned, some might argue that it was already known that 
school culture and colleagues have impact on novice teachers, however, the thematic 
results enable understanding of how and why that impact occurs. Also, as shown, 
these new understandings make it possible to reinterpret results from earlier beliefs 
studies (for example, regarding novice teachers’ regression after graduation).

In summary, this study and thesis is not perfect, but I have tried to carry it out in 
the best way possible, in accordance with the criteria discussed above including 
making the process as transparent as possible to give the reader insight.

\textsuperscript{25} See Palmér in the reference list. 
\textsuperscript{26} Palmér, H. (2010b)
SUMMARY IN SWEDISH

Denna avhandling handlar om processen att utveckla, eller att inte utveckla, en professionell identitet som tidigarelärare i matematik. Syftet har varit att förstå och beskriva denna process ur nyexaminerade tidigarelärares perspektiv vilket innebär att fokus i avhandlingen är det som har varit i fokus för de nyexaminerade tidigarelärarna i studien. Perspektivet har resulterat i ett etnografiskt synsätt där förståelsen för och beskrivningen av processen att utveckla, eller att inte utveckla, en professionell identitet som tidigarelärare i matematik har genererats genom närvaro i respondenternas vardag. Perspektivet innebär också att inneböden av professionell identitetsutveckling som tidigarelärare i matematik är ett resultat i studien, snarare än en utgångspunkt.

En tidigarelärare i Sverige undervisar vanligtvis i flera ämnen men i studien har undervisning i matematik fokuserats. Studien är en fallstudie där sju tidigarelärare har följts under två år efter lärarexamen. Det empiriska materialet har samlats in via intervjuer, observationer och självinspektioner. Detta empiriska material har dels analyserats med ett begreppligt ramverk och dels med analysmetoder inspirerade av grounded theory. I studien kopplas resultat från de två analysmetoderna samman i syfte att ge en sammanhängande bild av professionell identitetsutveckling som tidigarelärare i matematik.

Studiens resultat är indelat i tre delar där den första delen belyser tiden för respondenternas lärarexamen. Inför lärarexamen har respondenterna en klar uppfattning om bra och mindre bra matematikundervisning. Under sin lärarutbildning har de utvecklat ett medlemskap i en praktikgemenskap där reforminriktad matematikundervisning är centrerat och de tar avstånd från den matematikundervisning de själva mött som elever i skolan och på VFU. Vid tiden för sin lärarexamen har respondenterna en vision att förändra matematikundervisningen i skolan i linje med den matematikundervisning de kommit i kontakt med på lärarutbildningen.

Den andra resultatdelen belyser fyra respondenters professionella identitetsutveckling under två år efter examen. De fyra fallen är valda då de visar olika vägar in i, och även ut ur, lärarytet. Fallen visar hur respondenternas matematikundervisning influeras av olika medlemskap i olika praktikgemenskaper. Fallen visar också att det är sällsynt med praktikgemenskaper där matematik och/eller matematikundervisning är del av den delade repertoaren. Den reforminriktade praktikgemenskapen som respondenterna blev medlemmar i under lärarutbildningen blir allt mer avlägsen efter examen då möjligheterna till engagemang och fysiska möten med likasinnande försvarare.

De inre och yttre kriterierna påverkar respondenternas möjligheter att bli medlemmar i praktikgemenskaper och att få feedback för den (matematik)undervisning de bedriver. Under studiens två år får respondenterna nästan ingen feedback för sin matematikundervisning och de får ingen positiv feedback för den reforminspirerade matematikundervisning de uttryckte som central inför examen. För att utveckla en professionell identitet som tidigarelärare i matematik skulle respondenterna behöva arbeta som tidigarelärare på skolor där de kan bli medlemmar i praktikgemenskaper med matematik och matematikundervisning som del av de delade repertoarerna.

Sammantaget har matematik och matematikundervisning en mycket undanskymd roll de två åren efter respondenternas examen vilket är bakrunden till avhandlingens titel *to become – or not to become – a primary school mathematics teacher*. Matematikundervisning har varit i fokus i studien men inte i fokus för respondenterna. En tidigarelärare i Sverige är lärare i många olika ämnen, inte enbart i matematik. Samtidigt är tidigarelärare de första matematiklärare som våra elever möter i skolan och önskvärt vore om matematikundervisning utgjorde en del av tidigarelärares professionella identitet.
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Interview before the respondents’ graduation.

Information regarding the background of the respondents has been completed before in the initial telephone conversation.

The interview guide is divided into three parts:
1. Initial open questions
2. Student solutions
3. Possible clearance questions

The purpose of the divided structure is not to navigate the respondents in the first part of the interview but to be able to direct the questions at the end if it is needed in relation to the aim of the study. Which of the clearance questions will be needed depends on the focus of the respondents in the first part of the interview.

1. Initial open questions

- Give some examples of good mathematics teaching situations. (For example from your own schooling or practice periods.
- What is it that makes these examples good?
- Give some examples of less good or bad mathematics teaching situations.
- What is it that makes these examples less good or bad?
- Describe a good mathematics teacher. You can describe someone you have met if you want to.
- What is it that makes him or her a good mathematics teacher?
- Think of a good mathematics student. What is it that makes this student good at mathematics?
- How do you feel when you think of your future profession as a mathematics teacher?
- What will be most difficult?
- Are there any differences between teaching mathematics and other subjects?

