Understanding the Role of Mathematical Anxiety, Disaffection and Emotion in Learning and Teaching the Subject of Mathematics

A Qualitative Study of Swedish Student Teachers’ Experiences and Feelings towards Mathematics Education

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Abstract

Alongside the international consensus about the importance of mathematical competencies in today’s knowledge society, the awareness about children’s and adult’s mathematical anxiety has increased. Within this, relatively limited, field of research it has moreover been revealed that the level of mathematical anxiety is considerably higher among students within teacher education programs compared to other university students. Furthermore, the studies suggest that the anxiety of prospective teachers may influence their performance in the classroom and in turn their pupils’ perception of mathematics. In the case of Sweden, the PISA 2012 revealed a significant increase of mathematical anxiety among Swedish 15 year old pupils in the past ten years.

With this background, the purpose of this study is to investigate prospective teachers’ feelings and experiences towards the subject of mathematics where the aim is to gain a deeper understanding about negative feelings, such as mathematical anxiety. Based on a qualitative research approach, including a survey with around 100 Swedish student teachers, interviews and a focus group session with a smaller group, the findings of the study have shown that the majority of the participants have in different ways experienced negative feelings towards mathematics. With support in poststructuralist theories, where emotions are viewed as a social construction, the study indicates that feelings emerge when students position themselves, or become positioned, within discursive practices. The concept of subjectivity was further used to gain a deeper understanding of students’ process in becoming a teacher.

Key terms: student teacher, mathematics, mathematical anxiety, emotions, subjectivity, discursive practices, Sweden, PISA
Sammanfattning

Vid sidan av den internationella konsensusen där vikten av matematik lyfts i dagens kunskapssamhälle, har medvetenheten kring matematisk ångest bland barn och vuxna ökat. Inom detta, relativt begränsade, forskningsområde har studier visat på att matematisk ångest är avsevärt större bland lärarstudenter i jämförelse med andra universitetsstudenterande. Dessutom har studier påvisat att denna ångest kan påverka lärares framförande i klassrummet och i sin tur sina elevers uppfattning av matematik. I Sverige har resultaten från PISA 2012 undersökningen visat att svenska 15-åriga elevers ångest gentemot matematik har ökat signifikant de senaste tio åren.


Nyckelord: lärarstudent, matematik, matematisk ångest, känslor, subjektivitet, diskursiva praktiker, Sverige, PISA.
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<th>Description</th>
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<tbody>
<tr>
<td>EACEA</td>
<td>Education, Audiovisual and Culture Executive Agency</td>
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<td>ECTS</td>
<td>European Credit Transfer System</td>
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<td>ICT</td>
<td>Information and Communications Technology</td>
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<td>IEA</td>
<td>International Association for the Evaluation of Educational Achievement</td>
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<td>MARS</td>
<td>The Mathematics Anxiety Rating Scale</td>
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<td>NCTM</td>
<td>National Council of Teachers of Mathematics</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>PISA</td>
<td>Program for International Student Assessment</td>
</tr>
<tr>
<td>SFS</td>
<td>Svensk författningssamling [Swedish Code of Statues]</td>
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<tr>
<td>SOU</td>
<td>Statens offentliga utredningar [Governments Official Reports]</td>
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<tr>
<td>TIMSS</td>
<td>Trends in International Mathematics and Science Survey</td>
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Acknowledgements

Over the years I have encountered several children and adults, both inside and outside of educational settings, to whom the very notion of mathematics have caused negative reactions such as anxiety, despair and even hatred. From that, a question emerged that have set the base for this thesis. While the long process of planning and conducting this study has many times felt like a lonesome struggle, I hereby express my gratitude towards the number of people and organizations that have been involved.

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Chapter One

Background

1.1. Introduction

There is an elephant in the room is an expression that refers to an idea that is very important but not talked about. [...] there is often a very large elephant standing in the corner of math classrooms. The elephant, or the common idea that is extremely harmful to children, is the belief that success in math is a sign of general intelligence and that some people can do maths and some people can’t. (Boaler, 2009, p. 2)

In the past decades, an increased emphasis has been placed on research and development of different aspects of mathematics education, as well as a growing need to measure the attainment of mathematical competencies with various testing methods. While countries, regions and schools continue to compare their results with the hope to top the charts, there is also a growing awareness about how millions of school children are struggling with mathematics worldwide (Boaler, 2009). Recent studies conducted by the Organisation for Economic Co-operation and Development (OECD) have moreover revealed how many countries have had a statistically significant decline in students’ mathematical performance (OECD, 2013). More importantly the results showed how a large proportion of the participating students barely reached the knowledge level of basic mathematical understanding (ibid.). In addition to these difficulties, it has become a known fact that the subject of mathematics not only receives very low interest among students, but for many, mathematics is a source for discomforting feelings such as frustration, confusion and anxiety (Ignacio, Blanco-Nieto & Barona, 2006).

Within this field of research, there has been a growing awareness about the role of affect in mathematics education in which the notion of mathematical anxiety is becoming more common to study. A number of different scales have been developed in order to measure not only the level of anxiety, but also in which situations that it usually occurs as well as its effects (Evans, 2000). Aside from school children’s feelings,
studies further show that many adults experience negative feelings and discomfort towards mathematics. The measurements of mathematical anxiety among university students revealed that the level of anxiety was considerably higher among the students with specialization in the younger grades of the teacher education programs, in comparison to other programs (Geist, 2010; Perry, 2004; Wood, 1988). This shows that prospective primary teachers experience the most anxiety towards mathematics. Also, mathematical anxiety is even more apparent among women. In many cases the negative feelings towards mathematics are rooted deeply within people’s beliefs and assumptions about the subject itself as well as their own ability to learn and understand mathematics (Ignacio et al., 2006). According to some researchers, the way that the image of mathematics is portrayed in different aspects of our society, such as popular culture and mass media, is one of the reasons (Boaler, 2009; Palmer, 2011). Not only do the fictions mainly show an incredibly difficult and scientifically disciplined subject with numbers, symbols and formulae, there is also the stereotypical view of mathematicians as geniuses that are boring, nerdy and socially incapable (Palmer, 2011).

In further regards to how newly graduated teachers are more likely to hold negative feelings towards mathematics, the risk of students being negatively influenced by their teachers and inhibited of their future opportunities is raised (Dogan, 2010; Perry, 2004; Wood, 1988). This can further be related to how Geist (2010, p. 29) warns about “creating a country of ‘mathophobes’” in regards to the uncertainty of what the future of globalization holds. With that being said, the importance of mathematics seems today to be more emphasized than ever before. According to the European Commission, mathematical competencies have been identified as one of the “key competencies necessary for personal fulfillment, active citizenship, social inclusion and employability in a knowledge society” (EACEA, 2011, p. 7). Considering how mathematical competencies are valued by the society and viewed as a pathway to a successful position in life, the learning of mathematics in primary school is thereby also seen as a democratic right (Norén, 2010). Therefore, there is a strong need to challenge the notion that mathematics is only for selected ones (NCTM, 2000).
Finally, going back to the initiating citation, Boaler (2009) continues by criticizing the simplistic view of mathematical learning as just black and white, knowing and not knowing. Based on this view, I believe that the negative feelings towards mathematics also need further understanding that looks beyond the idea that some people tend to have mathematical anxiety and some just do not. Hence, a need of qualitative approaches in order to investigate how student teachers’ emotional experiences towards mathematics have evolved from their very first encounter of mathematics education, until their current position in the mathematics course within their teacher education program. The comparative aspects of the student teachers’ experiences are hereby significant where the similarities, and more importantly, the differences, can provide wider views of understanding the emergence of negative feelings. Before explicitly presenting the aims and objectives for this specific study, the upcoming section will present a more thorough insight and review of research related to the emotional experiences connected to mathematics education. While this literature review will form the core background of this study, one specific research will be raised in the separate section Previous research, due to its particular relevance in the methodological choices.

1.2. The (Dis-)Affective Variables of Mathematics

In regards to the history of research within mathematics education, the position of affect, or perhaps disaffect, have had a very insignificant, if not even a nonexistent role (Lewis, 2013). However, a broader aspect of affect within this field is growing and gaining more attention. McLeod (1994, referred in Ignacio et al., 2006) argues that the affective variables do have a significant role in learning and teaching mathematics, meaning that they are questions that need to be researched in order to fully understand how individuals acquire mathematical knowledge.

The conceptualization of affect can be described in different ways, where the explanation given by Reye (1984, referred in Evans, 2000) involves students’ feelings and perceptions about the subject of mathematics, but also about oneself as a learner of mathematics. The concept of affect has in turn also been divided into three dimensions; beliefs, attitudes and emotions (McLeod, 1994, referred in Evans, 2000). While the
research within this area is fairly limited, the studies that have been done have for a long time mainly investigated attitudes, with quantitative approaches (Evans, 2000; Ignacio et al., 2006). Within these types of research studies, great attention has been put on measuring students’ and adults’ levels of anxiety towards mathematics. The Mathematics Anxiety Rating Scale (MARS) is one of the major and most commonly used tests for measuring mathematical anxiety within the field (Suinn & Winston, 2003). While the original scale from 1972, including 98 items, is still used, a number of modified, shorter versions have been developed such as the MARS 30-item test which is sought to be comparable with the original (Suinn & Winston, 2003).

The definition of mathematical anxiety has been provided in both a general and explicit sense, much depending on the discipline in question. The more general ones are often related to the so-called “I can’t syndrome” and the feeling of insecurity in doing math and working with numbers (Gresham, 2007). The definition provided by Buckley and Ribordy (1982, referred in Furner & Berman, 2012) falls under the same category where the authors define mathematical anxiety as an "irrational dread of mathematics that interferes with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations" (ibid., p. 170). Hembree (1990) discusses the understanding of mathematical anxiety in relation to test-anxiety where studies have shown that low anxious students perform better on tests than the high anxious students. Additionally, it is claimed that high anxious students are more likely to take on behavior of heightened heartbeat, a loss of self-esteem and a strong desire to escape the situation during tests. Meanwhile the low anxious students have higher chances in reducing the anxiety drives and actually completing the test (ibid.). While many authors claim that a direct relationship between mathematical anxiety and test anxiety does not exist, Brush (1981) revealed through his study that the majority of students were more anxious towards mathematics test situations and examinations of different kinds than the actual procedure of doing calculations and solving problems.

With that being said, a large part of the literature is focused on how mathematical anxiety does not necessarily come from the mathematical content itself, rather from how
it is presented by the outside (Geist, 2010; Lewis, 2013). Other than exam situations, as described above, these outside factors can, for instance, be parental or societal influence in terms of how mathematics is talked about and portrayed. Governmental decisions and reforms of the mathematical curriculum and assessment procedures further impact the expectations of education and in turn students. However, one aspect that is raised as a direct factor, throughout the literature, is the classroom setting and how mathematics is presented by teachers. The latter is described by Lewis (2013) as specific teaching methods, styles, pedagogy as well as distraction during class. More importantly, when teachers themselves are not comfortable or secure with their mathematical knowledge and abilities, if they themselves have anxiety or an overall negative perception, there is a high risk in them passing it on to their students (Geist, 2010). In the same way, Palmer (2011) claims that if a teacher has a positive attitude towards mathematics it will influence the children and students.

To further view the impact of affective variables, other factors have also been studied within educational settings. In a mathematics classroom the notion of disaffection can usually be depicted by the students acting passive and less engaging or by a bad behavior such as truanting (Lewis, 2013). Dogan (2010) raises the notion of confidence in relation to mathematical anxiety where a doubt in one’s own ability will not only limit the student in gaining a comprehensive understanding of the subject, but also lead to discouragement from pursuing studies or careers that require mathematical knowledge. While a number of studies have revealed that these features are more often seen among females than males, the research further claims that the phenomenon is more common in relation to prospective teachers during their teacher training programs. In turn, the fear and low self-confidence may influence their performance in the classroom (ibid.). Moreover, studies claim that some of the teachers who have mainly negative experiences themselves due to traditional, teacher centered mathematics lessons will plan a lesson based on primarily fun and practical activities to make students interested, however at the expense of sufficient mathematical content (Kaasila, 2007).
Additionally, the negative feelings experienced by individuals towards mathematics have more recently been studied in relation to the concept of identity and how mathematical subjectivity is constituted, reconstituted and maintained in relation to different experiences throughout the course of life. Palmer’s (2010a) research on prospective preschool teachers’ mathematical subjectivity, revealed how disaffection and aversions to mathematics is closely related to the prevailing discourses. Within a traditional mathematics classroom setting, the students expressed feelings of boredom, discomfort, confusion and anxiety while alternative teaching practices showed an opposite effect. Based on the notion of mathematical subjectivity as a social construction, this in turn means that an individual’s relationship towards mathematics is likely to change depending on the existing discursive practices (Palmer, 2010a).

1.3. Previous Research: A Narrative Approach

The research conducted by Kaasila (2007) had the purpose to investigate how pre-service teachers’ views of, and emotions towards, mathematics are developed during elementary teacher education. Based on a narrative inquiry, the researcher constructed individual mathematical biographies by emplotment\(^1\) for every participating student, based on their shared experiences. The aim was to provide a retrospective explanation in order to gain an understanding of how their school experiences were reflected in the development of each individuals’ mathematical identity. Other than raising the content of their storytelling, the narrative analysis also focused on the form of the stories in terms of linguistic features which was helpful for distinguishing the turning points in the students’ views of mathematics (ibid.).

This particular study of Kaasila (2007) is based on four pre-service teachers during their second year of studies at the University of Lapland in Finland. The research was conducted during the students’ enrollment in the second subject didactics course of mathematics. While the initial research data was based on a larger scaled survey with questionnaires about school memories, a smaller group of students with different

\(^1\) Emplotment refers to the assembly of a series of historical events into a narrative with a plot
backgrounds were thereafter selected to participate in observations and interviews and prepare teaching portfolios. The results revealed diverse experiences among the students, and the different ways of developing one’s mathematical identity (Kaasila, 2007).

Based on the idea that the human world and knowledge is structured and organized in narratives, Kaasila (2007) argues that human life and conduct should also be studied narratively. He continues by explaining that since narratives encourage the telling of a story and the representation of experiences, not only is it an adequate method for understanding students’ educational experiences, but it further involves personal and emotional dimensions, which are considered essential in understanding the process of becoming a teacher (ibid.).

1.4. Aim of the Study
The purpose of this study is to investigate student teachers’ feelings and experiences towards the subject of mathematics. As part of the national education program for primary teaching in Sweden, the study will be conducted with a group of student teachers enrolled in the mathematics course within the teacher program. The overall aim of this study is to gain a deeper understanding of how and why negative feelings towards mathematics emerge and what impact they may have on individuals, particularly in the case of student teachers and the processes of becoming a teacher. The focus is on highlighting the role of emotion and subjectivity in the relationship between an individual and the subject of mathematics. More specifically, the study will attempt to answer the following research questions.

1.4.1. Research Questions
- How can the student teachers’ emotional relationship towards mathematics be understood through their experiences?

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2 A student teacher, in this context, refers to a college or graduate student who is enrolled in a teacher education program, in order to qualify for a degree in education. Other than the academic credits, the education program usually includes teacher training under the supervision of a certified teacher. In addition to student teacher, the terms “prospective” teacher or “pre-service” teacher may also be used as synonyms.
In what way can the student teachers’ feelings towards mathematics be understood in relation to the discursive practices of mathematics education?

In what way can the student teachers’ experiences and emotional relationship towards mathematics impact his or her process of becoming a teacher?

Is it possible to gain a deeper understanding about the emergence of disaffective variables towards mathematics, such as mathematical anxiety, based on the findings of this study?

1.5. **Significance of the Study**

The Ministry of Education in Sweden stated that mathematical knowledge is required in order to live in a democratic society and actively participate in decision making about the future (SOU 2004:97). The important role of mathematics is moreover evident in different ways; the subject has, for instance, been considered a fundamental part of education throughout the years of schooling. Also, Sweden regularly conducts and participates in various national and international studies to learn more about different aspects of mathematics education and knowledge attainment. Moreover, studies have shown that Swedish citizens value the subject of mathematics (Norén, 2010). Despite the high value that the subject is given, recent investigations have raised the lack of mathematicians, but also a lack of general mathematical knowledge and skills, in relation to the development of society and future labor force requirements (SOU 2010:28). This issue is also apparent in how Swedish students’ mathematical knowledge and interest has continued to drop in different measurements in the past decade while the level of mathematical anxiety has stably increased (Skolverket, 2013).

Much of the issues facing the mathematical education in Sweden seem to be connected to attitude. This in turn can be related to how most individuals have a strong emotional relationship with the subject of mathematics (SOU 2004:97). In most cases, both children and adults find the subject of mathematics as meaningless, boring and least interesting compared to other subjects (SOU 2004:97; SOU 2010:28). The profound impact of negative feelings and experiences towards mathematics, not to mention mathematical anxiety, is further believed to inhibit a person’s confidence in his or her
abilities and in turn career choice. The role of student teachers is hereby highly relevant, not only because studies show high rates of mathematical anxiety among prospective teachers, but because it is believed that teachers with unresolved feelings and negative experiences towards mathematics have a high risk in influencing the attitudes of their students (SOU 2004:97). This means that a new generation of negative feelings and perceptions towards the subject of mathematics is created. Considering the relatively limited research area about affective variables in learning and teaching mathematics, most of the conducted studies have focused on measuring mathematical anxiety through mainly quantitative methods. With that being said, there is still not enough qualitative research about the emotional aspects of mathematics education, and even less about the impact of previous experiences and negative feelings.

Therefore, this study will offer a group of student teachers the opportunity to share their experiences and stories from the mathematics education of their school-time as well as the current mathematics course within their teacher education program. The students will also share their expectancies about their future profession. According to Kaasila (2007), when personal experiences are told and shared with others, awareness about your relationship to the subject is gained. Moreover, engaging in other peoples’ experiences can further support your own process in understanding your feelings towards mathematics, a notion referred to as narrative rehabilitation (Kaasila, 2007; Lutovac & Kaasila, 2009). Therefore, this particular study that includes the narratives of seven students will not only provide a deeper understanding about the important role of emotions in mathematics education, but hopefully also support those readers that might identify themselves with some of the stories. Finally, if an understanding about how to avoid these negative emotions does arise from this study, then an insight about strategies to inform teacher preparation may arise.

1.6. Limitations of the Study

A complete objective stance cannot be claimed in this study considering that a subjective interpretation, in the various choices, has been undeniable due to the fundamental role of the qualitative research approach. Although an attempt to be as
bias-free as possible was made, the selection of data is, nevertheless, influenced by previous experiences and personal opinions. The issue of subjectivity is further evident in relation to the investigation of students’ emotions and personal experiences. While every step of the study has been carefully planned, where both research methodological and theoretical considerations have set the base for the understanding of emotional aspects, defining and gaining an insight in other peoples’ feelings is difficult and evidently based on interpretations. Therefore, even though the survey is based on a large sample of student teachers, the findings from this study cannot be generalized, not only due to the qualitative nature of a case study, but also, because the experiences and understandings of emotions may vary depending on individual and cultural differences.

