Choosing post-compulsory mathematics

A comparative study of students' accounts of choosing mathematics in Norway and England

Masteroppgave i skolerettet utdanningsvitenskap
med fordypning i matematikk

Katarina With

2013

Avdeling for lærerutdanning

Høgskolen i Oslo og Akershus

Acknowledgements

Mathematics has always been ‘my subject’ throughout school, and it has always been a special part of my close relationship to my mother who is a mathematician. She has always encouraged and motivated me and I believe that I would never have chosen mathematics if it was not for her. This was my motivation for choosing to do a master thesis with a focus on mathematical identities and students’ accounts of choosing post-compulsory mathematics. I want to thank my mother for my interest in mathematics, and for all the help and time she has given me through this project. I could never have done it without her. Thank you!

I also want to thank my supervisor, Yvette Solomon, for her initial interest in my project and for all the help and guidance she has given me. She has helped me with everything from finding students to interview in England to helping me with writing this thesis in English. She has helped me through the jungle of theorist and theories. I am very grateful for all the help and motivation she has given me. Thank you!

To all the students and the schools that have participated in my study and made it possible, I want to thank you for your time and your participation. I have learned so much from you.

I also want to thank my teachers Hans Jørgen Braathe, Bodil Kleve and Leif Kværnes for what they have taught me through the last two years, and a special thank you to Hans Jørgen for always answering every question I have had.

It has been two amazing years and I want to thank my fellow students for good discussions and great lunches. You have given me much motivation, and I want to give a special thank you to Cecilie Mortensen, Sara Østbye and Lene Henriksen for always being there for me.

I want to send one last thank you to the rest of my family. My dad for pushing me to do my best, my sister for keeping calm and always being there for me and my two wonderful brothers for their encouragement, for my new niece and my new neighbor.

Thank you all so much!

Katarina With

Mai 2013, Oslo

Summary

The purpose of this master thesis is to interpret and compare Norwegian and English students' accounts of choosing post-compulsory mathematics, to try to recognize cultural differences and similarities in the students' stories. Therefore, my research questions are:

> *What cultural differences and similarities are visible in English and Norwegian students' accounts of choosing mathematics?*
>
> - *What cultural models of gender and education do they draw on?*
> - *How do they self-author as students of mathematics?*

I took a qualitative approach with semi-structured interviews with 15 students studying post-compulsory mathematics in Norway and England. The interviews were transcribed and analyzed using theory from Bakhtin (1981, 1986), Gee (2012) and Sfard and Prusak (2005a, 2005b). These theorists tell us that narratives can be understood as identities, and that through self-authoring we draw on cultural models and tools to explain ourselves to ourselves and others.

In the analysis, I focus on how the students position themselves and others and are positioned by the social practices they participate in, and the discourses and cultural models they draw on. The focus is on showing how the students' answers increase in complexity from initial and seemingly rational answers of why they have chosen mathematics, to more complex stories revealing prevalent and sometimes contradicting discourses and influence from cultural models and significant others. My analysis of the students' stories will show that actually choice is not just a question of 'I'm doing this because it's good for my career' but 'I'm doing this because of the person I am'.

This study shows how there are more cultural similarities in the students' accounts of choosing post-compulsory mathematics than differences, both between the individual accounts and between the two groups of students.

This report shows how choice is far more complex than many says, and I ask the question if choice is so complex that in a way maybe it doesn't make any sense to talk about or use the word choice at all.

List of contents

1.0 Introduction

My motivation for this study came from a discussion which challenged my ideas around why I had chosen mathematics and why other people choose post-compulsory mathematics. It was claimed that girls opt out of mathematics because it is understood as a masculine subject, but this was in stark contrast to how I saw myself and my relationship with mathematics. This discussion emerged from a lecture on Yvette Solomon's paper 'Finding a voice? Narrating the female self in mathematics' (2012) about how two women told the story of choosing mathematics in interviews with Solomon. To analyse these stories, Solomon used Bakhtin's theory of how we self-author by drawing on the tools in our culture to explain ourselves to ourselves and others (Bakhtin, 1981, 1986). What fascinated me was how Solomon was able to tell a 'richer' story about those women's choice of continuing with mathematics, rather than explaining choice through, for example, predetermined answers from questionnaires in quantitative research (for Norwegian research reports on choice in upper secondary school see Bjørkeng, 2011; Bøe, 2012).