2. Student solutions

The purpose of this part of the interview is to relate it to the context of mathematics teaching. The respondents are asked to comment on the student solutions/dialogues and how they, if they were the teacher, would continue the situations.

Example 1
The dialogue is read to the respondents.
Teacher: What is two plus one? *(Long pause without any reaction from the student.)* How many are two buttons and one button together?

Student: Three.

Teacher: Okey, so what is two plus one?

Student: *(long pause)* Four? *(hesitating)*

Teacher: How many are one button and one more button?

Student: Two buttons.

Teacher: Then, what is one plus one?

Student: One maybe?
Example 3
The teaching example is told to the respondents orally.

Three students (A, B, C) and one teacher are sitting around a table. The teacher has a plate with 15 biscuits. The teacher has planned an activity aiming at challenging the students' knowledge of dividing.

Teacher I want you to divide these biscuits so that each one of you gets the same number of biscuits.

The three students cooperate and take one biscuit each from the plate at the same time. In no time they are finished, ending up with five biscuits each. Now the teacher says that she also wants some biscuits. The students start to move the biscuits from their stacks to the teacher and then back again. Now and then they stop and count the biscuits in the four stacks. They quit when the teacher has three biscuits and the students have four biscuits each.

Teacher Do we have the same number now?

All three students No

Teacher Is it possible to divide the biscuits in a way that will give us the same number?

Student C But that is not possible.

Then student C takes one biscuit from each student and puts them back on the plate. Now everyone has three biscuits.

Teacher Yes, but now there are three biscuits left. Can we use them?

Student A Yes. We get one each.

Teacher There are only three left. Can we divide them so that we get the same number?

Student A suggests that they are to split the three biscuits on the plate down the middle. The two others are doubtful about the suggestion but student A splits one biscuit and then he gives half a biscuit each to students B and C. After that he gives himself and the teacher one whole biscuit each. Students B and C are dissatisfied with this division but A shows that it is possible to connect their halves into one whole biscuit saying "now we have the same number" making no difference between whole and half biscuits.

3. Possible clearance questions

- What do you think will become the starting point of your future mathematics teaching?
  - What role do you think that the curriculum will have?
- What will decide which mathematics content you will teach?
- What will decide how you will teach that content?
Group interview

- Start by making them introduce themselves. (If they do not include their work place I will ask them to do that)

- Ask one at the time to tell about their two years after graduation.

- If necessary, ask them to tell about these two years with the focus on teaching mathematics. (schools, colleagues, students, parents, knowledge, surprises)

- Do they feel like teachers? Do they feel like mathematics teachers?

- Is it possible for them to teach the way they want to? Is it possible for them to teach mathematics as they want? If not, why? Finally, show them a summary of the limitations they expressed before graduation. How did it turn out?

- Show them the dichotomy. What do they think about it? Is it valid? If not, what needs to be changed?

- What are their thoughts about the future?
Appendix 3

Example of an interview guide used in connection with an observation.

The aim is to start with an open question to see the focus of the respondents themselves and only after that use more directed questions.

1. Tell me your reflections about the lesson.
2. What was the goal of the lesson?
   i. What was the starting point when you planned the lesson? (the students, the previous lesson, the text book, the curriculum …)
   ii. What was the mathematical aim of the lesson? (process – product)
   iii. Where there other goals with the lesson? (for example social ones)
   iv. Did the lesson have a special goal in a series of other (mathematics) lessons?
3. Did the lesson follow the original plan? Why/why not?
4. Was it an “ordinary mathematics lesson”? Why/why not?
5. Was it a good or a less good mathematics lesson? Why?
6. If you were to plan the lesson again, what would be different?
7. Will there be a follow-up lesson? If, when and how?
8. Questions based on episodes observed in the lesson…
   i. Who took the initiative? Why?
   ii. What was the aim?
   iii. Did it succeed?
   iv. Which representation was chosen? Why?
9. A good teacher: How do you think about a good mathematics teacher today?
10. Good students: Which students in the group are good at mathematics? Why?
To the parents of Helena’s students at the Aldro School,

My name is Hanna Palmér. I am a teacher and PhD student in mathematics education at the School of Computer Science, Physics and Mathematics at Linnaeus University (formerly Växjö University). I am part of a research project focusing on mathematics teachers and teacher identity. The project is led by Professor Jeppe Skott. In this project I study a number of teachers during their first time after graduation. One of them is Helena, the teacher of your child at the Aldro School.

It would be of great value for the research project to study Helena’s mathematics teaching. Based on that, I would like to observe Helena during some lessons and to make audio recordings of those lessons. The aim is not to change the original plan of the lessons but to observe ordinary mathematics lessons in the class. The material will only be used in research, and all recordings will be kept under lock and key so that no unauthorised person will get access to them. All students will be anonymous in the study and the focus is not on them. I have met the class and Helena has informed the students about the study. But, since the students are not of age it is important that your parents give their consent to my presence in the classroom.

Please contact me if you have any questions about the research project or the practical arrangement of the study.

Best Wishes,
Hanna Palmér
Linnaeus University
0470-708641
0738523211
Hanna.Palmer@lnu.se
☐ I have read the information and agree that Hanna Palmér is to observe and make recordings during Helena’s mathematics lessons.

☐ I have read the information and do not agree to Hanna Palmér observing and making recordings during Helena’s mathematics lessons.

_________________________________________  _______________________________________
Student’s signature                           Guardian’s signature
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