Finally, while several methods have been used in order to verify the findings and reach the purpose of this study, the limited time frame for finishing the thesis needs to be considered. Bryman (2012), states that qualitative research sought to view and interpret the social world through the eyes of those being studied. The issue of time is hereby raised as it restricted the possibility to engage in the lives of the participants and create the necessary relationship in order for them to feel completely safe and open in sharing personal experiences and feelings.
Chapter Two
Setting of the Study

Although the focus of this study may be found on a rather micro level, where the purpose is to understand individuals’ relationship towards the subject of mathematics, it is nevertheless necessary to explore the wider role of mathematics through its position in society. Therefore, this chapter begins by describing the possibilities of mathematics in relation to development and the notion of globalization. The role of mathematics will also be viewed on a national level and specifically in the context of Sweden.

2.1. Mathematics in the 21st Century

There are many different approaches to take when trying to understand the role of mathematics. The first question to ask might be why mathematics is even taught in schools? Niss (2011) attempt to answer this questions by conducting a historically and contemporary based analysis of the mathematics education. From that, he identifies three fundamental reasons for the existence of mathematics within the general education sector:

It will contribute to the technological and socio-economic development in the wider society, either for oneself or in competition with other societies and nations, […] It will contribute to society’s political, ideological and cultural continuance and development, either for one self or in competition with other societies and nations, […] It will give individuals the necessary prerequisites to manage what will happen during different stages of their lives – during the education, professional life, private, leisure time, and in the role as citizens.” (Niss, 2011, p. 53. my translation)

Bearing in mind that each reason has been focused on to different extends depending on the specific time, Niss (2011) starts from the 19th century and the very first public school settings. In light of the era of modernity, the general purpose of the mathematics education was that it would contribute to society’s ideological and cultural development through knowledge about measurements, weight, navigation, finances and so on. As the democratic movements started occurring, more citizens became entitled to basic education which meant that the elementary level of mathematics education now became a reason to develop the technological and socio-economic aspects of society as well as
providing tools for individuals to manage their own private and professional life (ibid.). However, since the more advanced settings of mathematics education within the tertiary enrollments were still only offered to a small minority of citizens, their contribution of mathematical knowledge was rather limited (Niss, 2011). Continuously, the 20th century is described as a time where all three reasons were raised together in light of increased enrollments in all educational sub-sectors, and more importantly due to the increased awareness of the use of mathematics in other areas.

The purpose of mathematics education is still discussed today, where one of the current debates is whether it should have more traditional basis of procedure skill development or a more contemporary approach were mathematics is better connected to the social life (Abbot, 2010). Today, the role of mathematics is not only viewed as a necessity for solving specific problems or functions; it is an understanding of the world, where some researchers take a rather broad view. Skovsmose (2007) describes mathematics as a tool for development in the setting of globalization. Within the informational age, and a growing knowledge-based society that is becoming evident in many parts of the world, he describes mathematical knowledge as a strategic resource which influences the technological and socio-political development (ibid). However, in order to understand the significant role of mathematics for globalization, the mathematical conceptualization must take a rather broad approach. As a further argument, the author reasons that starting from the industrial revolution and forward, it is possible to identify how mathematics has taken part in reaching today’s informational and technological societies. In this, Skovsmose (2007) continues to discuss the power of mathematics by which he identifies four vital categories where this can be viewed in society. The first three are mainly relevant. The “constructers” are those within the higher education systems involved with mathematics and development, not only as a fundamental base in their field but also to continuously develop the use of it. They are students of engineering, computer scientists, economics, pharmacists et cetera. The “operators” refers to the labor force and to how mathematics is also involved in the majority of processes taking place in job functions and work practices, for instance in construction, banking, buying and selling houses and all kinds of ticket reservations. Thus, all job-
functions have some kind of mathematics-based system, although some are more visible than other (ibid). Setting aside education and labor, the third category of “consumers” are those involved in the day to day information flow that every citizen experience. Images of mass media, television and newspapers, are filled with numbers and figures in ads and different offers, news and updates from the financial sector, about the economy, elections and other results, all of which need to be processed by individuals (Skovsmose, 2007).

The forces of globalization has increased the demands for nations to develop more rapidly and becoming leading countries. Within this competitive context, the role of technology and other science oriented subjects have in Sweden been identified and raised as prioritized areas in order to reach success (SOU 2010:28). Hence, the role of mathematics can once again be viewed as a tool for development. The focus is, however, more about how to create the strong competence within the country, or rather how to empower the mathematical competencies. Thereby, the debate is directed towards the role of mathematics within the educational settings, on all levels from preschool to higher education. In order to map the needs of the education sector and understand how it has developed, assessment and evaluation practices are becoming more popular than ever. The results from the various comparisons are thereby largely considered by stakeholders when developing educational policies, curriculums and reforms. The extensive attention given to the subject of mathematics is further proof of its importance in society. Furthermore, with support in Heymann (2003), the role of mathematics and its position in schools is supported by an international consensus that goes against all cultural and political differences.

2.2. The Political Context of Mathematics in Sweden

Together with the school subjects Swedish and English, mathematics has in the Swedish education system been considered as one of the core subjects in order to reach educational development and qualify for continuing studies throughout primary and secondary school. The debates about the mathematics education in Sweden have in recent years been dominated by the decreasing results among primary students in both
national and international measurements, an aspect which will be further discussed in the upcoming sections. This down going trend has evidently meant that increasing demands are placed towards the governance of the Swedish education system where extensive emphasis has been placed on the development of the education of mathematics. In light of a decision taken by the Swedish Government in 2009, development initiatives for all levels within the education sector were taken towards the subject of mathematics, which was now considered a national priority area (Utbildningsdepartementet, 2009). The Minister of Education commissioned the National School Agency to allocate project funds to the school directors in several municipalities in order to support the development work. By the end of 2012, a nationwide professional development work for in service mathematics teachers was further initiated by the Government as part of the investments in mathematics education (Utbildningsdepartementet, 2012). The so called Matematiklyftet, had the main purpose to improve mathematics education through collegial work between mathematics teachers and support from specifically educated mathematics supervisors. Continuously, the development work has also led to changes of legislation for different educational levels. According to the Swedish Code of Statues (SFS 2013:248), the change of the Swedish Education Act, which came into force in July 2013 and was implemented in the fall semester, meant that the instruction time for the subject of mathematics in primary school was increased with 120 hours.

Moreover, the Government proposed an improvement of the national teacher education program where on one of the aspects was to increase the amount of credits in the subject of mathematics within the program for primary teachers. According to the Government’s proposition (Regeringen, 2010), one of the main reasons for the reform is the shortage of teachers with required credentials in mathematics. In addition to more subject didactics, grade specialized teaching degrees were also proposed in order for teachers’ mathematical knowledge to be more suitable for the grade that is to be taught. Based on the decision taken by the Government in 2010, the teacher education program for primary education up to sixth grade gained 15 additional credits of mathematics, leading to a total of 30 ECTS (Utbildningsdepartementet, 2013).
2.2.1. **National Measurements of Mathematical Knowledge and Attitudes**

In regards to the mathematical attainment of Swedish students, statistics of national measurements have shown that the percentage of students achieving the national goals in mathematics by the end of primary school have been stably decreasing between the years of 2003 and 2012, with only a 0.9 percent increase in 2013 (SIRIS, 2013). Moreover, the number of students who did not reach the knowledge requirements by the end of primary school is considerably higher within the subject of mathematics than in both English and Swedish, as was the case between the years 2006 and 2011 (ibid.). In addition to the statistical decrease, a comprehensive national evaluation from 2003 showed general deterioration in mathematics since 1992. While this was the case for both the students at the end of primary schools and in fifth grade, the down going trend was more evident among the lower ages (SOU 2010:28). Based on national quality assurances, the School Inspectorate states that the decreasing knowledge development is a quality related issue with many deficiencies in the school education of mathematics. A fundamental problem raised is the growing trend of “silent counting, a non-reflective and lonely process” (Skolinspektionen, 2009, p. 88. my translation) where focus is on independent work through textbooks. Thus, in combination with the lack of discussions during math lessons, students are not learning how to autonomously use calculations procedures when facing new mathematical problems (ibid.).

In further regards, the attitudes towards school mathematics in comparison to other subjects have been measured in different ways where most results reveal that students’ ranking of mathematics is consistently among the lowest. Meanwhile, other studies show that Swedish students’ value of mathematics is significantly high (Norén, 2010). The attitude measurement of one specific study (see Figure 1) asked students during their last year of primary school to rank their school subjects based on their level of importance and enjoyment (SOU 2009:2). While the majority of students rank mathematics as one of the most important subjects, they further found most other subjects more enjoyable and fun.
2.2.2. **International Assessments of Mathematics: Sweden in PISA**

Sweden has regularly participated in a number of international assessments and studies of pupils’ performances in the past decades, and more frequently in the past 10 to 15 years (Skolinspektionen, 2009). The country values the activities of assessments and evaluations and much of the work of administrating, presenting and evaluating the different results are conducted by different entities within the National School Agency. When the results are to be presented, there are some large-scale studies which include mathematics that receive the most attention in social media. These are either the Trends in International Mathematics and Science Survey (TIMSS) conducted by the International Association for the Evaluation of Educational Achievement (IEA) or the Program for International Student Assessment (PISA) by the OECD. Based on a quick overview from former internationally compared results, history has shown that the mathematical attainment of Swedish pupils in primary school has been decreasing for many years now. The low results can be traced back to 1964 and 1980, where the two
studies conducted by the IEA revealed low mathematical outcomes among 13 year old pupils (Skolinspektionen, 2009). In an evaluation report, published by the Swedish National School Agency, further evidence of decreasing results are raised, mainly based on the TIMSS and PISA studies (Skolverket, 2012). With focus on different aspects of mathematical understanding and related factors, the study show how the pupils between the ages of 11 and 14 have shown consistent low results since 1995 in the case of TIMSS and from 2005 in PISA (ibid.).

During December 2013 the results from the most recent PISA studies were presented by the National School Agency during a press conference (Skolverket, 2013 December 3). While PISA looks into different aspects within all three knowledge areas of mathematics, reading and natural sciences, the main focus for this year’s cycle has been mathematics. The results, that were based on 4700 pupils between the ages of 15 from 200 Swedish schools, revealed deterioration compared to both the 2009 and the 2003 cycle (Skolverket, 2013). Moreover, Sweden did not only perform much lower than OECD average, but the consistent low results also positioned Sweden with the lowest performance improvement in comparison to all OECD countries, with mathematics in the very bottom. The other major concern in the latest survey results, which is of further interest in this particular study, was the measurement of Swedish school students’ attitudes towards the subject of mathematics. Compared to previous years, the level of anxiety has increased among students, with higher levels among girls. Although the current anxiety level is still viewed as rather low in relation to most countries outside of Scandinavia, the figures do nonetheless show the highest increase of anxiety, when compared to all participating countries, since the last survey cycle (ibid.)

Although mathematical knowledge among Swedish students has gone through a major decline, there are some aspects which proved to be higher than OECD average. These included the students’ general interest towards the subject of mathematics and their view of its value. Also, Swedish students’ self-perception of their mathematical abilities was higher than OECD average (Skolverket, 2013). This is of further interest since studies have shown a positive correlation between these aspects and high performances.
The relationship between students and teachers was also described as better than OECD average, but the classroom environment in terms of students’ late arrivals and class skipping have become more common (Skolverket, 2013).

2.2.3. Reasons and solutions
The discussion about the reasons behind the low results have several elements, for instance that the number of reforms taking place in recent have not yet been implemented adequately or concerns on whether the recourse allocations are actually reaching the schools or students with the most needs (Skolverket, 2013 December 3). The aspect that received the most focus was the teaching practice and the role of teachers. The solutions to increase the teaching quality that were raised by the National School Agency during the press conference (ibid.) were; developing a foundation of strong subject knowledge and a variety of intermediary skills in combination with evaluations through collegial learning and formative assessments. Increasing the quality of teaching also means more professional and societal support. Thus, in order to improve the Swedish students’ results there needs to be more active support from teachers during classes, considering that another issue was that students are often left to face their mathematical challenges alone (ibid.).

2.3. Other initiatives and further support
In addition to the national and international measurements of the mathematical results, a nationwide investigation from 2010 further revealed that in light of the growth of the technological and knowledge based society, Sweden will be facing a significant lack in necessary labor force within a near future (SOU 2010:28). The areas in risk are for instance engineering and technology, but also finances and the need of stock market mathematicians and insurance mathematicians. This is mainly due to the reducing applicant rates within education programs oriented towards sciences, mathematics, ICT and technology. Other than specialized knowledge and skills in mathematics, the study also raises the need for broad mathematical competencies that will be vital in most labor market positions ahead.
With this background, there is a growing need to find strategies and understandings that will not only support the mathematics education but also strengthen children’s’ and adults’ understanding of the subject. While educational reforms and improvements of for instance curriculum, teacher education and assessments processes, are all aspects with the mission to achieve better mathematical attainments, additional activities play an important role in shaping and sustaining these goals. In 2008, the government of Sweden appointed a delegation to both map the need of a workforce who were educated within the areas of mathematics, natural sciences and ICT, but also highlighting and supporting the development work to increase the amount of students choosing higher educations within these areas. In one of the delegations reports, the importance of additional initiatives towards children and adolescent is raised and later mapped. These initiatives do not only have the purpose to increase the general knowledge of the subjects, but also provide an understanding about their importance in society and create role models (SOU 2010:28).

The first understanding when identifying the various initiatives is that they exist on different levels within the country. The changes of the curriculum, assessments practices and teacher education programs that have been mentioned in previous sections are all initiatives taken on a governmental level. The various programs, courses and activities offered by universities and higher education institutions can also be viewed as initiatives with the mission to strengthen the mathematical understanding in different ways. A recent growing trend that is becoming more apparent around different parts of Sweden is the initiatives that have been taken place outside of school settings and by different actors. The majority is directed towards children and youth, but many of them also include a professional support towards teachers, different educational leaders as well as parents. These are for instance centers, organizations, networks and different associations directed towards mathematical development. In addition to the increased knowledge about mathematics, further initiatives that can increase the understanding about learning mathematics on a research level, and also initiate and support an engagement among different groups in society, are the events, projects, conferences and other activities that they offer.
Chapter Three
Theoretical Framework of the Study

The purpose of the following section is to familiarize the readers with the theoretical framework in which this study is situated. With that being said, the notion of postmodernism can be viewed as an overall umbrella and a theoretical approach, while the concepts presented are better able to concretely connect theory to what has been encountered from the field studies. In a sense, the concepts are tools which can lead to a deeper understanding of a phenomenon through theoretical analysis and discussion.

3.1. Postmodernism

While the term “postmodernity” has been used since the 1950s and 1960s in reference to movements within architecture, literary criticism and sociology from the late nineteenth century, it was not until the 1980s that it came to the general public attention and took on much broader and comprehensive meanings (Kvale, 1992). Within psychology and pedagogy the term has instead referred to different theories of knowledge and perspectives of the individual and subject (Nordin-Hultman, 2004). More commonly, postmodernism is described as a reflective retrospective view of modernism where the theories and perspectives, as well as the deeply rooted assumptions and perceptions, which our current practices are based on are critically examined (Kvale, 1992; Nordin-Hultman, 2004). In addition to this critical perspective, the postmodern attitude stands for openness and tolerance as well as complexity, subjectivity, uncertainty and the nonlinear (Dahlberg, Moss & Pence, 2006). Whether postmodernism is a disruption with modernism or just a continuation is debatable and further discussed by many writers (Kvale, 1992; Dahlberg et al., 2006). But unlike a global systematic theory of a secure, objective, reality, the notion of postmodernism is rather understood as interpretations of a range interrelated phenomenon. A fundamental idea is that reality is viewed as socially and linguistically constructed. This, in turn, goes against the dominant dichotomy within modernism which separates between the universal and the individual and further overlooks the social and cultural contextual setting of humans. When considering the role of the context, and the unstable and
constantly changing nature of a postmodern world, it becomes apparent that a standard measurement method for knowledge, a “common frame of reference” (Dahlberg et al., 2006, p. 35) does not exist. There is no absolute truth, no absolute knowledge and thereby no existing reality ready to be discovered (ibid.).

Same goes for the linguistic aspect of constructing reality, every form of language has its own way to express, interpret, and make meaning of the world. Thus, a contextual understanding towards the notion of language further means that the relationship between a linguistic sign, word or expression and what this sign actually stands for does not necessarily have a natural connection (Nordin-Hultman, 2004). Hence, the notion of, for instance, a “child” or “mathematical” may have different meanings depending on the different times, societies, cultures, practices and even situations. This is referred to by Nordin-Hultman (2004) as the “culturally specific language” (ibid., p. 39, my translation). Therefore, the word itself does not have a meaning rather meaning is given to the word. In this sense, reality and knowledge becomes available through our categories and descriptions, which in turn mean that an attempt to understand different phenomenon can only occur within the discourses that we ourselves have constructed. What is important to understand is that language and discourses are not only created in the verbal and written language (ibid.).

More recently the understanding of language has become wider where even the practical aspects of pedagogy, such as the structure of the daily schedules, classroom arrangement, teaching materials and methods, are viewed as theoretical and discursive (Nordin-Hultman, 2004). With that being said, the conditions of postmodernism do set considerable demands on pedagogical processes and educational practices. The challenge lies in for instance creating spaces and opportunities where individuals can produce reflective and critical ways to attain knowledge through investigations and construction. In that sense, higher demands are also set for the learners who will have to form an understanding of the world, of one’s life and knowledge. While a strong self-confidence of one’s abilities is hereby implied, Dahlberg et al. (2006) further claim that these perspectives can help learners be creative but also to deal with anxiety.
Finally, as postmodernism sets the theoretical framework of this particular study, the notion of poststructuralism, also has a prominent role and is evident throughout the thesis. Closely related to postmodernism, poststructuralism further emphasizes the instability and complexities of human sciences by criticizing the understanding of human culture through a determined structure (Lather, 1992). Here, much focus is put on the productivity of language and the construction of the subject under investigation (ibid.). While the thoughts of poststructuralism will be better presented in relation to the upcoming key concepts, one fundamental idea is to view language, cognition and context as broad, social and inseparable systems (Evans, 2000).

3.2. Mathematical Subjectivity

The concept of identity is in many ways important to understand when looking into the experiences and feelings of individuals. Other than individual experiences, identity includes and connects knowledge and perceptions of the self, such as one’s beliefs, values, emotions, motivations, attitudes and life histories (Hannula, Kaasila, Laine & Pehkonen, 2005; Kaasila, 2007). The construction of identity can in turn be viewed differently depending on prevailing theoretical disciplines. Within developmental theories, the individual becomes the focus of identity formation through self-determined processes of adaption and development in order to fit into various life situations. A belief of a universal, essential truth, a fixed, inner self, is a fundamental aspect of these theories (Nordin-Hultman, 2004). Other more socially oriented theories also view identity as located within the individual but with an external aspect. In that, the focus is rather on the interaction between the individual and social elements where identity is influenced and developed through social and cultural practices (ibid.).