In many countries, including Norway and England, there is a concern about the low number of students continuing with post-compulsory mathematics, and especially the low number of girls. In sociocultural theory, the concept of identity is connected to the social practices students participate in, and identity is also seen as connected to students' subject choices (Boaler & Greeno, 2000; Lerman, 2006; Mendick, 2006; Paechter, 2001; Solomon, 2009). The school systems and educational ideologies in Norway and England are very different, with a correspondingly different educational ethos. Students will therefore draw on different cultural models and discourses in developing their identities and their narratives of choice.

With these concerns in mind, I have chosen to do a comparative study with students in upper secondary school in Norway and in Sixth Form in England who have chosen to continue with post-compulsory mathematics. Through using sociocultural theory about identity and qualitative interviews with students from both countries, I want to interpret these students' accounts of choosing mathematics. I aim to look for differences and similarities in how they self-author as students of mathematics, and how they draw on the various available cultural models and discourses which they participate in and are influenced by. Therefore, my research questions are:

What cultural differences and similarities are visible in English and Norwegian students' accounts of choosing mathematics?

- *What cultural models of gender and education do they draw on?*
- *How do they self-author as students of mathematics?*

In the second chapter of this report, I place my study within the context of the two school systems of Norway and England. I describe the educational ethos and school policies of the two countries and discuss central issues of mathematics educational research on choice and gender. In the third chapter, I will describe the sociocultural theoretical background of this study with a focus on identity. Here I describe the theoretical lens I have used in this study. In the fourth chapter I will describe my choice of research questions in relation to the context and the theory. The fifth chapter is about my methodology and the methods I have used during collection of data and analysis of this data. The sixth chapter describes the analysis of the data, and I show how analysis reveals the complexity in the students' initially straightforward accounts of choice. In the last chapter, my conclusion, I will sum up my findings, answer my research questions and conclude the research report with some reflections on the study and on its implications for our understanding of choosing mathematics.

2.0 Two different educational contexts

In this chapter I will describe the background context of my study and central issues in mathematics education research which are related to my study. The social practices students participate within are a central part of my study, because I understand subject choice as intrinsically connected to the social practices, including the mathematical discourses and the school systems, the students participate in.

In the first part of this chapter I will describe the educational systems of both Norway and England with a focus on differences and similarities which the students in my study experience and are part of. In the second part of this chapter I will describe how gender and choice are seen as issues in mathematics education research, and relate these to the cultural context in which the students in both Norway and England are making their choice of continuing with mathematics post-compulsory.

2.1 Norway and England compared

2.1.1 Status of mathematics in both countries

There are many ideas of what mathematics is, who does mathematics and what is needed to be good at mathematics. For example: mathematics is definite with only one answer; only those who are born good at mathematics can be brilliant; it is a natural ability; mathematics is masculine, rational and indicates intelligence (Mendick, 2006; Schoenfeld, 1992; Solomon, 2009; Wedege, 2007). These ideas of mathematics are powerful and they are imbedded in our culture and society. The mathematical practices which students in both Norway and England participate within are also colored by these ideas; hence the students' views of mathematics can be related to these ideas (Solomon, 2009). Through these ideas of what mathematics is, it has been made special, different and it is only for one type of people. As Mendick puts it:

> 'Mathematics is a powerful subject, a signifier of intelligence that acts as a 'critical filter' (Sells, 1980) controlling entry to high-status areas of academia and employment.'
>
> (Mendick, 2005b, p. 235)

There is an increasing concern about the low number of participants in science, technology, engineering and mathematics (STEM) in many developed countries, and especially the low number of women working or studying in these sciences is a point of concern as noted by Bøe

(2012) writing about Norway and Noyes (2009) and Noyes and Sealey (2009) writing in the UK. This has been explained in terms of the masculine nature of mathematics and the traditional gendered roles of men and women in society (Paechter, 2001). Throughout the developed world including Norway and England it is seen to be important that the participation in STEM increases, and writing in Norway, Bøe, Henriksen, Lyons, and Schreiner (2011) have stated five reasons for participation in STEM:

> 'to fill demands for STEM professionals, to ensure a greater diversity of STEM professionals to increase the innovative potential, to improve empowerment of groups that are currently under-represented in STEM fields, to give everyone the chance to experience the wonders of science and technology; and to ensure that everyone has real free choice of education by reducing mental and cultural barriers arising from stereotypical views of scientists.'
>
> (Bøe, 2012, p. 2)

Writing in the UK, Noyes also agrees, stating that 'maintaining the flow of suitable qualified mathematicians (and scientists) into the economy is understood to be critical in maintaining future economic prosperity and international competitiveness' (2009, p. 167). Smith discusses the implication of governmental interference in students choices of studying mathematics, criticizing it for 'blur[ring] the two different arenas of global competition and personal life-trajectory' (2010, p. 99). The government encourages high achieving students to choose to continue with mathematics not for the students own future aspirations, but for the political future goals of higher participation within STEM. Smith is critiquing the mixing of people's personal lives and a global competition in relation to STEM. She argues that the economy driven policy is telling people that they should choose STEM for global competition and economic prosperity, but that has nothing to do with people's personal choices about what they want to do (Smith, 2010).