With that being said, this particular study looks beyond the debate on whether identity is in essence individual or social and takes one step further when trying to understand the experiences that student teachers have towards the learning and teaching of mathematics. Thus, current literature related to the process of becoming a teacher raises contemporary theories of poststructuralism which challenge previous ideas of identity as a stable, static and constant entity (Nordin-Hultman, 2004). Moreover, some
supporters of poststructuralism not only question the concepts and approach of developmental theories, but also the terminology used. Nordin-Hultman (2004) claims that the word identity is embedded within a modernistic view; one that carries features of classification and an individually isolated view of identity formation. Palmer (2010a) takes further distance by replacing the term of identity to *subjectivity*. She further justifies this replacement with support in Butler’s writings about the contemporary theory shift (Butler, 1990 referred in Palmer, 2010a). Ultimately, a more postmodern approach towards the concept of identity is the notion of subjectivity in which the experiences of being a person are constituted by the discourses and practices that the subject meets and have access to (Nordin-Hultman, 2004).

Thus, the constitution of subjectivity is hereby viewed as a dynamic and changeable process, a construction of the self that is constantly shifting. Within this constant shift, the individual is described as an active maker and creator of his or her conduct. Unlike the modernistic view of a passive and “typical” identity, deeply rooted within or behind a psychological consciousness, subjectivity is never recurring and enables the multiplicity of identity (Dahlberg et al., 2006; Nordin-Hultman, 2004). More importantly, this understanding means that the view of subjectivity is not about *being* something or someone but it is rather about *becoming* in different ways in relation to prevailing discourses as well as the physical environment (Nordin-Hultman, 2004; Palmer, 2010a). An individual’s relationship towards the subject of mathematics is understood as part of the person’s subjectivity which thereby means that the *mathematical subjectivity* of individuals is also constructed. Hence, the notion of being mathematical is understood as something you become. We view ourselves as more or less mathematical, as well as make ourselves and become mathematical differently depending on the context (Palmer, 2011). Continuously, Palmer explains how the processes of mathematical subjectivity not only occur in the early years and among children and students, but it is a lifelong process where even adults and mathematics teachers experience subjectivity shifting (ibid.).

Similarly, Kaasila (2007) describes the concept of mathematical identity as constantly
under construction and part of an individual’s relationship towards mathematics. Other than accentuating the strong social connection, and the possibility of constructing several identities, he further describes a person’s mathematical identity as context-bound. Meanwhile, a significant aspect of Kaasila’s (2007) research is the role of narratives where a person’s mathematical identity is “manifested when telling stories about one’s own relationship to mathematics, its learning and teaching” (ibid., p. 206). This means that an individual creates and develops his or her perception about the self, or subjectivity, through personal narratives, a concept referred to as a narrative mathematical identity (ibid.). In further regards to narratives, Sfard and Prusak (2005) claim that a person’s identity is defined by the stories that are told by both oneself and others and thereby the role of the communicational practice is emphasized throughout the identification process. While the uncertainty of distinguishing an actual identity from a designated one is sometimes raised as a criticism towards the notion of narratives, it is further argued that the learning processes occur in the intertwining of imagined, present and expected identities (ibid.).

Finally, the notion of identity, or subjectivity, can be understood as fragile. This indicates that the processes of subjectivity are unpredictable and difficult to determine which in turn means that an individual’s identity is not necessarily complete or sustainable (Stentoft & Valero, 2009). Moreover, due to the uncertainty and lack of structure, Stentoft and Valero claim that these processes become very vulnerable to disturbances. While this fragile aspect does point out the complexities in individuals’ teaching and learning processes, the following section will attempt to provide further support in how such a volatile concept can actually be used to gain understanding about student teachers’ relationship with the subject of mathematics.

3.3. Discursive Practices

Based on the idea that the processes of subjectivity are constantly shifting and constructed in relation to social and cultural practices, a further understanding of the context in which subjectivity is constituted is necessary. Discourse is often raised within poststructuralist perspectives in connection to the discursive practices surrounding
different relationships and institutional practices. According to Foucault (1993, referred in Palmer, 2010a) a discourse consists of a specific practice that produces certain statements, in its own time and space, which in turn are viewed as effective and powerful. Thus, while some discourses are more dominant than others, they nonetheless control the practice and determine what words and actions that are significant, but also possible to express in certain settings. Simply put, it is a set of invisible rules on what is considered as right, true and appropriate in that specific context (ibid.). Moreover, a discourse is as equally active through the unstated, in attitudes and behaviors as in the verbal (Foucault, 1976). He further claims that subjectivity is not only constantly changing and created through discursive practices, but it is also captured and assigned positions and qualifications that were previously not present (ibid.).

Meanwhile, the notion of *positioning* raises a double process where subjectivity is both constituted through socially dominating discourses as well as an active constructor of subjectivity within different discourses (Nordin-Hultman, 2004). With that being said, individuals’ opportunities to position themselves or become positioned are either limited or possible depending on which practices one participates in. Thus, unlike a pure deterministic view of subjectivity, this means that the subject is not completely ruled by prevailing discourses and can instead challenge those that are conflicting as well as create counteracting discourses, a view mainly supported by a feministic approach of poststructuralism (Palmer, 2011). Continuously, the concept of discourse should be seen in light of the multiplicity nature of subjectivity, since an individual often has access to a variety of discursive practices, all of which exist within the same system (Nordin-Hultman, 2004). While some might be challenged, as mentioned earlier, others may intertwine or just occur in parallel with one another (Nordin-Hultman, 2004). By understanding that subjectivity, as a fragile and dynamic process, varies depending on different discursive practices this further means that a mathematics classroom does not necessarily need to include discursive practices directly concerned with a mathematical content or the learning and teaching of mathematics (Stentoft & Valero, 2009). Despite the physical educational setting of a mathematics classroom, there are many factors and disturbances which enable other subjectivities than mathematical. Therefore it becomes
a matter for the external observer, investigating the discursive practices within the mathematics classroom, to question the role of the deviating activities for the issues raised in relation to mathematics education (Stentoft & Valero, 2009).

Hereby, the role of the physical environment and the material is also raised in relation to discourses and the processes of subjectivity. Nordin-Hultman (2004) writes that the self is created in en flow of activities, materials and relationships. Palmer (2011) describes the relationship between subjectivity, material and the physical environment through the concept of performative agents. Based on the idea that individuals are performative in the sense that they create themselves in their daily lives through actions and thoughts, the author raises a recent understanding of how materials as agencies are connected to these processes. The notion of agency can simply be described as a force which can make something happen, and thus, by also viewing materials as agencies, they take a powerful and active role in the constitution of knowledge and identity (ibid.). The textbook in a mathematical classroom is an example of a performative agent that, in relation to the prevailing discourses, has the power to make individuals talk and act in certain ways. Palmer (2010b) describes the link between an individual, the material and the discourse as an intra-active network where it becomes almost impossible to tell who is doing what in the interrelation. Additionally, intra-activity focuses on the agency of not only materials and things but also the environment and places, and highlights their mutual and ongoing transformation processes (Barad, 2008). Barad further claims that even discourses are agentical and can be viewed as performative agents.

3.4. **The Social Construction of Emotions**

Considering that the literature review about the affective variables in mathematics, as presented in the beginning of this paper, focused on the notion of mathematical anxiety and attitude, the theoretical approach in this study will rather focus on emotion as a variable. Moreover, a fundamental aspect within this theoretical focus is the understanding of emotion as a social construction. While beliefs and attitudes are considered as cold and stable elements, emotions are instead viewed as hotter, more intensive and unstable (Evans, 2000). Based on the theories of subjectivity formation
through positioning within the available discursive practices, it is assumed that
emotions evolve in the processes of subjectivity. More specifically, it is in the
interaction of power and values in relation to conflicting discourses that emotions are
constructed (Evans, Morgan & Tsatsaroni, 2006). In order to understand these
processes, the relationship between affect and cognition needs to be viewed from the
perspectives of poststructuralism and how these have progressed from psychological
theories. Affect has, in dominating psychological understandings, been considered as
stable characteristics or traits within the individual which in turn influences, or
intervenes with, the mathematical thinking, performance and thus the cognitive (Evans,
2000). Here, the affective variables are viewed as internalized. Hence, while a person’s
social experiences and process of socialization takes place outside the individual
through cultural and social influences, the differences between individuals is raised in
how affect influences cognitive outcomes (ibid.). In addition to the view of the
cognitive and affective as separated, some psychoanalytical approaches focus on the
behavioral aspect to understand individuals’ feelings, based on observational research of
for instance problem solving episodes. However, Evans (2000) further claims, with
support in his study about mathematical anxiety, that the expression of emotions is
neither observable nor available for self-report.

Continuously, from psychoanalytical perspectives, emotional experiences are
understood as “charges attached to particular signifiers” (Evans, 2000, p. 130) where
ideas, words and feelings of strong negative charges are expressed through repression,
displacement, condensation and other, mainly unconscious, defense mechanisms. Lacan
(1977, referred in Evans, 2000) further develops these theories by including the social
world through the notion of language as a way to form the unconscious. The formation
takes place through the semiotic processes of metaphors and metonymy, a metaphor
superimposes the signifiers and metonymy creates a continuous covering of signifiers
through combinative dimensions of language (ibid.). While the idea of metaphore and
metonomy does consider a social aspect and, thus, brings cognition and emotion closer
together, Evans (2000) claim that several poststructuralist writers emphasize the need
for a broader understanding of signifiers which accounts for the complexities of
emotion. This does not only mean that the cognitive and affective should be viewed as inseparable elements, but emotions should further be considered as actively in play and related to discursive practices, of both cultural and historical base (Evans, 2000).

Hereby, the experiences of emotion can be viewed as rather complex including not only personal and psychological features and qualities, but, more importantly, the experiences from the social world constructed within different relationships and prevailing discourses. As a final account within this complex nature of emotions, the notion of self-transformation is raised (Zembylas, 2003). As it has been argued throughout the theoretical framework of this study, mathematical subjectivity is understood as embedded within and constructed through spaces of affective variables and discourses. Based on Zembylas (2003) research on teacher identity, a poststructuralist approach implies the possibility of individuals to empower themselves and overcome the feeling of inadequacy in teaching. The process of identity transformation takes place “when the emotional salience[…]of one’s experiences changes.” (ibid., p. 229). While the use of narratives and storytelling is helpful for individuals to elicit and understand feelings, these processes also call for a great vulnerability. With that being said, becoming aware about one’s emotions is not only empowering, but it is further described as a tool to sort out personal experiences, anxieties, fears and so on (ibid.).
Chapter Four
Methodology of the Study

4.1. Epistemological and Ontological Considerations
As the focus of this study lays in understanding and interpreting how individuals make sense of their world, and more specifically their experiences and emotions, a stand against the notion of positivism was taken at an early stage. Rather than just measuring and explaining a set of feelings deriving in certain situations, this particular study involves a deeper investigation of subjectivity and human conduct. Through these ideas, the researcher is set within an interpretivist epistemology where the main focus is to study the social world, including people and their institutions, by using adequate methods. This, in terms of the ontological consideration, means that the social world is to be viewed through the theory of constructionism (Bryman, 2012). While constructionism derives from the postmodern paradigm, it further reflects the understanding of how subjectivity and emotions are constructed within the social world and, hence, in relation to prevailing discourses. Based on the methodological considerations as presented above, the notion of a narrative research approach is of further importance in this type of inquiry. While researchers’ influenced by interpretivist traditions have always employed techniques associated with literary analysis and criticism, in many cases the analysis emphasized an informational content and, thus, missing important features of a talk or its relationship to experience (Sandelowski, 1991). More recently, a growing trend has been to focus more on storytelling and the narrative research approach. By seeing the story in the study, and the participants as narrators, the link between science, history and the social world becomes closer and in turn naturalizes the research process (ibid.). Interacting and engaging in the life stories of the student teachers will further allow me to understand the individual’s expressions and meaning making, while decreasing the risk of standardizing the data.
Some criticism has been raised towards the notion of narratives within research. According to Evans et al. (2006), a narrative research approach towards the study of emotional experiences can be viewed as restricting considering that the participant’s actual *experiences* have not in fact been observed as they took place, only accessed through shared stories (Evans et al., 2006). However, the authors further claim that most school mathematics discourses are strictly regulated and give little opportunity for the expression of feelings. In that sense, the interview setting with focus on personal narratives allows a greater space for the participants to share life stories, experiences and express feelings. Moreover, although narrative inquiry is more common in participant observation and semi-structured interviews, Bryman (2012) argues that the use of narratives analysis should not be restricted to certain research methods as it can be employed in a variety of data-collection methods. Zembylas (2003) describes narratives as a powerful tool, specifically in relation to understanding emotion and teacher identity, as it can “document the way discursive environments provide the construction of teacher identity” (ibid., 2003, p. 215). The relevance of a narrative research approach towards student teachers’ experiences and feelings of mathematics education is hereby evident. With that being said, the specific use of this approach in terms of both data-collection methods and analysis will be provided in the upcoming sections.

### 4.2. Qualitative Research Approach

As the focus of the data-collection has been narratives within the framework of the participants’ everyday lives, the major part of the data will consist of words, texts and stories rather than a numerical data. Therefore, the qualitative research approach with the techniques of open-ended questions and face-to-face, in depth interviews were highly appropriate in this study. According to Bryman (2012) the use of multiple qualitative data-collection methods helps in reaching a better understanding about the life story and experiences of each person being studied. Moreover, as a qualitative research is more occupied with a process oriented inquiry through flexibility and limited structure, the outline of the study did not necessarily have to follow a strict or predetermined sequence. Instead, by taking on an inductive approach where theories
derives in relation to the data-collection, the researcher was able to enter the field with fewer assumptions and a more open mind. This also meant that more time had to be spent on analyzing the data through different aspects in order to find patterns and a relevant theoretical framework. Although the inductive process more commonly involves theories deriving from the data, Bryman (2012) claims that it may also include some degree of deduction. With that being said, although this research did not decide on a theory before starting the data-collection, the literature review and readings of previous research that occurred in the beginning of the study have possibly offered some understandings of what might derive from the data.

4.3. Sampling Design and Selection Process: A Case Study Approach

Due to the methodological considerations that have set the basis for this study, a case study approach was employed as it offers the opportunity to go in-depth and explore more complex research questions of qualitative nature (Atkins & Wallace, 2012). Also, the qualitative approach emphasizes the contextual understanding of the social world and, thus, lifting the importance of the case in question. Continuously, as this specific case involves a higher education department, the notion of closed versus open settings, as well as access, were of importance when planning and conducting the data-collection. According to Bryman (2012), a location such as higher education institutions or a specific university department is more commonly regarded as a closed setting. With that in mind, access was gained with the help of a so called gatekeeper a few months before the first inquiry with the study participants. A gatekeeper refers to the person who agrees on giving access and usually holds a higher position in institutions (ibid.). After that, there was a continuous need to secure the access, firstly by informing the course instructors of the study in order to meet with all students at the same time and, secondly, after the first meeting with the students when requesting interview subjects. Continuously, the sampling process can be presented through two levels: the context and the participants.

4.3.1. Selection of Context

The national teacher education program for pre-primary and primary school up to sixth
grade is divided into three specializations; either preprimary class and primary first to third grade (F-3), primary fourth to sixth grade (4-6) or primary specialization of leisure-time. This particular study is located within a university department that offers mathematics courses for students enrolled in the first two specialization programs. The Swedish Ministry of Education’s webpage states that in order to reach a degree in either of these two, the education has to include 165 ECTS in subject didactical studies relevant for the specialization chosen, 60 ECTS in educational science and 30 ECTS in teacher training (Utbildningsdepartementet, 2013). For the lower grades of primary, 30 credits each are distributed to the subjects of Swedish and Mathematics and 15 credits for English. The student further chooses 15 additional credits in either natural science oriented subject or social sciences. The specialization in fourth to sixth grade also includes 30 credits each for Swedish and Mathematics, as well as English. Moreover, 30 additional credits are required in either natural science oriented subjects, social science or any practical and esthetic subject. A completed program leads to a degree in primary education teaching with specialization in either preprimary to third grade or fourth to sixth grade. Thus, part of the qualifications for teaching these grades in Sweden includes not less than 30 ECTS in Mathematics (ibid.).

Other than offering teacher education programs and courses on different levels, there are many activities taking place within this specific department. In light of the department’s involvement in research projects and cooperation with other departments, organizations and educational institutions, there is a constant stream of various stakeholders, mainly educators and students, who, during their time at the department, all focus on the educational aspect of mathematics and science. Some of the department’s research areas within mathematics education involve assessment and evaluations practices, knowledge development over time, multiculturalism and language as well as conceptualization. Furthermore, the department is also, from time to time, involved in educational projects commissioned by the government. In further regards to this study, the departments work with the teacher education programs has expanded in recent years as a result from the national reform of increasing the ECTS in mathematics. The credits are divided into four courses spread over the four yearlong programs and
specifically adapted to the specialization of each teacher program.

Considering that the focus of this study is related to the becoming of a teacher, the context of the compulsory mathematics courses within the students’ current teacher education enrollment can be viewed as purposeful in this small-scaled investigation. Out of the various mathematics courses offered within the teacher education programs, this study has been conducted in relation to two of them. One of the courses was the first within the teacher program directed to the primary grades from preprimary class to third grade with the mathematical focus on basic number sense and number use. The other course was the second of the mathematics courses offered for student teachers with specialization in fourth to sixth grade. The mathematical content was geometry. The selection of courses was mainly based on a convenience sampling, as these were available during the semester when the data-collection was conducted. Finally, although the specific mathematics courses within the department have set the framework for this particular case study, they should from here on merely be seen as the location which provided access to investigating the real objects of interest. Therefore, the unit of analysis consists of the group of students that are enrolled in the teacher programs and not the course itself.

4.3.2. Selection of Participants

As mentioned in the previous section, the selection of the initiative group of students could be described as a convenience sampling due to the fact that they were enrolled in the two mathematics courses available at that time. Once access was gained to these two groups, the findings from a self-completion questionnaire were used to further identify participants that were willing to be interviewed. In that sense, a generic purposive sampling was partly used since the selection of participants was conducted in relation to the context and also because the survey questions were related to the research topic and could thereby set the criterions for choosing interviewees. While the students have their background in two different mathematics courses, as well as two different specializations, this study will not address the differences between the groups. Rather, the investigation is focused on a group of student teachers in relation to a compulsory
mathematics course within their teacher education program. The questionnaire was constructed and later distributed to both groups of student teachers during the introductory lecture of their mathematics course. In total, 106 students participated in the study, whereof seven provided an interview (see Table 1). Out of the interviewees, three students further participated in a focus group session. The group of interviewees consisted of both male and female participants with a wide age range; two males and five females between the ages of 23 and 48. This allowed for a more diverse understanding of the research topic. In order to keep the anonymity of the participants from the interviews and focus group, fictive names have been made up and used throughout this thesis. Although the profile of each participant (see Table 1) may be viewed as rather brief, a closer presentation will be provided in relation to the findings, in each individual narrative.