Subject choices made by students in upper secondary in Norway or Sixth Form in England are critical because of requirements for higher education. For example in Norway if a student wants to study STEM in higher education a requirement is that they choose the 'Natural Sciences and Mathematics' route, and within the STEM studies there can be requirements of what subjects the student will need (Bøe, 2012, p. 4). Another example is that students who study advanced mathematics receive more credits than students studying social sciences,

meaning that they will have a higher average, and thus a better chance to get in to the university of their choice (Bøe, 2012). One of the leading universities in Norway offering studies of engineering, gives all girls extra credits if they apply to study engineering, on the basis that this will encourage more girls to apply to this type of education (Norwegian University of Science and Technology). I will come back to the issue of extra credits in section 2.1.3. The situation in England is that if one wants to study within the STEM field at a university advanced level mathematics is required (Noyes, 2009).

Norway is often compared to the other Scandinavian countries in international studies such as TIMSS, while England is compared to other European countries (Andrews, 2001; Kleve, 2007). Norway is slightly below the TIMSS Scale Centerpoint in Mathematics Achievement, while England scores above, but there are smaller differences between schools and students in Norway than there are in England (TIMSS and PIRLS Internations Study Center, 2011). This difference may be connected to the different educational ideologies in Norway and England. In the next section, I will describe these educational ideologies more closely.

2.1.2 Educational ideologies

> 'An ideology is any social theory, which tries (consciously or not) to defend existing social conditions and legitimize them by making statements which in a sense appears as scientific'
>
> (Israel, 1973, p. 50, my translation)

The educational ideologies which these two school systems are influenced by and enact are different. In Norway the focus is on equal rights for education, mixed ability teaching and late specialization which can be related to an egalitarianism ideology (Braathe, 2012). A central concern and the aim of the Norwegian school system is to give all children and adults equal opportunities for education (Ministry of Education and Research, 2007). It is illegal to structurally stream the pupils permanently by their achievements and perceived knowledge. All students in Norway have the right to 13 years of education, where Year 1 through Year 10 is compulsory and all the students study the same curricula throughout that period (Braathe & Ongstad, 2001).

In England the school system can be described by the term neoliberalism where 'we all make choices in order to choose "who we want to be", to regulate and govern ourselves in an era of apparent freedom' (Mendick, Moreau, & Epstein, 2009, p. 71). This means that everyone has

to take responsibility for their own choices and their own success or failure with respect to these choices. In England there is a tradition of grouping students by their perceived ability into what is called 'sets' which can be connected to an ideology of competition and ability. I will explore the implications of these differences further in section 2.1.3.

2.1.3 Overall description of the two school systems

How school is organized

In Norway, compulsory education is divided into two parts: the primary school which lasts from Year 1 through Year 7, and the lower secondary school which includes Year 8 through Year 10. Students who have completed the compulsory 10 years of schooling have the right to three years of upper secondary school. Students who wish to study higher education need to finish a programme which leads to General University Admission Certification. Students who have done a General Studies programme automatically earn this, but students who have studied a vocational programme in upper secondary school need to do a supplementary fourth year to get this certification (Ministry of Education and Research, 2007).

There are differences between the school system in England, Scotland, Wales and Northern Ireland. I will here focus on England, because my interviews were held in England. Their first year is a reception year, ages 4 and 5, and this year together with Year 1 and 2 can be located at an infant school or at a primary school. The pupils spend Year 3 to Year 6 in primary school, before they go on to secondary school from Year 7 to Year 11. Generally after the students have finished the compulsory years, the students may choose to continue for two more years at what is normally referred to as Sixth Form (Mendick, 2006). In England, to get into Sixth Form, which is the equivalent of the Norwegian upper secondary school, students have to get five or more higher grades, meaning A*, A, B or C, in their General Certificate of Secondary Education (GCSE) qualifications. Most students with these qualifications study three or four Advanced level awards (General Certificate of Education or GCE) at Sixth Form, earning standard university entrance qualifications (Noyes, 2009; Noyes & Sealey, 2009). In Year 12 students study Advanced Supplementary, AS, and in Year 13 they continue with A2. Students can stop after Year 12 and get an AS qualification (Noyes, 2009; Noyes & Sealey, 2009).