Table 1
Presentation of study participants

<table>
<thead>
<tr>
<th>PARTICIPANTS</th>
<th>QUESTIONNAIRES</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distributed</td>
<td>Responses</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Grade F-3</td>
<td>87</td>
<td>61</td>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>Grade 4-6</td>
<td>47</td>
<td>46</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>TOTAL</td>
<td>134</td>
<td>106</td>
<td>70</td>
<td>37</td>
</tr>
</tbody>
</table>

PROFILE INTERVIEWEES

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Specialization</th>
<th>Participant in focus group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carl</td>
<td>32</td>
<td>Male</td>
<td>4-6</td>
</tr>
<tr>
<td>Robert</td>
<td>43</td>
<td>Male</td>
<td>4-6</td>
</tr>
<tr>
<td>Anna</td>
<td>32</td>
<td>Female</td>
<td>4-6</td>
</tr>
<tr>
<td>Linda</td>
<td>23</td>
<td>Female</td>
<td>F-3</td>
</tr>
<tr>
<td>Jessica</td>
<td>23</td>
<td>Female</td>
<td>4-6</td>
</tr>
<tr>
<td>Norah</td>
<td>36</td>
<td>Female</td>
<td>4-6</td>
</tr>
<tr>
<td>Sara</td>
<td>48</td>
<td>Female</td>
<td>4-6</td>
</tr>
</tbody>
</table>
4.4. Data-Collection Methods

4.4.1. The Questionnaires
In order to maintain the qualitative nature of the study and assure an inductive approach, it was highly important that this was reflected in the design of the questionnaire. Therefore, the 13 questions included were mainly of an open-ended character, allowing the respondent to answer in their own terms and with the possibility of unexpected answers deriving (see Appendix A). After a short verbal presentation about the purpose of the study and the survey, the questionnaires were handed out and took approximately 15 minutes to fill out. Other than the actual questions, the questionnaire began with some written instructions and information about their ethical rights for participating. Moreover, the structure of the questionnaire was inspired by the narrative research approach, and the overall aim of the study, regarding the understanding of how student teachers have felt about and experienced mathematics during different periods of their lives. This becomes evident in how the questions were divided within three sections reflecting the past, present and future.

As mentioned above, the survey had the initiate purpose to serve as a sampling method in the process of selecting interview participants but also as an opportunity to identify relevant concepts from the data which would perhaps set the basis for a theoretical framework of this study. While the data did generate a number of interview participants and identified possible leads for theories or at least relevant concepts, a third aspect which became of further importance in this investigation was the large amount of rich data that derived. Due to the nature of the open-ended questions, it was possible to identify the tendencies within a large group of student teacher in terms of their experiences and feelings towards mathematics, as well as their expectations of the program and future profession.

4.4.2. The Narrative Semi-Structured Interviews
The second phase of the data-collection consisted of an approximately one week period of one-on-one interviewing with a sample of the students from the survey. This
occurred shortly after their mathematics course ended. The students from the first survey were given the opportunity to reply in the questionnaires on whether they were willing to participate in interviews. These were later contacted through e-mail in order to confirm their continuing participation, and those who were still interested and were able to devote their time were thereby chosen. Out of the 21 students that had requested to be contacted for interviews, seven students confirmed and agreed on being interviewed. With that being said, the selection of interview subject can also be viewed as a convenience sampling since these were the students willing to participate.

As for the technical aspect of the interviews, the interview guide used was semi-structured with open-ended questions. In relation to the methodological considerations, additional focus was given to the narrative approach. Mischler (1987, cited in Kaasila, 2007, p. 207) claims that “there is usually not enough scope for recounting narratives” in the traditional semi-structured approach, thus, the 14 questions included in this guide have been inspired by the form of a narrative, unstructured interview. Moreover, the questions were developed with support from the researcher who was presented in the beginning of the thesis in Previous research. Kaasila (2007) was contacted through e-mail and asked about the specific methodological approach of narratives that he has used, as well as the type of questions that can be asked in such an inquiry. Question 4 in the interview guide (see Appendix C), in particular, was recommended by him. This is mainly visible in how most questions start with the open-ended prompt “tell me…” and ask about different periods of the person life as well as future expectations. The purpose of this method was to elicit stories about experiences that are important and meaningful to them and in relation to some central themes.

Further, while the interviews followed the content of the intended guide in all interviews, some specific questions did change and some additional were added in order to maintain a natural conversation flow between the interviewer and the interviewee (Bryman, 2012). Finally, as the interviews were conducted in Swedish, the appended interview guide is a translation of the questions prepared (see Appendix C). Each interview was further audio recorded and transcribed, since details and expressions are
important for the analysis.

4.4.3. **Focus Group**

In preparation for the final stage of the data-collection processes the interviewees were asked whether they were interested in participating in a focus group as part of this study. Each person was asked in relation to the interview session and all seven verbally agreed that they would. All responses were gathered and a final date for the focus group was thereby set based on a joint decision through e-mail. However, as the date came closer some of the students decided to withdraw from participating in the session because of different reasons and by the end only three of seven students took part of the session. The purpose of the focus group was partly to give the students an appropriate closure to their participation, considering that they had generously shared rather personal aspects from their life and school-time experiences. Moreover, the focus group was also a final attempt to gain insight into the students’ thoughts about some central themes that could not be raised in the individual interviews due to the time constraint of a single occasion. Additionally, the group dynamic involved in a focus group and interaction between participants provides the opportunity for rich discussions.

The main content of the focus group was the notion of mathematical anxiety, both as a research phenomenon and in relation to the increased anxiety among Swedish students in the recent PISA results. The students were also given a fictive case study that had been prepared in advance and is inspired by the interviews, questionnaires as well as the literature review conducted in relation to this study. The structure and content of the session, including questions that were asked and discussed, can be viewed in the appendices (see Appendix D). The session took nearly two hours, including the approximate ten minute introduction with some information about study results, statistics and explanations. Once the students had finished the discussions, they were asked to fill out a short individual evaluation (see Appendix E). The complete session was audio recorded, while only specific parts that were of significance for the study have been transcribed. Finally, while the notion of a focus group is usually compared to a group interview, this particular experience had additional elements of a work shop, in
terms of a short topic introduction and a case study reading.

4.5. Method of Data Analysis

The managing of the data as well as the initial analyses and interpretations has been done through a narrative analysis. With support in Lieblich, Tuval-Mashiach and Zilbert (1998), a narrative analysis involves four analyzing modes for the reading of a text which in turn are found within two independent dimensions, either the holistic versus categorical dimension or the content versus form dimensions. The first dimension determines whether the analysis is based on a section abstracted from a text or the whole narrative, while the second dimensions refers more to the linguistic features of the narratives and whether to include or exclude the content or the form of the text (ibid.) When considering the polar ends of each dimension, it becomes clear that the same data can lead to quite different analysis depending on which dimension that is in focus. However, the authors stress that the distinctions should not be seen as absolute or completely separated (Lieblich et al., 1998). More commonly, a narrative analysis consist of both dimensions overlapping in different ways, as demonstrated in Figure 2.

<table>
<thead>
<tr>
<th>HOLISTIC-CONTENT</th>
<th>CATEGORICAL-CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOLISTIC-FORM</td>
<td>CATEGORICAL-FORM</td>
</tr>
</tbody>
</table>

Figure 2: Lieblich’s framework for narrative analysis (Lieblich et al., 1998)

In this particular study, the data has been analyzed in two ways. The first part of the findings, which is based on the questionnaire responses of the large groups, has the purpose to highlight the general tendencies of student teachers. In that, a categorical approach was taken where focus is on lifting the content of the text through the so called categorical-content mode. According to Kaasila (2007), the categorical approach is useful when the interest is to raise a phenomenon common to a group of people. Similar to a content analysis, the categorical-content analysis is focused on the process of coding and defining categories from words, fragments and sections in different texts (Bryman, 2012). Considering the inductive approach of the study, the key contents and issues deriving from the questionnaire data informed which categories and themes to
present. The guiding question for this part of the data was to figure out what kind of feelings and experiences that the student teachers expressed.

For the second part of the findings, a more in-depth analysis was made with focus on the individual narratives of the student teachers who participated in the interviews. Here, a holistic approach is taken where the relationship between the different events and aspects of the person’s life-story will be analyzed as a whole through the notion of emplotment while considering a chronological order. The holistic approach has also been used in relation to the data from the focus group session. Moreover, although the main analysis of the interviews and focus group session has been based in the holistic-content mode, the holistic-form mode have also been considered to some degree, in terms of how they have expressed themselves, the linguistic features of words used, gestures and body language. Continuously, while the narrative analysis does provide the overall frame of the data analysis, the comparison has, moreover, been fundamental in the process of gaining a comprehensive understanding of the shared experiences. More specifically, by comparing the various aspects that derived from the data, both within the tendencies of the large group and each individual case, it was possible to highlight and present the most significant findings. This is mainly evident in the summary sections in chapter five. On a final note, not every single question asked to the participants and found in the appendices (Appendix, A, C & D) have been included in the final presentation of the findings. This was due to some questions and responses that turned out to be less relevant in relation to how the thesis developed.

4.6. Criterions for Trustworthiness

An important part in choosing the specific study to conduct is to evaluate the design according to different criterions in order to identify possible issues or restrictions. Firstly, although this specific case study may be of a representative kind, considering that the participants are students enrolled in a national teacher education program existing in different parts of the country, the findings that will eventually derive from the fieldwork cannot be generalized to a population or broader context. The choice of a smaller sample was nevertheless made, because it was necessary in relation to reaching
the depth that is expressed in the aim of the study. The small group, viewed in terms of
the possible transferability of the research, or the external validity as seen within the
quantitative approach, is further compensated for by the large and rich questionnaire
data including responses from over a hundred student teachers.

In further regards to the trustworthiness, the second aspect which is of importance in
addition to the transferability is confirmability (Bryman, 2012). Confirmability involves
the notion of being completely objective in the interaction with the study’s participants
(ibid.). Considering that the issue of subjectivity is more commonly raised in relation to
qualitative studies, and is often a factor of criticism by quantitative researchers, it has
been an important aspect throughout the study. Being aware of the nature of this study,
including the theoretical and methodological considerations, I have tried to diminish
this issue in a number of ways. Starting from the choice of research topic and the
formulation of research questions, they have been written in a way that makes the study
both recognizable and relatable to a broad audience and different disciplines. As for the
methods that have been chosen within the study, although an interpreting approach
towards individuals personal narratives may come across as very subjective, each step
of the selection and data-collection processes have been handled with particularity. For
instance, how the choice of questions for the interview guide were inspired by previous
research in this area. Additionally, although an attempt will be made to reach all the
above mentioned criterions in best possible way, as well as trustworthiness by acting in
good faith, it is, however, almost impossible within social science research as it mainly
copes with the social world of humans.

4.7. Ethical Considerations
In any research the notion of ethics has to be taken into consideration when planning,
conducting and publishing the final report of a study, more so in the case of social
science research as it involves studying the life of humans. While a variety of research
methodology authors have written different texts about the ethical principles of
research, it is also important to view the specific study within the guidelines and
recommendations set by national laws and other governing ethic committees. In the case
of Sweden, the legislations that are mainly associated with this study are the Freedom of the Press Act, the Archives Ordinance, the Archives Act and the Official Secrets Act (Swedish Research Council, 2011).

Since this study expected the individual students to share a personal aspect of their lives, in terms of emotions and experiences from different periods, there was a further need to assure the researcher’s good faith towards any sort of involvement from the subjects’ side. With the mission to avoid any misconduct towards the students, the four ethical research principles of social sciences given by the Swedish Research Council (Vetenskapsrådet, 2002) have been employed. In regards to the information requirement, the participants have been informed by the researcher about the study and their role throughout the entire study. This has taken place both verbally, in the first meeting with the large groups of students, as well as written in the form of information sheets for the survey and interviews. The information requirement was also reached in terms of letting the students know about the voluntarily conditions for participating and their right to withdrawal at any moment. The second requirement, consent, was met when the students were given the opportunity to reply and confirm their participation both in the first questionnaire, a following e-mail and finally by signing a consent form before the interviews (see Appendix B). This was also the case for the confidentiality requirement as the students were informed from the very start that not only would identities and all record be anonymized in the report but that all data would be kept safely by the researcher (ibid.).

In regards to the last requirement about the use of the final report, although the participants were at first informed that the study would only be used for the researcher’s educational purpose within the framework of a master thesis, there was yet another aspect that needed to be explained in the following consent form (Vetenskapsrådet, 2002). Educational organizations that conduct research, such as universities, are in Sweden viewed as public authorities (Swedish Research Council, 2011). Since this study was conducted within the framework of a master’s program, the data-collection can be considered as “official documents” which in turn might lead to the
documentation being spread and jeopardizing the privacy of the research. Although the identities and locations would be kept anonymously as much as possible, the participants needed either way to be informed about a possible publication.

Other than following the ethical principles and being as honest as possible with the participants, without it impacting the naturalism of the data, some final concerns were accounted. With support in Bryman (2012) it was highly important that nothing in the study would be of harm to the participant or be seen as deception.
Chapter Five
Data Analysis and Findings

The following chapter will present the findings from all data-collection methods that have been used; the initial questionnaires from the two large groups, the individual interviews and finally the focus group, including the discussion and final evaluation. Although the findings from each method have been written in three separate sections, they should nevertheless be viewed as connected considering that each step has been based on the previous. Moreover, while the large amount of data has been compiled and categorized within the framework of the thesis, the purpose of this chapter is to provide the reader with the reality of the field to the best possible extent.

5.1. Tendencies of the Questionnaire Responses
The findings from the questionnaire responses have the purpose to highlight the tendencies of student teachers’ school-time experiences of mathematics education as well as their future expectancies. Considering the large amount of data deriving from open-ended questions from over 100 responses, these findings will be presented in a rather general sense. It is, however, important to understand that the complexity of each case and the differences between the cases are nonetheless of significance. Therefore, other than demonstrating the tendencies of the whole group through numerical data, thematic categories will be used to highlight the nuances of the material.

5.1.1. Experiences and Feelings towards Mathematics Education
As an initial analysis of the first section in the questionnaire, three main groups have been used to demonstrate the students’ experiences and feelings of mathematics: positive, negative and neutral. The positive group consisted of the students whose responses described the school subject of mathematics as their favorite subject and mainly a fun activity. More commonly, the words used to express the enjoyment of learning and working with mathematics were related to interest, stimulation, passion and logics. As for the second group, the spectrum of negative experiences was wider. The description varied from students that described their experiences as challenging,
difficult and frustrating, to those who mainly found the education and subject of mathematics as boring, under-stimulating and, in different ways, meaningless. Within this group, many students also expressed negative feelings of discomfort and aversion. The last of the three categories, the neutral group, included the students who, in different ways, fell in the middle ground of the two above mentioned dimensions. Other than not being merely negative or positive, the feelings and experiences towards the subject were expressed more subtle. Many students described their experiences of mathematics as uneventful, and in the cases where feelings were raised they were directed to a specific factor, situation or phase during the education. With that being said, a clear majority of the experiences described in the neutral group did nonetheless involve a more negative than positive connotation. In summary, the questionnaire data showed that while 20 students (18.9%), have had rather positive experiences in relation to school mathematics, 54 students (50.9%) expressed an overall negative experience and the rest, 32 students (30.1%), expressed a more neutral view towards the subject of mathematics.

In order to better understand the above mentioned categories in relation to the widely ranged responses and the experiences of the student teachers, a more detailed presentation of the responses will be hereby be presented. Through the categorical-content approach of the narrative analysis, six sub-themes have been formed based on the expressions and stories told within the questionnaires (see Figure 3). The themes have derived from a further reading of the three main categories, and thus have either a positive, negative or neutral base. Each title has been influenced by the content of the categorized sub-theme, as a way to portray the larger picture.
Positive sub-themes

I have always been good in math: These students write about their experiences and feelings from school mathematics in relation to their personal abilities. Their memories involve positive experiences of learning mathematics in which the students describe themselves as mathematical in one way or another, for instance by referring to oneself as a “math-person”. More specifically, the notion of being mathematical is mainly described as finding mathematics easy, and being someone that did not have to struggle when learning mathematics. In some cases the students explain their positive experiences in relation to being clever, something that they are good at or as feeling safe when having to solve mathematical problems.

Learning mathematics was interesting and exciting: The positive experiences of this group are related to elements specific for the subject of mathematics; for instance how they found the subject and tasks interesting, appreciation of the logical and analytical aspects and the subject’s challenging nature. A few students raised the teacher as a key role in their positive view where the descriptions of their teachers varied from great and fun to fantastic and inspirational. Some concrete teaching methods were also raised positively, such as technological and visual support materials and cooperative learning.
Negative sub-themes

I have never been a math-person: This group includes the students with the most evident negative feelings and experiences of the school subject. The negative view and experiences of mathematics common to the students in this group becomes evident in how the focus of the students’ descriptions is low self-confidence, lack of mathematical abilities and an overall distancing towards the subject. Some of the students explain that the reason they find mathematics so difficult is because they, as individuals, are more of an “aesthete” or “language-oriented” and not mathematical. This is further raised in their descriptions about not being good enough, smart enough or “mathematical” enough in the eyes of the teachers and others. Hatred, repulsion and anxiety were some of the words and expressions used to describe these experiences. While some students describe this as being weak in mathematics, others explain mathematical ability and understanding as something that they might have had once but are now “lost” or “dead”. The experiences of mathematics education from school are described as bothersome in the majority of the cases and many students write how they found the subject difficult to comprehend.

The problem was the unengaged teachers and the focus on textbooks: The aspect raised by almost every single person in this group is the students’ experiences of mathematics education as extremely tiresome. This is described to different extent and with different emphasis, but other than boring, or incredibly and terribly boring, the students describe it as not fun or uninspiring, uncreative and insufficient. One student even claims that mathematics education can never be made fun as a school subject if based on traditional methods. Among the students that found mathematics as boring were also those who described the lessons as not challenging or serious enough. Instead they expressed their frustration about how mathematics education was meaningless and never able to stimulate their learning well enough. Most of the students blame their school teachers for their negative experiences in mathematics, where a lack of support, engagement and varying teaching methods are some of the problems raised. Traditional teaching, with textbook and lecture focused lessons, was further described as reasons for the meaningless and negative experiences by the majority of the students.
Neutral sub-themes

*It started out good but then...*: The common feature that most students in this group share is how their first experiences of mathematics education started out good but changed over time until the students instead started disliking the subject. More specifically, these students explain in different ways how the transition to upper primary and secondary school caused a sudden turning point in their feelings towards the subject. While many write that the subject became more difficult, complicated and abstract, others raise the problems of boring lessons, teachers with only one way communication and how they would always work with the textbooks, individually. In further regards about mathematics becoming too abstract in the higher grades, many students write that since the subject and mathematical tasks could no longer be connected to reality or situations from everyday life, it not only became more difficult to understand but the relevance and importance of the subject was less evident.

*Mathematics was okay except for some things*: Unlike the students in the previous group, whose positive experiences and feelings towards mathematics changed in the transition to higher grades, this group of students had mainly positive experiences and was not necessarily bothered by the main individual work. Instead, they raise specific situations and aspects of mathematics education that caused negative feelings. Learning the multiplication table was one of the recurring situations that many students described as stressful. So did the notion of math tests and examinations. Starting a new mathematics course or not understanding certain mathematical domains where other experiences that these students relate to frustration, anxiety, difficulties and stress. Finally, a few students describe the other aspects that had a negative impact on their mathematics classes. The examples varied from lesson groups being too big, classes being scheduled on Friday afternoons, low quality of teaching, substitutes and frequent changes of mathematics teachers.

5.1.2. Teaching Mathematics and Future Expectancies

Besides the student teachers’ experiences and feelings from their school mathematics, the following section will instead focus on their responses in the other questions
included in the questionnaire. The responses that have been of most relevance for this section are those where the students, in one way or another, have shared their future expectancies of teaching mathematics. These will be presented in four sub-themes.

**Feelings about teaching mathematics in the future**

As part of the questionnaire, the students were asked how they felt about teaching mathematics in the future. Similar to the themes presented above, the responses varied quite a lot between the students. Overall, the students’ feelings about eventually teaching mathematics can be divided into either those who are looking forward to it, those who do not look forward to it or those who feel indifferent about it. While this description merely demonstrates the polar ends of the students’ responses, they are nonetheless useful for showing the response rates of students that feel either negatively and positively about teaching mathematics. Out of the responses, approximately 66 percent of the students wrote that they look forward to teaching mathematics to children in primary school. While most of these students expected it to be fun, exciting or interesting, some of them write that they are looking forward to using everything they will be learning in the courses. Many students were excited about teaching mathematics and doing a good job because they wanted to offer their students a better mathematics education than what they themselves had experienced in school. In contrast to this large group of students who felt positive about teaching mathematics in the future, around 11 percent of the students stated that they did not look forward to teaching mathematics. While most of these responses were related to students feeling nervous, afraid or insecure about having to teach mathematics, some students expressed that they prefer to avoid it. There were also students in the group who claimed that they did not like mathematics or that it was not something that they were passionate about.

The rest of the students’ responses, 21 percent, did not fit into the groups mentioned above and their feelings towards teaching mathematics can instead be described as somewhat indifferent. The indifference was represented either by the students that did not express any particular feelings towards teaching mathematics or those who had mixed feelings about it. As for the latter, it was an even variation of both positive and
negative feelings, such as being excited about teaching but, simultaneously, pointing out the challenges and difficulties of the subject. Another student teacher expressed the importance of providing children with a strong mathematical foundation, but was at the same time afraid about possibly spoiling their interest.

**Teachers’ influence on their students**

The students were also asked whether teachers influence their students, or more specifically if they believe that their own feelings towards mathematics can influence their prospective pupils (see Figure 4). While a clear majority of students do believe that their own feelings as teachers will influence their pupils, the results from around sixty comment responses further revealed in what way the student teachers believed they could influence the children. The majority of the responses showed that most students believed that a positive attitude, engagement and interest in mathematics will influence both the children and teaching of the subject. In the same way, a few students wrote that a negative attitude towards mathematics, as well as personal experiences does influence students. Thus, if a teacher is feeling insecure or afraid it will affect the pupils. Meanwhile almost the same amount of students expressed a wish, or hoped that a positive attitude towards mathematics could be of influence. In that sense, many student teachers raised the importance of teachers being inspiring and making an impact on their pupils. Additionally other responses included more concrete examples of how teachers may be of influence, such as teaching methods, clear and relevant purposes of the education as well as a genuine will and passion to teach. Some students even wrote that as teachers they need to work on giving mathematics a more positive image and creating an interest among primary pupils.
Prospective teachers about teaching abilities and a good mathematics practice

In order to gain an insight in how mathematics education should be taught according to the student teachers, their views about important abilities for teachers as well as the teaching of mathematics was raised. The first aspect is more related to the teacher education program in terms of what teaching abilities they find mainly important to develop before becoming teachers. A number of abilities were raised in the teachers’ responses and could in turn be categorized in different groups. The most evident ability was to develop a communicational skill in order to mediate and share knowledge with the pupils. This included mathematical conceptualization and the notion of language, different modes of expressions and communication. Many students express the need to develop knowledge of teaching as ability where both pedagogical and didactical tools, theories and other ways of explaining the learning of mathematics are in focus. Moreover, there were some students who sought after the ability of diverse teaching in terms of both practical aspects, such as different teaching methods and learning materials, as well as having a diverse mindset. In regards to the latter, this was represented as developing the ability to think diverse in order to reach out to all children, including those who are “weaker” or just learn in different ways. On the other hand, there were student teachers who expressed that the most important ability for them to develop was their personal mathematical subject knowledge. Not only gaining a better understanding of specific mathematical areas and procedures, but the feeling secure and confident in one’s mathematical abilities was also included. Finally, a few
students who did not necessarily describe an ability to develop did, instead, express a desire to *create a better interest* towards the subject of mathematics. The importance of making the subject interesting and fun was described in regards to the subject of mathematics generally but also for the future pupils and the teachers themselves who, in some of the cases, had a negative view of mathematics when growing up.

Figure 5: Students response to the question about important teaching abilities

Setting aside the teaching abilities, the other aspect within this theme looks more generally into how the student teachers think the subject of mathematics should be taught. The deriving data can be divided into four ways in which the student teachers think mathematics should be taught (see Figure 6). Many students raised the notion of making mathematics education as something enjoyable where a recurring feature of their descriptions was to teach in *a fun way*. Additionally, words such as creative, inspirational and encouraging were used. The majority of the students did, moreover, express the importance of a *varying practice* including both theoretical and practical knowledge, concrete and abstract as well as cooperative and independent learning. In regards to the latter, most of the students did, however, emphasize the need to replace the quiet and lonesome activities that are mainly based on a textbook with cooperative and interactive learning in mathematics classrooms. Continuously, the third group of students underlined the use of *supportive tools and methods* and, specifically, the involvement of different practical materials and visual means. As for the supportive methods, the examples given by the student teachers varied from incorporating playful activities, games and ICT to regular mathematics tests, examinations, increasing
teaching competence as well as the number of teachers per mathematics class. Finally, there were some students who focused on the *structure* of the subject and the need to regulate the pace and width of the subject. For some, this meant to teach mathematics in a more calm, slower or easier way, while others believed in a more explicit, clear and methodical way.

![Figure 6: Student’s responses to Question 12: How do you think mathematics should be taught?](image)

**Challenges in teaching mathematics**

The challenges of teaching mathematics according to the student teachers’ future expectancies involves several aspects, mainly reflecting on the relationship between the teachers abilities, the students understanding and the educational context. One of the challenges that were raised by most responses was the concern about not reaching out to everyone in the class; *ensuring all pupils*. The other large group of responses included many student teachers who would find it challenging to have to *change the view of mathematics* from negative to positive. This was raised both in relation to teachers being concerned about facing pupils that find mathematics boring, not interesting, difficult and anxious, but also in regards to how teachers themselves can cause mathematics to be boring and not inspiring. Thus, many students expressed the challenge of creating the interest, finding the joy within the subject and making it fun.

As for the third aspect, the challenge included teachers making sure that the primary *pupils’ understanding* in mathematics was reached. The majority of the students expressed that getting the children to understand the different areas and concepts of
mathematics and attain a deep mathematical understanding is challenging. Some of these students also emphasized this in relation to the national knowledge requirements in the mathematics curricula for primary school. There were also those students who described the challenge as related to a lack in personal knowledge or doubt in one’s ability. This was described either as not having enough mathematical knowledge or understanding needed for teaching the subject, but also as a concern about saying something wrong or facing a pupil that knows more. Finally, a few students expressed the challenge in organizing a more practical and varying mathematics lessons (see Figure 7).

Figure 7: Students’ responses to the question about the challenges in teaching mathematics.

5.2. Summary of Questionnaires Findings

Based on the student teachers’ responses, it can be understood that the majority of the participants have had negative experiences from their mathematics education when growing up. Even though a large group of the students do express a more or less neutral feeling towards their previous experiences, many of them describe occasional negative feelings from school mathematics and most of them experienced the emergence of negative feelings in connection to the transition to higher grades. Although a negative background of mathematics education in most cases, the majority of the students do feel positive about one day teaching mathematics to pupils in primary school. One of their main reasons is to be able to provide future pupils with better experiences of mathematics education than what they had themselves. It is, however, worth mentioning
that many of the student teachers did express mixed feelings about teaching in the future where, for instance, the excitement about teaching collided with the view of mathematics as challenging and difficult. In regards to what the prospective teachers thought about influencing pupils, based on the responses, a clear majority do believe that, as teachers, their personal feelings will influence their future pupils. While most students believed that a teacher’s positive attitude and genuine engagement in the subject of mathematics is likely to influence the pupils and their learning, some also raised the aspect of negative feelings influencing how mathematics is taught and learned.

Continuously, the most important abilities to develop as student teachers in preparation for teaching were firstly the ability to teach in terms of attaining the necessary pedagogical and didactical knowledge. On second and third place, the notions of language and different communication methods as well as strong mathematical knowledge were valued as fundamental abilities for teaching. The ability of teaching diversely was also raised as important for the teaching profession, which is further evident in what the students think should be included in the educational practice of mathematics. Based on most responses, the best way to teach mathematics is by a varying mathematics practice that considers different ways of learning. This was mainly described as interactive mathematical activities with different practical materials. Additionally, creating a fun and creative climate around mathematics education was also an important aspect in this. In regards to their concerns, the challenges of changing future pupils’ negative views of mathematics and turning them into positive learning opportunities was raised as one of the biggest concerns that the student teachers have prior to their future profession. Moreover, this concern includes both having to face pupils’ aversion towards the subject, as well as being the reason for the possible dislike created among them. Finally, another challenge that the majority of the students express is how to ensure the needs of all pupils in class and make sure that each individual learns in the most suitable way possible.
5.3. The Mathematical Narratives of Seven Student Teachers

The interview findings of seven student teachers will here be presented as individual cases, each as a mathematical narrative. The construction and emplotment of each story is mainly based on the interview sessions, but to some degree the students’ questionnaire responses as well. Considering the narrative approach of the study, and the importance of a thorough reading and analysis of the different aspects that creates a storyline, a chronological order of each individual’s mathematical experiences has been employed for the write up. Other than future expectations, the narratives are based on the students’ experiences from their years in school as well as the current mathematics course and teacher training. Continuously, the specific quotes or examples in the narratives that will later on be referred to in the discussion have been given a code according to the narrative and their order, for instance the first code in the second narrative will be (2a), while the third code in the fifth narrative is (5c). The codes’ positions in the narratives also show where the example that will be discussed begins and ends.

5.3.1. Carl’s Narrative

*Experiences from years at school*

Carl starts by explaining that the education of mathematics during his early primary years was not that memorable and goes on by summarizing his overall experience of school-time mathematics as mainly irrelevant and not something that he particularly enjoyed. Unlike the other school subjects, Carl could not seem to understand the purpose of mathematics which he blames on the poorly applicable tasks provided during the lessons and in the course material. Another negative aspect he raises was how the focus would usually be placed on set theory and mechanical counting, more so in the higher grades. (1a) The first time Carl was able to see a new side of mathematics, and its possible relevance, was with the help of the chemistry and biology teacher in high school. She made him understand the role of mathematics in specific contexts (:1a), something that his mathematics and physics teachers must have forgotten according to him. Furthermore, Carl explains that because hockey took such a large and significant part of his life, it was not until he started high school and cut back on the trainings that
he realized how much the sport had actually kept him away from learning. Not only because it took up a lot of his spare time, but as a hockey guy it was not considered cool to do school work. Moreover, he describes how he and his hockey friends would many times compare themselves with the bright students in class. Particularly one girl who would always get good grades, where they would convince themselves that it had to do with her background and that both her parents had intellectual jobs.

(1b) [...] ‘of course she gets good grades, it’s like written in her DNA. We can’t get higher grades, because it is not written in ours’. We were kind of doomed to be hockey guys and just kick and fight with our hockey sticks. (1b)

The second time Carl experienced mathematics as relevant occurred in relation to the final project he wrote for his bachelor’s degree where he needed to collect and present statistics of his data in a thorough manner. He continues by saying that for the first time in his life, mathematics became relevant on a very high level and he could then truly understand the importance of mathematics.

I could understand the numbers very well and the statistical [...] choices that I had made. [...] I felt safe in understanding what the different numbers in the different choices showed and could derive and then I could understand very well. And then I got a strong connection to how mathematics and numbers can show a lot about how we behave, if you start by asking humans.

Experiences from math course at university...

The mathematics courses within the teacher program have been one of Carl’s favorites compared to other courses. Other than the well-structured organization and seminars as well as the competent teachers and interesting content, the most positive aspect he lifts is the relevance of the course. In regards to the difficulty level, he found that learning how to teach mathematics in a good way was more difficult than to learn the actual subject. Hence, he experienced that the mathematical content was more about trying to remember and repeating what he once learned in school. The practical elements of the course were further appreciated, and Carl explains that in order to develop the ability to teach he also needs to visualize and experience it.
...and the teaching practice
Carl describes his teaching practice within the course as a mainly successful experience and felt rather stable about teaching mathematics, specifically in that particular group and with his supervisor. He based his lesson plan on tasks that he found in the students textbook but added some practical elements and “a little more color”. The students were expected to do their own statistical survey and were given about fifteen minutes to independently create groups and choose specific subjects and questions to ask. The students thereafter made a frequency list and a histogram which, according to Carl, went really well and all the students managed to do it.

Future expectancies
Carl expressed in the beginning of the course that it would be challenging and difficult, but also inspiring, to one day teach mathematics. After the course, and the teaching practice, he shares a much more secure attitude towards this notion and, moreover, looks forward to one day being a mathematics teacher. At one point he tells that if he would have been asked a few years ago, when he had just decided to enroll in the teacher program, whether he would want to teach mathematics in school, his answer would have been different. His initial thought was not to become interested in mathematics. (1c) “It has changed. It has turned over significantly […] math has received an additional head start because I have now understood its meaning.” (:1c) In regards to which abilities that are most important for a mathematics teacher, Carl raises the ability to think logically in the formation of tasks but also to be flexible in relation to each student. Although he values high subject knowledge, he further points out that it is not about knowing different formulas or calculations by heart but about being able to derive one’s mathematical understanding. Finally, Carl believes that everyone can with the help of education be better in mathematics, and thus everyone can be mathematical. Unlike his previous understanding of intelligence as connected to a person’s DNA, he now believes that the human knowledge depends on the sociological choices and the surrounding environment. It depends on the existing prerequisites, the teachers and supportive parents.
5.3.2. Robert’s Narrative

Experiences from years at school

Until ninth grade, Robert describes his feelings towards school mathematics as fun. In the last grade he received middle to high level grades and describes it as a time when he actually started understanding some mathematics. The main negative experiences of mathematics seemed to have started during secondary school, in connection to changing from the lower level mathematics class in upper primary school to the higher level class in high school. Robert describes the mathematics courses as “hell” where he spent most of his time avoiding math and truanting classes. His mains reasons were the boring classes, the lack of teacher support and that (2a:) he could not keep up with the level.

(:2a)

Yuuuk …I skipped all the math that existed […] because I did not get anything out of it, if you can’t learn anything you just feel dumber and dumber, and then you feel ‘should I just sit here like a damn moron… I don’t want to do that, no, Ill rather find some friends and get out of here and do something else. Just disappear’.

He had a difficult time understanding the text-based mathematical problems because they did not make any sense to him: “hieroglyphics, like it was written in Russian”, and he could never figure out what formulae to use. Robert also claims that his own mathematical knowledge was “worthless” and “crummy”. The least meaningful experiences according to him were when the teacher introduced a new mathematical topic to the entire class which was thereby followed by individual work in the thick textbook. The rare moments when mathematics became meaningful to him were when someone explained a problem to him. The aspect of time was also a concern, where he often worried about not finishing a certain amount of mathematical problems or pages in the textbook. Other than the occasional teacher that would spare some time and explain or the support from his sister, Robert’s memories mainly portray a lonesome struggle through mathematics education.

Experiences from math course at university…

After have worked within finances for most part of his life, he decided to become a teacher, a choice that Robert partly based on the will to help those who struggle and also
share some of the knowledge he had gained in life. (2b) The overall experiences of the math course within the teacher education program have been positive, but he expresses the need to increase the amount of sessions for practicing the subject knowledge. Although he describes the level of difficulty as rather low, he was very surprised about the final examination which he, on the other hand, found very difficult (2b). Once again, he mentioned the lack of mathematical content within the course but this time in terms of instructors not being willing to share formula sheets. (2c) Many times he expresses a strong need to rely on formula sheets in order to solve any mathematical problem. He further describes this as a type of cheating because, according to him, when applying a formula to a problem it does not require any real or deep mathematical understanding of the problem. Robert quickly rejects the possibility of being considered a mathematical person, where his way of using formulas is one of the reasons. (2c)

...and the teaching practice

The mathematics teacher training practice took place in the middle of the geometry course and Robert expressed, more than once, his insecurity about going out on the training before getting a full comprehension about the subject. Once in place, he agreed in consultation with his supervisor and the class schedule that the mathematical content of the lessons would be statistics. Robert taught two different groups of sixth graders and describes the teaching experience as rather problematic. The main experiences from his first lesson were that students were very loud, threw things, did not listen or pay any attention to the lesson. When describing the second lesson he mentions that the students were “troubled” as they tried to test his patience; sitting with their back towards him, calling him mean and so on. Robert explains that, regardless of the situation in class, he started his lesson and went on with it although being interrupted by students and having to stop from time to time. His main concern looking back, other than the lack of discipline, was that the students were on such different levels when it came to their understanding of the mathematical content that he felt he needed to be better prepared. Therefore he regrets not starting with a test, just to localize the students’ knowledge of the subject.
Future expectancies

(2d:) In the beginning of the course when Robert was asked how he felt about one day teaching mathematics he expressed nervousness. Later on, after he had finished the course he was rather excited about teaching mathematics where his main goal was to do as much as possible (:2d) and not become the person who “supplies quantitative misery to people and to students who thinks mathematics is the plague”. For him, a good mathematics teacher is someone who is nice and understands the difficulties that students might face towards mathematics. He means that when teachers see pass an incorrect answer it can encourage students to continue mathematics, instead of inhibiting them.

5.3.3. Anna’s Narrative

Experiences from years at school

When sharing her experiences from mathematics during her first years in school, one of the first aspects in Anna’s storytelling was how the very turbulent and tough school-time was one of the main reasons for the difficulties in learning mathematics. Besides being bullied from other children in school, Anna describes in different ways how the absence of teachers, both in terms of lack of involvement as well as those who had to suddenly quit for different reasons, is reflected in her negative experiences of mathematics. (3a:) In relation to a specific situation, she describes in detail the feeling of vulnerability, and exposure, when she had to learn a specific mathematics procedure referred to as “the reclining chair”. After several attempts of trying to understand why the procedure is used, both alone and with teachers, the final outcome was teacher telling her not to care about it because she would not be able to learn it anyway (:3a). (3b:) Although feeling defeated by that and other similar situations, she moreover describes that the overall subject of mathematics during the first years of school was something that she did in fact enjoy. This joy was partly in regards to the how some mathematical activities were simply logical for her, but more so she especially “loved” the competitiveness within subject. However, although the excitement about finishing the multiplication table and different calculations was high for a competitive person like her, she further expressed a dislike towards the notion of a multiplication table as well
as hatred against not being able to always finish on top. Thereby, in the situations when she was not necessarily the best - for instance she recalls her difficulties with the third and seventh multiplication table - she would instead give up because it was better than being on average. (:3b)

Moreover, as she moved on to the upper primary grades her experiences of mathematics education are described through the overall boredom of the school subject. Realizing that her mathematical knowledge was on average level in the middle grades, she quickly came to terms in upper primary that she no longer liked mathematics and, even more so, found it “awful”. This was mainly described in relation to her impatience and confusion towards the endless mathematical text problems as well as the lack of support from teachers. She also points out that her usual curious and inquisitive personality was seldom appreciated by her mathematics teachers who would rarely responded to her questions: (3c:) “I never understood it [math] and would never get responds to the questions I had. Only told that ‘that’s just how it is’ and ‘this is how you do it, period’.” (:3c) Moving on to her high school mathematics, she describes how she in the transition and the beginning of the courses felt anxiety. The main reason was that she was placed in the lower level mathematics course instead of the higher level like the rest of her friends: “Why can’t I do it if everybody else can?”