Exams and grades

In Year 11, the English students sit their General Certificate of Secondary Education exams (GCSE). They will have chosen the subjects for Year 10 and 11 in Year 9, and they will sit GCSE in 8 to 10 subjects. Compulsory subjects are Mathematics, English and Science. On the GCSE exams the students can receive the grades U (unclassified), and from G to A* (exceptional performance), but only grades from C and up counts for progression to further education (Education Audiovisual & Culture Executive Agency, (2009/2010); Mendick, 2006). In 2006 the GCSE mathematics went from 3-tier GCSE with foundation, intermediate and higher exam to 2-tier GCSE at foundation or intermediate (MEI, 2009). Students entering for the foundation tier can receive the grade G to C and those entering the higher tier can receive grades D to A*. If they 'fail' the exam, they will receive a grade U (unclassified). In Sixth Form, various students have exams in the winter and in the summer. How many exams they have vary in relations to what subjects they have chosen, but in mathematics there are three modules ending in three exams which together make one award each year (Education Audiovisual & Culture Executive Agency, 2009/2010; Ofqual/09/4144).

In Year 10, all students in Norway will have only one national written exam and only one locally given oral exam. The subjects which they may have an exam in include Norwegian, English, Mathematics, Natural Science (only oral), Social studies (only oral), Religion, Philosophies of Life and Ethics (only oral) and in a Foreign Language (only oral). In upper secondary what type of exams they will have depends on what type of programme students study and on the subjects which they have chosen. I will here give a general view of how the exam system works for the students who I have interviewed, but I cannot say anything about the subjects which they might have an exam in because this mostly depends on the choices they make. In the first year of upper secondary school, only 20% of the students will have an exam and this will be either written or oral. In the second year of upper secondary, all students will have either a written or an oral exam. In the third and last year of upper secondary school, all students will have one written exam in Norwegian. They will also have two other written exams and one oral. The students do not know which subjects they will have exams in, and the subjects are randomly drawn (The Norwegian Directorate for Education and Training, 2013).

The exam systems in Norway and England are very different as I've just shown, and they are an example of the different educational philosophies of the two countries. A significant

difference is that everything is assessed in the UK: nothing is studied without being assessed, while in Norway, the learning stands whether or not it is assessed with exams. Another important difference is the grading system and how this affects applications to further education. In Norway you get your exam grades, but you also get at least one grade for each subject. The grades are from 1, which is fail, and up to 6. If you choose to study mathematics in Year 12 and 13, you get half a point extra per year. This is very important because if the student gets a final grade 5 in mathematics, then having studied it for two years will in principle give the grade 6 as a final grade. The extra credit system applies also to other subjects and institutions. In Norway when you apply to higher education, you sum up all your grades and your extra credit, then you divide to get an average, and then you times this with 10 to get the points (Fylkenes informasjonstjeneste for søkere til videregående opplæring, 2013). Different universities and courses require different grades, but for example in 2012 for a first time applier to get into medicine in Oslo you would need 61.1 points and to get into NTNU and study engineering you would need 59.5 points (Færden, 2012).

In England the grading system is a bit different as described above with the GCSE, but it is also different in relation to how many grades they get and applying for university. As I've said before the students study three or four subjects in Sixth Form, and how they do on their exams is added up as percentages and they get one grade for each subject. In England students apply to university before January, and with their application their predicted grades are included. These grades are what the school and teachers assume that the students can get on their exams, and the universities make an offer to students based on these grades, reference letters, and sometimes, depending on the course or university, interviews and entry exams. If the students do not get the predicted grades, then they have not met the conditions for the admission to the university. If they get the predicted grades, then the universities will confirm the offer they have given (Education Audiovisual & Culture Executive Agency, 2009/2010).

Ability grouping

In England the students are placed into sets in secondary school, and the set which they are in determines what they are taught and sometimes what grades they can get on their GCSE exam (Boaler & Wiliam, 2001). Andrews (2001) describes how the UK government White Paper, Excellence in School (1997), appeals to the 'common sense' of the British people that it should be the norm to group students by ability and claims that mixed ability grouping "has been proved ineffective" (Andrews, 2001, p. 303). The argument for ability grouping is that it

raises achievement among all students, and this is 'a widespread and deeply held belief' (Boaler & Wiliam, 2001, p. 77). Gates disagrees with this argument and writes that 'setting is a mechanism for legitimising the very process of differential privileging of cultural background' (2001, p. 9). It has been shown that countries who teach their students in mixed ability classes have better results on international tests such as TIMSS. Instead, 'more important features of successful teaching are related, for example, to the learning environment itself, purposeful teaching, high expectations and positive reinforcement […] [and] attainment appears to be related to pupils' access to the curriculum' (Andrews, 2001, p. 303).