Experiences from math course at university

One of the main reasons for Anna to become a teacher for the primary grades is to make sure that future students will not have to go through what she did during those years of schooling, and she further accentuates that she does not want anyone hating mathematics as much as she did. Moreover, her experiences of the mathematics course within her teacher program have been good but, at the same time, she expresses a slight disappointment towards the amount of subject preparation included in the course. According to her, an increased focus on the theoretical knowledge of geometry and on calculating and solving different problems would have been more useful and make her more secure about the topic. Moreover, she feels that the amount of practical and didactical elements were just too many and, occasionally, too obvious.
**Future expectancies**

Due to some practical issues, Anna missed the teacher training practice during the mathematics course. She did, however, write in the beginning of the mathematics course that although enthusiastic, she also felt scared about possibly teaching mathematics in the future. When the same question was asked at the end of her course, her feeling remained the same because she did not know if she had enough confidence in the subject of mathematics to be able to teach yet. Anna does not view herself as mathematical and, furthermore, as she explains the notion of mathematical she describes someone similar to a calculator and “a little autistic”. According to her, a mathematics teacher should not only be confident but also have strong subject knowledge. Additionally abilities such as being creative, varying, flexible and attentive are further identified as highly important in order to approach students’ confusions and be able to explain in a suitable way.

**5.3.4. Linda’s Narrative**

**Experiences from years at school**

Linda remembers the subject of mathematics as the least favorite subject during her years in school. She starts by explaining that since her father, who had a master of engineering, often stressed the fundamental and important role of mathematics, she ended up distancing herself from the subject early on. “When you did not understand mathematics it felt like you did not understand anything at all, so you got like a huge blockage when you would work with mathematics.” She describes her frustration when trying to understand, and claims that because she was not able to structure her thoughts in a mathematical manner everything became confusing and she could not keep up. Linda struggled to understand the elementary knowledge of mathematics, such as the multiplication table and the four methods of arithmetic. In the transition to the higher grades, although the mathematical content became more difficult, Linda felt that it was somewhat easier. At least in the higher grades the students were allowed to use calculators and for the tasks, and there was no need to actually understand. She admits that the main focus was placed on doing the calculations, as a kind of mechanic activity, without really understanding what was being calculated. Thus, even though she never
really understood the core of the activities, she was able to get through it but with an awareness that she would never manage to continue a mathematical path. (4b) In that sense, Linda’s earlier years of school mathematics are remembered as the most meaningful because there was a better connection between the activities and the real life (4b).

In the process of reminiscing about previous experiences in mathematics, Linda interjects that after have taken this particular course in mathematics she understands the importance in gaining the basic knowledge in mathematics and realizes that this was her set back. Although she describes the effort her father made in trying to make her understand, she expresses an overall disappointment towards her teachers in mathematics throughout schooling. She raises one teacher particularly, and how he could not seem to accept that she could not keep up: “he [teacher] did not want to take it upon himself that we did not understand…”

Experiences from math course at university
Linda praises the well-structured and organized mathematics course at the university, the highly competent professors and relevant content that helped her understand how mathematics is so much more than just a subject. (4c) “Everything is mathematics, and not just to sit and do calculations from a book…because, it really does not have that much to do with that.” (4c) Continuously, when asked how it felt to solve mathematical problems and arithmetical calculations, she describes that when she would do it alone it was fine but as soon as there was a bigger group, for instance during the lessons, the stressful feelings would return. Her reasons are that mathematics as a subject is very competition-oriented and, when taking place in a group setting, the time pressure becomes very high. (4d) Continuously, Linda has always viewed mathematics as a sign of valued intelligence, which in her experience has just felt unreachable. (4d)

Although her views of mathematics as a subject have recently become broader there is, however, still a distance between her and mathematics which becomes evident in the way she separates mathematical thinking from the notion of being mathematical.
Because mathematical thinking is so different from what she refers to as a “common mindset”, it becomes something that you have to be “acclimatized” into. Moreover, Linda does not consider herself as mathematical partly because her abilities to write and express herself have been more apparent. Through these traits she has, indirectly, been defined as a none-mathematical person. Continuously she explains that once you have defined yourself as not mathematical, it is more likely to let someone else take that role. In the same way, if someone is defined as mathematical, then that will be amplified. Finally, as Linda gives an example of this by referring to a group of people splitting a restaurant bill, she subtly describes how those that normally avoid the calculations find themselves in a situation where they are ashamed about their mathematical abilities and tries to hide it in different ways.

**Future expectancies**

Although it might be difficult, Linda nevertheless believes that it is possible to become mathematical even if you are not, as long as you have the interest and motivation. She raises the importance for mathematic teachers to eliminate all the pressure and stress surrounding the subject as well as the internal competition. Only focusing on the correct or incorrect answers and assessing students mainly on how far they have worked in the textbook should also be avoided. As for her future expectancies, Linda’s overall mission for when she will teach mathematics is to make it fun. Because mathematics is often viewed as boring, this should not be too difficult to accomplish, for instance by including mathematical games. Her concerns about teaching mathematics are instead related to making sure that every student in the group can keep up, bearing in mind that individuals may easily fall behind in this particular subject.

**5.3.5. Jessica’s Narrative**

**Experiences from years at school**

Jessica’s strongest memories from the mathematics education during her first years of school are related to competition, where finishing the multiplication tables as quickly as possible was the main activity. Because this particular exercise was timed, how she and her friend used to compete and being so caught up with finishing first that she
barely considered writing down the correct answers. (5a) (5b) She further claims that she used to hate mathematics in school, where her strict teacher was a main reason, and the fact that she never dared to ask questions when having difficulties in understanding. (5b) Moving up to the upper primary grades, Jessica described that although the teacher she had was somewhat better than the previous one and tried to help her understand as much as possible, mathematics was still a struggle for her because she had missed out on learning the basics. As the mathematical content became more abstract, she blames herself for not putting more effort into studying and for not understanding better. Another reason she often raised was her poor motivation. Because she found the rest of the school subjects easier she became overwhelmed about how different mathematics was and about having to work harder. (5c) Jessica explains that this was the point when she gave up and the problems with mathematics started. Later on she describes that the biggest problems were the uneventful lessons and the lack varying activities which made the lessons straight up boring. (5c)

The first math course in high school was according to her only a repetition of ninth grade which she was able to manage. The second course, however, became a real struggle because she found everything incredibly abstract. Once again, the teacher seemed to have played a large role in her difficulties and negative experiences. The lessons would, usually, start with the teacher giving a quick review of the mathematical content to the class, without a sufficient explanation, and thereby leave the students to work alone. She further complains about how too much focus was placed on going through and finishing the textbook, hence she often received a lot of additional homework in order to keep up. As Jessica tells about her experiences of high school math she becomes frustrated and a bit angry because the teacher did not do anything to help her understand, even though it was clear that she needed it. Other than the short period when one teacher tried to help her, Jessica cannot think of any meaningful experiences from her mathematics education.

Experiences from math course at university…

As Jessica starts telling about her experiences from the math course within the teacher
program, there is a clear turnabout in her narrative. Although she was a little scared and nervous in the beginning, this changed once she started and got a good grade. With a smiling face, she describes the fun and enjoyment in doing mathematics with different kinds of materials and how she not only learned mathematics but she now understands what she had struggled with during her school-time.

(5d:) And why didn’t anyone do this with me when I was in school … Why didn’t anyone take out the ropes? Or why didn’t anyone take out the blocks? … I get it now…like it was really as if all the pieces fell into place kind of. (.5d)

While Jessica expresses her excitement about learning and finally reaching good grades in mathematics, she does, however, mention that the content of the courses are directed to a primary level and are thereby rather basic. Thus, although feeling more secure about basic geometry she further means that her understanding of algebra and similar domains included in the higher grades are gone.

…and the teaching practice
Jessica was given the opportunity to choose the content of the mathematical lesson on her own and designed a lesson about the coordinate systems in relation to statistics. Her students were told to gather information by asking their classmates different questions and then add the statistics, including the average and the typical value. She describes that the students moved around quite a bit and came up with a lot of different questions to ask. (5e:) Although she was proud about the lessons she held, and that she was able to use her imagination as well as draw connections to the national curriculum for mathematics, she hoped to be a lot calmer next time around by talking slower and not stressing out. (.5e)

Future expectancies
During different points in her story, Jessica mentions that because of the mathematics course at the university she went from avoiding and hating mathematics to enjoying the learning of math and looking forward to teaching math in a fun way. She further point out that, a good mathematics teacher should be passionate about the subject and enjoy
it. Based on her own experiences, she explains that students are aware of the teacher’s feelings towards the subject because it reflects on her teaching, thus if a teacher can provide fun lessons by not only using a textbook than this will evidently rub off on the students. Finally, in order to offer varying lessons and support the students in their learning, a teacher needs to have strong subject knowledge.

5.3.6. Norah’s Narrative

Experiences from years at school

Right from the first grade in primary school, Norah had to struggle to understand mathematics and explains that she had a difficult time to think in terms of numbers and their relation to each other. Unlike her friends who would get it as soon as the teacher explained, Norah questioned the logics of math and its use. Moreover, she was many times told that mathematics was not something that she was good at and to focus on her other abilities instead; being creative, dancing, singing, painting. (6a) Teacher would tell her: “You have one of those artistic souls. You should work with a creative profession mathematics is not your thing”. (6a) She specifically remembers the multiplication table as the least meaningful experience: “Around that time, already when you learn the multiplication table, I lost the interest…and they lost me”. Norah expressed many times that she would not get the support she needed during class, and most of her teachers accepted that she was bad in mathematics. Thus, when it was time to choose a course for the upper primary grades, although she had already planned on choosing the same as all of her friends, her teacher convinced her that it would be too difficult for her because she was not good enough. “How can you say that to a child?: ‘You are not good’. She [the teacher] is not good because she did not teach me good enough. It is because of her that I don’t have the basic knowledge.”

The general mathematics course in upper primary did not only consist of students that had difficulties in learning mathematics, but also those with the least study motivation. Combined with the laid back teacher, the lessons lacked discipline, structure and an adequate level of mathematics, which in turn became a setback for Norah’s learning. Considering that Norah preferred to stay away from mathematics, she did at the time
appreciate the low expectations. However, this low attainment also meant that when she started high school, she barely managed the basic mathematics courses included in the program. (6b) As for the economical orientation of her high school program, she deliberately chose the courses of marketing and advertising in order to avoid the mathematics in accounting and auditing. Moreover, before pursuing her teacher career, Norah wanted to study architecture but settled for interior designer because the program did not require as much mathematical knowledge. In choosing teacher specialization she almost applied for the lower primary grades because of her insecurity to teach older students (6b). Eventually, she realized that if she ever wanted to do anything with her life she needed to complete her high school mathematics courses, thus, with a strong will that she found long after graduation she retook and passed the exams.

Experiences from math course at university…

Norah feels like she needs to work much harder than her classmates in the teacher program. “I have it quite easy in school otherwise but when it comes to mathematics, I just don’t get it! It can’t be done!” Although she says that the instructions within the math course are very good, she is still constantly struggling with math and claims that she would not have made it without the help of her husband. When asked to tell about the support she gets, Norah says: “To explain it ten million times… and try to rub it in, because understanding it, I still don’t. And I think that a major aspect is that I lack basic knowledge, I notice that here [teacher program]”. Although she passed the first two mathematics courses in the program, Norah was convinced, before the final exam, that she would have needed to retake the exam and felt much stressed about it. Because this doubt is specifically related to the mathematical exams and courses in the program, she realizes that she has a very low confidence towards her mathematical abilities. She further feels that the second course about geometry was more comprehensible than the first course about number sense, something that she also thinks is due to her previous experiences:

(6c) […]just that it is more difficult for me to understand numbers, than seeing it as a visual language I think…or I think it is so because I have that image of myself…because that is how
teachers have perceived me or told that I am. I am an aesthete, not a mathematician. Therefore, I have associated myself, I think, with this that it is much easier to understand what is...more comprehensible on paper, and to be allowed to draw and experiment and stuff like that. (:6c)

...and the teaching practice

(6d:) As Norah tells about her experiences in teaching mathematics to fourth and fifth grade students she explains that her rationale for choosing lesson content was to avoid mathematics as much as possible. Therefore, she taught the math class in relation to a history class where they worked with the development of mathematics and how it has been used by ancient people, for instance how hieroglyphs are numerical mathematics through images. Norah appreciated that the school could provide materials, so that the children could work with mathematics in a practical way. In this way, Norah felt comfortable to teach mathematics and did not find it too difficult. (:6d)

Future expectancies

Norah feels really nervous about having to teach mathematics within her future profession and says that she would rather avoid it. She describes the notion of being mathematical as being rational and logical, someone that is able to raise different solutions by just seeing the problem, and someone different from her. Although she does not view herself as mathematical, she is moreover unsure on whether she could ever be and further questions what it actually means to not be mathematical in light of her future profession. Therefore, according to her a good mathematics teacher is someone that can see that every student is different and with that be able to raise each person’s uniqueness and meet the needs.

I do not want to teach my children that they do not have or that they lack the knowledge. I want to go in with the attitude … that everyone can. …it is the teacher’s job to make sure that you do it, no matter what it takes, I think.

5.3.7. Sara’s Narrative

Experiences from years at school

One of Sara’s strongest memories from her school-time mathematics experience was how her surroundings, including her teachers and family, valued mathematical
knowledge above other subject knowledge, and raised it as a sign of status. She explains how this often became evident in light of the strong competitive element that permeated the mathematics education back then. (7a:) In short, the person who was the quickest in finishing the tasks and was ahead of the class would openly be praised and ranked the smartest student (7a). Although Sara have always been good in mathematics and knew early on that she had an ability to understand mathematics, she does admit that being the quickest and finishing first did not necessarily prove whether a student was mathematically bright or even understood the mathematical task. When asked what she remembers as most meaningful from her experiences of mathematics education, she firstly refers to the teachers that she has had and describes them as relaxed, friendly and good at explaining. (7b:) Thereafter, she mainly talks about her own abilities and how she just knew and could understand what needed to be done in the tasks. She describes her thinking as a kind of device that would simply do all the work and provide the correct answers: “I guess I could see…some patterns perhaps…an ability to see, and then it became correct”. (7b)

At the same time, Sara’s least meaningful experiences from mathematics education are related to the many situations where she would have nothing to do because she had already finished all the tasks. This mainly occurred in relation to one particular teacher’s lesson structure where a certain amount of tasks would be provided in the beginning of each week, and the students finishing earlier were free to do what they wanted. Not only did this cause a lot of noise and disorder in the classroom but Sara also questioned the method in regards to her own learning. “The real question is how much I actually learned from that, more than just working through and finishing. And I do not know that, at all.” Finally, she describes that the additional tasks that she would sometimes be given by the teacher were always unprepared, spontaneously provided on the spot and never really thought through.

*Experiences from math course at university…*

Sara’s describes how she was very surprised about the extent of new mathematical content that she had to learn during the mathematics course. She barely recognized any
of the mathematical principles included in the course. She is further not sure whether it is because she cannot remember that she has done it or if it was just not part of her school-time education at all. Either way, she finds it very strange that she does not remember. Moreover, she says it was really difficult and felt incredibly insecure about how she would manage the course. Considering she did pass, she explains how extremely skilled the teachers of the course have been, and moreover, emphasizes the practical elements and the use of materials as the main reason for her gained understanding.

…and the teaching practice
Sara did not enjoy the fact that the teaching practice took place in the middle of the course because she felt that the preparation and planning was distracting and somewhat took over her learning mathematics. Later on she says that on a positive note, the lessons became relevant for her studies. Being encouraged by her supervisor to have a practical lesson, she decided to plan an activity with a so called sorting machine where a few students would act as different numbers going in and out of the machine and the rest of the group would discuss the outcome. Sara explains her difficulties in including every student and wished that she would have divided the class in two smaller groups. Looking back, she remembered another situation where one student, who was usually further ahead the rest of the class, had a question about a measurement unit that Sara did not consider. Not being able to answer the question, she told the student that she would look into it and get back to him. Although the student accepted this, Sara expressed in the interview that it somehow bothered her. Not only because, as a teacher, she would like to be ahead, but also in relation to the students learning. She explains that, maybe, many times there is too much focus placed on explaining to the students that do not understand, while too little time is spent on those that needs to be challenged.

Future expectancies
Sara thinks that the mathematics courses within the program, and specifically the teachers she has had, have made her feel prepared towards teaching mathematics in primary school, even if she would need to go back to her notes and the books to refresh
her memory. According to her, a mathematics teacher should most importantly be able to teach in a variety of ways, including practical elements and materials, because everyone learns differently. Focus should, furthermore, not be placed on giving the correct answer, but rather that the education should be about reasoning and discussing different solutions together with classmates and the teacher. Finally, although Sara has received much appraisal for her mathematical knowledge, she does not consider herself as a mathematical person nor particularly good in math. She does, however, believe that anyone can be mathematical through the right education, but, having an interest and being motivated is also an important part of it.

5.4. Summary of narratives

When summarizing the mathematical narratives of these students, the first view reveals that there are many similarities, but also, differences between them. Starting with how the feelings and experiences of the student teachers have been expressed throughout the narratives, all seven of them describe how the mathematics education during their school years had, in one way or another, a negative impact on their learning and personal development. Moreover, all of them express some kind of disaffect towards the education of mathematics. With that being said, these negative experiences of each individual are placed within a rather wide spectrum because of how much they differ from each other.

Looking at the predominant elements in every narrative, the negative experiences described by Carl, Anna, Jessica and Sara are quite similar because in all four cases the issues are mainly directed towards the content of the mathematics education. The education of mathematics was, according to them, highly irrelevant and lacked purpose where the teachers, structure of the lessons or the provided tasks are described as the major factors for not learning enough, or not liking mathematics. Although both Sara and Anna did enjoy doing mathematics during some periods of their school-time, looking back they realize how their learning opportunities were in fact limited and how they were being held back. Sara, for instance, who had managed school mathematics rather smoothly, started doubting her mathematical knowledge and how much she had
actually learned. Moving on to the three remaining students, Robert, Linda and Norah, they expressed somewhat different negative experiences. Although they also experienced similar issues in the educational practice as the first four students described, their narratives are more focused on a personal aspect and how the subject of mathematics made them feel about their understanding; low self-confidence, feeling stupid and useless or frustrated and stressed were some of the words used.

Despite the large differences in how their negative experiences were expressed, and also considering the wide age difference between them, their descriptions of the mathematics practice from their school years are surprisingly similar. There were specifically some elements that were recurrent in almost every narrative. Firstly, the notion of competition within mathematics is described as a common aspect in learning mathematics, and seems to be understood as something that is almost impossible to avoid. One example raised by Anna, Linda, Jessica and Norah was the competition in relation to learning multiplication and the use of multiplication tables. Other examples of the competitive element were how mathematics would divide and rank the students in class based on the smartest, brightest, quickest but also slowest, weakest and dumbest. Additionally, their descriptions about their experiences of the content and structure of the mathematics lessons were similar, including teacher-centered lessons with main focus on working through procedural tasks, usually from a textbook.

Moreover, unlike the students’ own experiences of a rather monotonous mathematics education, almost all seven of them chose to plan and conduct a lesson during their teacher practice which involved something other than just working with written exercises from a book or sheet. In most cases, the lesson also involved some kind of practical element or material. While Anna and Linda had not yet participated in a teacher training practice in mathematics, their future expectancies about teaching mathematics does, nevertheless, include the ability to teach in a fun, flexible and varying way, including practical materials. All seven students expressed in their future expectations a hope and desire towards being able to improve how the subject of mathematics has been taught. Other than the shared will to teach in a better way than
what they themselves have experienced, there is also a common concern about not being able to reach out to all pupils and the different needs in one class.

Based on the overall narratives of all seven student teachers it can be said that they have all gained many positive experiences towards mathematics during the course included in the teacher program. Although some express it more clear than others, all students describe how their view of mathematics and mathematical learning has changed. The practical content of the course and the highly competent teachers were raised by most of them as the main reasons, which led some students to wonder how their own mathematical understanding would have been if they would have had this kind of education during their school-time. Moreover, the change of the students’ understanding of mathematical knowledge is also evident in relation to the notion of being mathematical. Although none of them consider themselves as mathematical, they all believe that anyone is able to become mathematical if provided with the right conditions.

5.5. **Focus Group: Student Teachers Discuss Mathematical Anxiety**

Four questions from the focus group discussion between the students were of particular relevance for this study and have moreover set the basis for the three themes in the following section. Based on the PISA 2012 results, the main focus of the discussion revolved around the possible explanations of Swedish pupils’ increased mathematical anxiety and the mismatch between the increased anxiety and high interest, self-esteem and motivation towards their mathematical abilities. The student teachers did not only discuss the concept of mathematical anxiety, but they also shared their thoughts about how they, as teachers would do to prevent mathematical anxiety and more importantly, how to create a positive view of mathematics.

**The root of mathematical anxiety and other affective variables**

As the student teachers became familiar with the concept of mathematical anxiety, they have different ideas about what might have caused an increase of anxiety among Swedish pupils. Robert claims that it has become more accepted today to say that you
have mathematical anxiety, which might explain the significant increase over the years. Linda raises a similar notion, and explains that it is more accepted in society to admit difficulties in mathematics than in other school subjects or abilities, such as reading. The increased anxiety is thereafter discussed in relation to a more competitive society that involves the pressure of constantly being better and more successful. Linda describes that because the subject of mathematics is connected to high-performing and demanded jobs, such as civil engineering, there is awareness about the importance of high mathematical abilities. In light of a more competition oriented society and the constant images of up-and-coming people, individuals are almost required to strive for success. This may in turn describe why the Swedish pupils express a high self-esteem and motivation towards their abilities, without necessarily having the knowledge and thereby, feeling anxious.

The student teacher continues to discuss that because the subject of mathematics has for the longest time had a high status and value, a very common assumption is that a person, who is good at mathematics, is a smart person. Thus, as the smart pupil is identified in a classroom it becomes easier to categorize and rank pupils’ knowledge and separate the smart from the dumb, a notion that may cause anxiety. Finally, all three students raise the role of the surroundings, more specifically the impact of adults such as parents and teachers. Feeling anxious, afraid or insecure about doing mathematics has, according to Linda nothing to do with the cognitive ability rather it depends on what is believed about your knowledge. Frequently being told that you are not good in mathematics and that you cannot do mathematics is “stigmatizing”. Both Carl and Robert agrees and adds that when a person hears that he or she is actually capable of something it will increase the learning opportunities.

**Preventing mathematical anxiety and negative feelings**

The students’ main solution for preventing anxiety in relation to the subject of mathematics is to remove the competitive aspects and time pressure within the mathematical activities and the overall education. Although they admit that competition, through for instance mathematical games and tests, is in many ways a tool that teachers
can use to both increase pupils motivation and simplify the assessment process, they still favor less competition. They further argue that when the pupils are expected to finish certain amount of chapters in a textbook and also pass the written test for each period, the issue of time is raised where the pupils that finish most parts is on top. This is moreover described as directing the focus onto the wrong knowledge and giving credit to those that have been quickest instead of those who might have gained a deeper understanding by taking longer.

In addition to making mathematics education more fun, Robert further claims that a prevention of mathematical anxiety needs a more fundamental change and a reform of the national teacher education programs. Referring to his own program, with specialization in grades four to six, he explains that once they graduate they become class teachers or “generalists” which means that they will know everything pretty well. But as he views it, there should be subject teachers all the way down to first grade of primary school, in order to assure capable teachers in every subject that is taught.

**A positive change towards mathematics**

According to Linda, the first step is to change the belief about some people being destined to do certain things. Instead, there needs to be an understanding that, depending on the particular culture and background, anyone is able to do anything. Moreover, the main part of their discussion about increasing the positive experiences of the subject was connected to broadening the concept of mathematics. Robert explains that the term mathematics has had a negative tone for a long time but that much of this is due to a limited view of what mathematics really is. Therefore it is important to make sure that mathematics is not only understood as the activity of working in a textbook, but that it is also practical. Carl describes mathematics as a language that can be used by many and bring individuals to new conversations. With this, he emphasizes the need to understand the importance of mathematics for a person’s life. Finally, a concrete suggestion for making the mathematics education more positive is to take a step away from the individual oriented activities, usually seen in classrooms, and include more
group oriented tasks where pupils are allowed to discuss and work with mathematical problems together.

5.5.1. Self-Evaluation of Student Teachers

This last section of the findings will present the evaluations made by the students at the end of the focus group (see Appendix E). Although this particular section is rather small, the responses from the evaluations are still of great significance for the overall study. Thus, in relation to the two questions, Linda explains that it is important to talk about mathematical anxiety in order to emancipate oneself and absorb knowledge. When asked what she has learned by participating in the study she wrote:

To discuss mathematics as a teacher is incredibly important because you develop your own perception about the subject. Thoughts are born through the language. I have discovered that my own relationship towards mathematics has improved, when you discuss a phenomenon it becomes incapacitated: there is nothing to be afraid of, just different roads to find out more.

Robert describes how the study has not only made him more open about his own experiences but also made him want to do better in his future profession as a teacher. He wrote the following about what he had learned: “To dare to talk about mathematical problems that [I have] had, [I am] not alone […] as a teacher I will try to make mathematics fun, more group work.” Robert further writes that he found it interesting to talk with other about this particular topic. Finally, Carl expresses how participating in this study has not only increased his understanding of why pupils may find mathematics difficult but also motivated him to learn more.
Chapter Six
Discussion of Findings

A deeper approach will be taken in the following chapter where the research questions, presented in the beginning, will be answered through an elaborate discussion of the findings and data analysis. While the findings are based on interpretations of contrasts and similarities identified in the data, there is further a need to view these with support in a more theoretical perspective. Thus, the upcoming discussion will mainly involve the theoretical framework and, particularly, the key concepts. Before this, a separated methodology discussion will also be provided, to gain further understanding about the findings through a critical insight in some of the issues deriving from the methodological choices of the study.

6.1. Method Discussion

In view of the methodologies that have set the base of this thesis, two concerns have been raised in the process of conducting the study, which are of particular significance at this point. The first one was related to choosing appropriate data-collection methods and, more specifically, the use of questionnaires in a qualitative study. Looking back on the field experiences, an understanding has been gained about the issues that can occur when conducting a survey, with over 100 participants, based on questionnaires of a qualitative nature. Many students started by filling out the first questions thoroughly and but gave shorter, less detailed responses in the last sections, which might have been due to the large amount of open-ended questions. Constructing a shorter questionnaire and reducing the number of questions to half or even a third, might have motivated the students to provide more elaborate responses about their experiences and views, instead of being overwhelmed by the comprehensive questionnaire. Hereby, although the data deriving from the wide span of questions did provide rich and multifaceted understandings as well as implications of key concepts and possible theories, the main difficulty was to comprise the material in relation to the framework of this thesis. Thus, because the large-scaled survey differed from the individual interviews, the
questionnaire findings could not be analyzed and discussed to the same extent as the interview findings.

The second concern raised was in regards to the inductive approach of this study, which evidently led to one of the original research questions being removed. Initially, before any data had been collected or analyzed, the understanding of the student teachers’ feelings had to be of a rather open and unbiased nature with respect to the inductive approach. Therefore, as the first research question was formulated, *what experiences and feelings do prospective teachers have towards mathematics education*, the purpose was to enter the field without preconceptions about the students’ feelings that would possibly derive from the data. This also meant that, although the literature review indicated that mainly negative feelings would derive from the findings, there was still a need to present the findings from the field as authentic as possible. However, due to the extensive categorization process needed for the comprehensive questionnaire responds, this initial research question was already answered as the questionnaires were being compiled. Moreover, as the study progressed, the questionnaire findings turned out to be insufficient in terms of answering the remaining research questions and gaining a deep understanding about the emotional relationship towards mathematics or the process of becoming a teacher. Therefore, while the questionnaires did set a strong base, the findings from the interviews and focus group sessions were more appropriate for reaching the aim of this study.

**6.2. The Student Teachers’ Emotional Relationship to Mathematics**

The focus of this section is to answer the first research question about the student teachers’ emotional relationship towards mathematics. The discussion will revolve around two main aspects that have derived from the findings about the students’ feelings: the *internalized* and the *context-bound*. Thus, in addition to the positive, negative and neutral aspects that set the base of the initial data analysis, the six, more detailed, sub-themes that were presented as well as the narrative interviews have revealed implications of the student teachers having either an internalized or context-bound emotional relationship.
6.2.1. An Internalized Emotional Relationship

With support in developmental theories, the features of an internalized relationship include the students who have described their knowledge and understanding of mathematics, as well as their difficulties and lack of understanding, as something located within, a personal trait or attribute (Evans, 2000). This also becomes clear in how some students refer to their mathematical abilities as something they have dropped or lost, as if it was a fixed entity. The internalized relationship is further evident in how these students view their mathematical abilities in relation specific classifications or types that generates typical features which either enables or limits them (Dahlberg et al., 2006; Nordin-Hultman, 2004). The more commonly used by the students relate to whether or not they consider themselves as “mathematical” or a “math-person”. Continuously, the students’ reasoning and explanation of their feelings towards mathematics have a biological nature in terms of how they describe them as individually rooted, separated from social influences (Evans, 2000). For instance, the students that considered themselves as clever and good in mathematics explained this as a reason for feeling safe when doing mathematics. Similarly, the students who claimed that they were more aesthetical than mathematical also explained the emergence of anxiety, stress and aversion towards mathematics as emotional consequences of those traits. The examples of the student teachers’ internalized emotional relationship have been identified in the two sub-themes from the questionnaire findings, I have always been good in math and I have never been a math-person, which together constitutes almost 40 percent of the study participants.

Moreover, elements of the internalized aspect were also revealed in some of the narratives from the interviews. One example, in particular, that clearly describes how the emotional relationship towards mathematics has a biological source and located within the individual was found in Carl’s narrative. In relation to elementary school, Carl blames his low grades in mathematics on his DNA (see quote 1b). By explaining how he, like the rest of the hockey guys, were “doomed” and expected to attain low grades, it further relates a mathematical ability to a stable notion. Another clear example was how Linda rejects the idea of considering herself as mathematical due to her more...
apparent writing abilities (see example 4e). Finally, when telling about her positive experience of mathematics, Sara expresses an internalized understanding in her narrative by referring to her abilities as a device that would simply provide her with the correct answers (see example 7b).

6.2.2. A Context-Bound Emotional Relationship

In contrast to the internalized understanding, the majority of the students describe their emotional relationship towards mathematics in relation to surrounding factors. Hereby, the context-bound aspect is raised which involves influences of postmodernity and an understanding of how multifaceted and interrelated social and cultural factors have a significant role in the student teachers’ feelings and experiences (Dahlberg et al, 2006; Kaasila, 2007). More concretely, this is evident in how the student teachers’ emotional experiences of mathematics are directed towards the different elements involved in the education as well as in the subject itself. The teaching methods, lesson structures, type of tasks and materials provided were some of the aspects raised that either promoted or limited their understanding, and in turn influenced their relationship towards mathematics. A particular emphasis was placed on the role of the teacher. The two sub-themes, which mainly included how the student teachers’ positive or negative experiences were understood in relation to surrounding factors, were Learning mathematics was interesting and exciting and The problem was the unengaged teachers and the focus on textbooks. Furthermore, the two remaining sub-themes deriving from the neutral category It started out good but then... and Mathematics was okay except for some things, also reveal a context-bound emotional relationship in the student teachers’ expressions. This is evident in how their feelings are described as situational and connected to a certain area or phase within their education of mathematics. For instance, many described the emergence of anxiety, stress or frustration as the content, materials and expectations within mathematics education changed in the transition to higher grades. The context-based emotional relationship was especially present in the examples of learning multiplication, which for many was a source for negative feelings.

In conclusion, the two elements have been very useful in order to understand how
student teachers themselves have described their emotional relationship towards mathematics. According to the questionnaire findings most of the students, around 62 percent, describe the surrounding context as the main factor for their emotional relationship towards mathematics. This was also the case among the interviewees, where four out of seven included predominately context-based features. Hereby, the question raised is what the nature of the emotional relationship actually means for the individual. Considering that an internalized emotional relationship further implies that the understanding of feelings and abilities are viewed as an essential truth, an absolute knowledge and reality (Dahlberg et al. 2006), this in turn would mean that an individual’s relationship towards mathematics is determined and cannot be changed. For a person with an internalized understanding about his or her negative experiences and feelings towards mathematics, the risks may be that these deeply rooted beliefs are obtained and further become apparent and relived in future situations. Whether the situation is to split a restaurant bill, set up a mortgage plan when buying an apartment or choose a career path, an internalized emotional relationship may become an obstacle or a reason to avoid the situations. In Norah’s narrative, her low self-confidence and beliefs about her mathematical abilities were evident in both her academic and career choices (see example 6b). While this issue may not seem as dangerous for a person whose internalized emotional relationship has a positive base, identifying oneself through specific classifications, in this case as a “math-person”, can nonetheless be limiting for other aspects in life. Moreover, if the positive experiences simply relate to finding the subject of mathematics as logical and unambiguous, as in *I have always been good in math*, there is also a risk in students not recognizing the need for new mathematical ideas. Hence, the notion of a context-based emotional relationship implies a more open, allowing and complex understanding of negative feelings, in which they are not viewed as permanent. The student teachers’ emotional relationship towards mathematics will be further viewed in the upcoming section. The focus will, however, be the role of educational practices through prevailing discourses.
6.3. The Discursive Practices Surrounding Mathematics Education

The following section will answer the second research question. While the physical setting of education, such as the school, mathematical classroom and university seminars, are of significance when understanding the students’ experiences, the focus of this study goes beyond an analysis of the environment and instead looks into which discursive practices that have been identified in the student teachers’ shared experiences. Thus, as discourses are manifested through certain words, statements and actions (Foucault, 1976; Palmer, 2010a), it was possible to draw out dominating and parallel discursive practices from the findings:

- **Traditional school mathematics discourse:** The mathematics classroom is influenced by a teacher centered lesson structure in which quiet individual work in relation to a specific mathematics textbook occurs to a large extent. Within this discourse a *mechanical learning discourse* is also evident through the type of activities, tasks and lesson materials offered.

- **Alternative school mathematics discourse:** This contemporary discourse give rise to the inclusion of communicational and cooperative practices within mathematics education. A varying teaching practice, where practical and esthetical elements such as technological support materials, is incorporated. The mathematical content is more related to real life situations.

- **Competition discourse:** The notion of competition is generated on both an individual level and a society level. The individual competition discourse is mainly active in relation to the previously mentioned *mechanical learning discourse* where competition is created through procedural tasks and finishing certain amount of them in time. On a society level, competition is generated through todays increased and constant strive towards high-performing jobs and success.

- **Emotional discourse:** The affective variables produced within mathematics education, including emotions, attitudes, confidence and self-perception, are evident through words, expressions, beliefs and experiences. Within this
discourse, a *mathematical anxiety discourse* is further present and dominating where negative feelings towards mathematics are generated. The *pleasurable discourse* could also be identified, as part of the overall discourse.

The above mentioned discourses are only a few of the many discursive practices prevailing within mathematics education, for instance, all of them are active within an overall *school mathematics discourse*. Moreover, with support in Foucault (1976) about the invisible rules and presupposed ways of acting and speaking, the expectations and influences within the student teachers’ current university mathematics studies are also active and produce a *teacher education discourse*. This discussion will, however, focus on the discursive practices described above since they have been dominant. Thus, based on the understanding about how individuals are positioned, as well as position themselves, in relation to discursive practices (Nordin-Hultman, 2004; Palmer, 2011), the elements of an alternative school mathematics discourse produces possibilities for students to position themselves as co-constructors of their mathematical learning. This can firstly be viewed in Carl’s narrative, where he was able to understand and engage in mathematics in relation to a different and more concrete situation during elementary school (see example 1a). Similarly, in Linda’s narrative her memories of the more reality-based content from her earlier school mathematics education produced more opportunities to position herself as a meaningful learner of mathematics (see example 4b). Despite Carl’s and Linda’s experiences, the scope of an alternative school mathematics discourse from the students own school experiences was close to non-existent. However, as the students told about their experiences from their current mathematics studies and teacher training, the narratives predominately included implications of the alternative mathematics discourses. This was not only evident in how they described the content of the university math seminars, but also in how they described themselves as learners within this context.

In contrast, due to the dominating traditional school mathematics discourse, the students’ positioning is, with support in Foucault (1993 referred in Palmer, 2010a), viewed as controlled by what is considered appropriate and right in the specific setting.
One clear example of this power can be viewed in Norah’s narrative where the traditional, one-sided teaching practice did not allow her to position herself as mathematical (see quote 6a & 6c). Anna’s narrative includes other clear examples of how the mathematics teachers from her school experiences enhanced a traditional discourse, by dismissing Anna’s questioning and reasoning of certain procedural aspects. The traditional discourse further limited Anna’s opportunities to position herself as investigator and, instead, she was bound to follow the already established norms within the framework of the discourse (see example 3a and quote 3c). Another example where the traditional school mathematics discourse is evident in the students positioning is identified in Jessica’s narrative. Again, the example demonstrates a discharge of communicational practices where the student takes on a passive and almost avoiding positioning (see example 5b). This is further evident in how Jessica described the lack of a varying teaching practice (see example 5c).

Additionally, with support in Nordin-Hultman (2004), the narratives further reveals how one individual may take on several positions at once in relation to various prevailing discourses. For instance, the individual-oriented work structure in the traditional school mathematics discourse combined with the competition discourse, where students are ranked based on their individual performance, allow students to position themselves as either smart, dumb, fast, slow et cetera. These ranks were specifically evident in Sara’s narrative (see example 7a) but also by the notion of keeping up and not being sufficient which both Robert and Linda expressed (see examples 2a and 4a). The role of performative agents further increases the possibilities of positioning, which here not only include the discursive practice but also physical materials (Palmer, 2011). Other than the mathematics textbook, which in a traditional school mathematics discourse generates mechanical learning, the formula sheet as described by Robert can further be viewed as a performative agent (see example 2c). Hence, based on how Palmer (2011) describes materials as powerful and active, the idea that Robert positioned himself as non-mathematical and a hypothetical cheater due to how he uses the sheets can be understood as an intra-active relationship between Robert and the performative agent.
Finally, the double process of positioning, in terms of both being positioned and mastering the positioning, is further helpful when understanding some deviating aspects in the findings. In some cases, although the students’ overall experiences and feelings towards mathematics were predominately expressed through negative notions such as anxiety, hatred, frustration but also boredom, the same narratives also included memories where mathematical activities led to pleasure, joy and a desire to learn mathematics. In both Anna’s and Jessica’s narratives (see examples 3b & 5a) the love/hate paradox is mainly identified in relation to learning multiplication where the multiplication table as a performative agent encourages a certain behavior which is further enhanced by the competition discourse as well as the emotional discursive practices. Thus, the examples show the possible conflict as several positions are taken up at once. In this section a further understanding has been made about the various opportunities, but also unstable process, of positioning. This further informs the fragile and dynamic processes of subjectivity raised by Stentoft and Valero (2009). In the following section, more focus will be placed on the notion of subjectivity in relation to the process of becoming a teacher.

6.4. The Process of Becoming a Teacher

The last section of the discussion will answer the third research question about how the student teachers’ experiences impact the process of becoming a teacher. Starting with an overview, the findings from the questionnaires revealed that the majority of students have had negative experiences of mathematics education where a traditional school mathematics discourse was mainly evident. According to several researchers, mathematics teachers’ personal experiences and feelings can have a major impact on the educational practice and, in turn, on pupil’s relationship towards the subject (Kaasila, 2007; Geist, 2010; Palmer, 2011). Considering that 74 percent of these students further admit that, as teachers, their personal feelings and experiences towards mathematics does have an influence on prospective pupils (see Figure 4), their expectations about teaching mathematics is a vital aspect. In contrast to their experiences, the ideas and future expectancies shared by the majority of the students indicated open and alternative teaching practices (see Figure 5 & 6). This difference can in many cases be supported
by how students want to do better than what they have experienced themselves. However, the deviating aspects within the students’ questionnaire responses cannot be ignored, for instance, the expression of mixed feelings towards teaching mathematics, insecurity about not being able to provide pupils with fun mathematical experiences or being the cause of negative feelings deriving among pupils (see Figure 7).

Thus, in order to illuminate and gain a deeper understanding about the students’ process of becoming a teacher, these indications and further deviations in the data are important to discuss. Hereby, the individual’s experiences need to be viewed through the constitution of subjectivity as a fragile, unstable and dynamic notion (Hultman, 2010; Palmer, 2010a). This process can be understood by identifying turning points within subjectivity through their self-perceptions, views, beliefs, attitudes and emotions (Hannula et al., 2005). More specifically, by highlighting changes and inconsistencies, in which the findings from the narratives as well as the focus group discussions have a principal role in forming this understanding.

6.4.1. Changes in Subjectivity
According to Zembylas (2003) subjectivity occurs in relation to the emotions of individuals changing. The changes of the student teachers’ feelings and attitudes towards the subject of mathematics have been identified in different aspects within the findings. Both Carl and Jessica give examples of how a change occurred in relation to the mathematics course at the university. In Carl’s narrative, he describes the change as an unexpected turnover when he was able to understand mathematics (see quote 1c). Similarly, in relation to praising the practical elements of the course, Jessica explains her realization through a metaphor about how all the pieces fell into place (see quote 5d). Additionally, in Robert’s narrative a change is identified in relation to his feelings towards teaching mathematics. By the end of the mathematics course he was no longer nervous, and instead expresses an excitement about teaching mathematics (see example 2d). The examples mentioned above indicate, with further support in Zembylas (2003), that the students have an awareness of their emotions which in turn enables the self-transformation process.
Continuously, other than changes in attitudes, the findings also revealed how many students gained new views about the subject of mathematics, in which understandings about prospective teaching practices can be made. Jessica expresses, in relation to her experiences of the teacher training practice, a changed viewed in the notion of teaching mathematics. In her narrative she describes a gained insight about being calmer and less stressed as a teacher (see example 5e). Linda describes how she has realized that mathematics is much more than just a subject and emphasizes that it can be found everywhere (see quote 4c). The fact that all seven students express a will to make mathematics more fun and interesting by incorporating games, practical elements and materials further indicates a changed view. However, this specific aspect of a fun practice, where students places great focus on providing fun and practical lessons to provide pupils with interesting and wide learning opportunities, needs careful analysis. As Kaasila (2007) claims, an excessive degree of fun activities will not only take over the mathematical content, but may also reveal the mathematical insecurity of the teacher. In view of Norah’s teacher training experiences, the lack of sufficient mathematical content during her lesson might be unnoticed since the pupils appear engaged and joyful, according to her narrative. However, Norah does also admit, during the interview, that her overall motives for the lesson were to avoid mathematics as much as possible (see example 6d).

6.4.2. The Inconsistencies of Subjectivity
While an understanding of the student teachers’ subjectivities have been exemplified through identified changes, this section will instead highlight the possible disturbances of subjectivity. The notion of inconsistency is based on how Stentoft and Valero (2009) describe the process of subjectivity as uncertain and vulnerable to disturbances. In Linda’s narrative, the previous discussion revealed that she had gained new insights about the subject of mathematics. However, in another part of the narrative she describes how mathematical intelligence is unreachable for her and, instead, distances herself from the process (see example 4d). Furthermore, as she discusses the notion of being mathematical she expresses that once you have been defined as non-mathematical it is difficult to take on the role of a mathematical person (see example 4f). Here, Linda
confirms herself as non-mathematical and an uncertainty in ever becoming mathematical. Another similar example is identified in Robert’s narrative. Although he claims to be excited about teaching mathematics, the insecurity he expresses at the end of the course about not getting enough subject knowledge or about the lack of a comprehensive understanding in mathematics does reveal disturbances of subjectivity (see example 2b).

Finally, the most evident inconsistency in relation to the students’ subjectivity formation is connected to the notion of being mathematical. Not only because all seven student rejects the idea of considering oneself as mathematical, but mainly because of what the students consider constitutes someone mathematical. When asked to describe someone mathematical, Linda describes a person who is similar to a calculator and somewhat autistic (see example 3d). While these descriptions varied between the students, the common features used by all of them were characteristics of someone who was either extraordinarily, intelligent, logical and rational or strange and an outsider. These specific descriptions do, in turn, indicate that the students have a narrow and stereotypical view of what constitutes someone that is mathematical.

This last section of the discussion has raised implications of subjectivity in the process of becoming a teacher where the changes and inconsistencies were possible to identify due to the narrative research approach. Other than being useful for the understanding of the findings, narratives have also been raised in the literature as a tool for self-transformation and as well as empowerment through the processing of personal experiences and feelings (Zembylas, 2003; Kaasila, 2007; Lutovac & Kaasila, 2009). Although the scope of this study is too limited for a deeper understanding of how the narratives have been useful for the participants’ subjectivity, the final evaluations conducted by the three students after the focus group session did reveal some indications. As the students describe what they have gained by participating in this study some describe their increased awareness about personal feelings, which can further be viewed as part of the process.
Chapter Seven
Concluding Remarks

7.1. The Emergence of Mathematical Anxiety

Within this field of research, the main approach towards the notion of disaffect has, until recently, focused on measuring individuals’ attitudes, particularly mathematical anxiety. In light of how affect has been viewed as a measurable variable and further distinguished as either cold and stable or hot and dynamic, a deeper understanding about the nature of negative feelings is necessary. In this study, anxiety towards mathematics have been identified in many parts of the student teachers’ shared experiences and feelings, both in relation to the tendencies of the initiating survey, but also in the narratives from the individual interviews. However, anxiety was only one of the many different feelings expressed where fear, hatred and worry as well as enjoyment and excitement were also identified, sometimes in the same narrative. Hereby, one of the first understandings gained from comparing the student teachers’ narratives and statements was that the experiences and feelings towards the subject were far more complex than just a simple liking or disliking, mathematical anxiety or not.

Based on a qualitative research approach, the focus of personal narratives made it possible to investigate these complexities which in turn revealed how attitudes, emotions, beliefs and views are constantly shifting and unpredictable. Thus, although indications of the individuals’ emotional relationship towards mathematics and process of becoming a teacher have been identified, these should not be viewed as constant. Instead, they highlight the significant role of subjectivity and discursive practices when attitudes and beliefs towards mathematics are shaped. Continuously, in relation to how the student teachers’ emotional relationship towards mathematics changed depending on the discursive practices, a further understanding was gained about the possibilities of becoming mathematical through positioning. However, the discussion also raised the power of dominating discursive practices, where deeply rooted assumptions and
perceptions about mathematics, as well as personal abilities, were reinforced.

A general perception about how some people can do mathematics and some cannot is, according to Boaler (2009), extremely harmful to children. Hereby, it is in the responsibility of adults to decide on which perception of mathematics that we would like children and future, active citizens to have towards mathematics. Thus, it is vital that adults stop distancing themselves from mathematics and inconsiderately express notions about how mathematics has always been a weak trait or about never being able to consider oneself as a “math-person”. These ideas only strengthen the already dominating views of mathematics, and encourage classifications of abilities. Moreover, future teachers have the most essential responsibility, not only because they are surrounded by learners on a daily basis but because, as teachers, they are many times viewed as role models and advocates of each subject. In conclusion, becoming aware about one’s experiences and emotional relationship towards mathematics is the first step of reconstituting subjectivity and countering dominant discourses.

7.2. Suggestions for Further Research
Considering how this study has informed the importance of social and cultural surroundings for understanding the emergence of disaffect in relation to mathematics education, a suggestion for further research is to conduct a similar study in another country and compare the findings. The PISA 2012 results, where the mathematical anxiety level of 15 year old pupils is measured, can here be used as an appropriate base when identifying the second case. There are a number of participating countries which have managed to maintain their high position in terms of pupils’ mathematical attainment throughout the years. In the most recent results Singapore, South Korea and Japan were among the highest performing, but also Finland (Skolverket, 2013). Considering the correlation between high results and pupils’ positive affect towards mathematics, the high performing students should have lower anxiety rates. However, without placing too much focus on the anxiety rates per se, this proposed cross-national comparative study would instead focus on teacher students enrolled in an equivalent university mathematics course in the specific country in order to conduct similar
investigations. While Finland could, in this case, be viewed as more accessible, the larger cultural differences between Sweden and Asian countries would in this particular study reveal more interesting findings.
References


Foucault (1976). Diskurser ska inte uppfattas som… [Discourses should not be perceived as… ] In Götselius, T. & Olsson, U. (Eds.) *Diskursernas kamp* [The struggle of the discourses] (pp. 181-182, J., Stolpe, Trans.).


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Appendices

Appendix A. Questionnaire

Questionnaire for student teachers

This questionnaire is part of a master thesis study, which intends to investigate student teachers' experiences and feelings towards the subject of mathematics. The questions are divided into three sections based on different life periods. In accordance to the ethical considerations of research, all the shared information will be handled in confidence. Participation is optional, but I would very much appreciate if you would spare a few minutes of your time and answer some questions. There is also the possibility to leave your contact information in the bottom of the questionnaire, if you are interested in participating in interviews further into the study. You may choose to stay anonymous throughout the entire study. Your contribution is very valuable.

This is where the questionnaire begins.

Male ☐ Female ☐

You name (Optional): ____________________________________________

Name of program: ________________________________

Course name: ________________________________

A retrospective view: Mathematics during your childhood

1. How was your experience of starting school and of the different subjects Swedish, English and Mathematics? What was your favorite subject and why?

2. What are your first memories of school mathematics, in terms of both teaching and feelings? How was it later on, in upper-primary, secondary school? What kind of teaching methods and materials were used during the lessons?

3. How did you learn the best? (You can select several options if appropriate)
4. When growing up, in what ways or which situations was the subject of mathematics raised in your family? How were the conversations around mathematics? What experiences and/or attitudes did your parents have of the subject?

5. Have you ever felt any negative feelings towards mathematics? If yes, in relation to what/which situations?

Present: Mathematics within your current studies

6. Why did you choose this specific teacher education program? Did your choice have anything to do with your own childhood or school experience?

7. What is your opinion about the amount of mathematics education within the program?

☐ Just right
☐ I would prefer more
☐ I would prefer less

If your answer was either *more* or *less*, please explain why.

_________________________________________________________________________________________

_________________________________________________________________________________________

8. What would you say is the most important skill to learn during the mathematical courses of the teacher education, which will be useful in your future profession?

_________________________________________________________________________________________

_________________________________________________________________________________________

Looking into the future: Mathematics in your upcoming teaching profession

9. Which subjects will you teach in?

_________________________________________________________________________________________

_________________________________________________________________________________________

10. What are your feelings about possibly teaching mathematics in the future?

_________________________________________________________________________________________

_________________________________________________________________________________________

11. Do you think your own feelings towards mathematics might influence your students?
☐ Yes
☐ No

If yes, how?

_________________________________________________________________________________________

_________________________________________________________________________________________

12. How do you think mathematics should be taught? Methods, knowledge, materials?
13. What do you think are the challenges, in terms of delivering a good mathematics education?

14. Would you be willing to participate in an interview, as part of this study?

☐ Yes

☐ No

If yes, please leave contact information below:

E-mail: ________________________________
Phone number: _________________________

Thank you for participating. Please feel free to contact me if you have any questions.

Stephanie Shamoon (Master student)
Institute of International Education, Department of Education
Stockholm University
E-mail: XX
Phone number: XX
Appendix B. Consent form and information sheet

Consent form and information about your participation

Thank you for participating in this study. The following information will explain what this study is about and how I would like you to take part in it. Before continuing your participation, you are required to sign a consent which you will find at the end of this document.

The purpose of this study is to investigate student teachers' feelings and experiences surrounding the school subject of mathematics. This will be studied with a sample of students that are currently enrolled in a teacher education program, specialization in F-6th grade. In preparation for the interview sessions, a survey has been conducted where the student teachers filled out questionnaires. By looking into several individual cases, with the help of qualitative research methods, the aim of the study is to reach a better understanding about prospective teachers' relationship towards the subject of mathematics. Within the framework of my Master thesis, written under Stockholm University at the Institute of International Education, I would like to interview you as part of the study. The interview will last around 1 hour. If you agree to this, please read the following conditions and ethical principles of your participation. These are based on the Swedish Research Council’s research ethical requirements for social science research:

- “The requirement of information”: The researcher shall inform the participating informants on the purpose of the research.
- “The requirement of consent: The participants of a study have the right to decide on whether they want to participate or not.
- "The requirement of confidentiality: All data on the participants in the research shall be given most possible confidentiality, and all personal data shall be kept away from any unauthorized people.
- "Requirements of utilization": All collected data on individual people are only to be used for research purposes.

For a further clarification of the above requirements, you also have the right to withdraw from the entire study before it has been completed. This also means that you, as an interview subject can interrupt the questioning if you do not want to or cannot answer. You will get the opportunity to take part of the transcription of your interview before it is finalized. Furthermore, by signing this consent form you also agree that the interview session will be audio recorded and that your words might be quoted in reports, publications and other research outputs. However, all personal details, such as names and other significant quotes or materials will be translated to English and anonymized by the researcher in order to avoid any recognition of identity or location.

Signature of participant: __________________________ Date:
Researcher signature: __________________________ Date:

Once again, thank you very much for participating in this study. Please do not hesitate to contact me with any questions you may have about the study.
Appendix C. Interview guide

Interview guide: English

1. I would like you to start by telling me a little about yourself. Your age? What were you doing before this program?

2. I was going through your questionnaire and there was one part about your earlier school experiences that I found particularly interesting; [individual question]. Could you please tell me more about that?

3. When looking back, what have been the most meaningful experiences that you have had in mathematics during your own school-time?

4. What experiences of mathematics have been less meaningful?

5. Tell me a little about the teachers you have had in mathematics?

6. Tell me why, and how you decided to become a teacher?

7. Can you tell me about how you have experienced the mathematics course within your current teacher education program?

8. I would also like to hear about your practical teacher training within the mathematics course and the lessons you had with the school students. What did you do?

9. Have you ever encountered the word or concept of mathematical, or to be mathematical?

10. Do you, or have you ever, considered yourself as mathematical?

11. How would you describe a good mathematics teacher?

12. Tell me your thoughts about possibly teaching mathematics in the future.

13. Are you interested in participating in a focus group session within this study?
Appendix D. Structure of focus group

Focus group session

Time: February 20, 11.00-12.30 (approximately)
Equipment/Material: Power point, audio recorder, evaluation sheet

Structure of session:

➢ Introduction: Information about terms and conditions for participation
➢ PISA: Presentation of Sweden in most recent PISA results: Present some facts, one or two tables over the Swedish results and how they have decreased. Focus on the study’s measurement personal aspects such as students’ interest, motivation, self-esteem and anxiety.
➢ Discussion: see Questions for Part One
➢ Presentation of case study: After the overview of Swedish students’ feelings towards mathematics, as presented within PISA, the students are asked to read the prepared, fictive case study about Sara.
➢ Discussion: see Questions for Part Two
➢ Conclusions: Conclude discussion. Anything they want to add?
➢ Evaluation: Hand out evaluation

Questions for Part One:
- Why do you think that mathematics anxiety among Swedish students has increased, according to the PISA results?
- And how does that relate with the results showing how their self-perception and self-esteem towards mathematics is still rather high? How would you explain it?
- As future teachers, how do you think one can avoid anxiety in relation to mathematics? (Is it even possible to avoid?) Could you mention any preventive factors?

Questions for Part Two:
- What are your first thoughts after reading about Sara’s experiences in mathematics?
- How important do you think it is that Sara passes the second math course? (That she once and for all takes passes math?)
- In what part of Sara’s story do you think that her fear towards math started?
- What period of her life, part of her life story do you think was mostly critical for her mathematical learning?
- What can provide a positive view of mathematics? What could contribute to positive experiences in mathematics?

Part Three: Evaluation
Appendix E. Evaluation sheet

Name:

EVALUATION

By participating in this study, have you learned anything about your own relationship towards mathematics? If yes, what?

Would you like to add anything at this final stage of your participation?

Thank you!

Stephanie Shamoon (Master student)
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Institutionen för pedagogik och didaktik
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