Another issue with setting is that the students are through textbooks subjected to different domains of mathematics, where the lower groups are only introduced to functional mathematics and the high groups are introduced to mathematics which is more about mathematical principles and abstractions. It is only in the higher groups that the students get access to mathematical principles – apprenticing the high ability students to the mathematicians and the low ability students to manual workers (Dowling, 2001). Because of this it might seem that only the 'brightest' students get the opportunity to learn and understand mathematics: they get to take part in the social practices where the principles of mathematics are central. Solomon (2009) argues that hiding the central practices of mathematics from students may cause them to develop identities of marginalization, where they are not positioned as participants within the discourse of mathematics education, but rather on the margin of this discourse.

Bernstein (2000) speaks of how students from different social backgrounds are positioned differently by the pedagogy used in schools, and that there has been a turn from an explicit, traditional pedagogy to a more invisible, reform pedagogy where the rules are made implicit. Lerman argues that in England this places the middle class students in an advantaged position because they have learned these rules through their background, but the students from working class backgrounds are disadvantaged (Lerman, 2006). One of the problems is that 'the everyday-ness [of questions] mislead pupils into focusing on the everyday and not on the required mathematical meaning' (Lerman, 2006, p. 7) not giving the students a fair chance of showing their real mathematical knowledge (Lerman, 2006). Hence, 'schools reproduce the access to symbolic control in society at large. Pupils' mathematical identities are produced in the classroom with different effects on different social groups' (Lerman, 2006, p. 7). This suggests that in research undertaken with English students who have chosen to continue with

mathematics post-compulsory, one will most likely find informants from a more advantaged background.

Boaler and Wiliam (2001) has done research on ability grouping and achievement in mathematics and report three major findings in this field of research: 1) students in higher sets are not advantaged by the ability grouping, while for students in lower sets attainment is reduced, 2) ability grouping is critical for future levels of attainment and 3) ability grouping 'enhances educational inequalities' (Boaler & Wiliam, 2001, p. 77). The students in this study raised three issues about ability grouping. The first one was that in the higher sets there were higher expectations and more pressure, for example, to work at a high speed. Second, teachers had lower expectations of students in lower sets and provided limited opportunities for learning. The last issue was that everyone had to work at the same speed at the same level, and that the expectations of the teachers to teach a unit resulted in a restricted pedagogy. The 'official' view of ability grouping in mathematics and the results from Boaler and Wiliam (2001) raises an argument that we can expect this view of ability grouping as being evident within the discourse of the students as well as the teachers.

Whereas the English system is dominated by ability grouping, structurally streaming pupils permanently by their achievements and perceived knowledge is illegal in Norway and there are discourses around equality including cultural models around not being different. Consequences of a strong cultural model of equality have been debated, and in 1933 a Norwegian-Danish writer, Aksel Sandemose (2000), wrote a novel where he criticized the narrow-minded small communities in Scandinavia described through the Law of Jante. The Law of Jante emphasizes the collective and devalues individual success and achievement through rules like 'you're not to think you are anything special' and 'you're not to think you are smarter than us'. Sandemose's description of small communities in Scandinavia has later been used by many influential writers and the Law of Jante has been widely accepted as a way of describing negative consequences of the idea of equality as a cultural norm (Andersen, 2012).

2.1.4 Who chooses mathematics and when are the subjects choices made?

In 2009 approximately 10% of Norwegian students chose mathematics in their third year of upper secondary school, and 40% of these students were girls (Bjørkeng, 2011). About 40% of all 16-18 year old students in England and Wales study at Sixth Form (Smith, 2010), and

11,4% of all students in Sixth From study mathematics A levels (Institute of Mathematics and its Applications, 2012).

Students in upper secondary school in Norway studying General Studies and Specialisation to general studies have the same subjects in Year 11. In Year 12 they have to choose which route they want to follow: 'Natural Science and Mathematics'; 'Language, Social Science and Economics'; or 'Arts, Crafts and Design'. In 2008 40% of these students chose 'Natural Science and Mathematics', and 46% of these students were girls (Bøe, 2012). The students who choose mathematics can choose between two types of mathematic routes. One is called R1 and R2 mathematics and the other is called S1 and S2 mathematics, and these two have different curricula. Students studying 'Natural Science and Mathematics' study R1 and R2 which prepares them for further study within STEM subjects, while students studying 'Language, Social Science and Economics' study S1 and S2 which is more related to economics (Fylkenes informasjonstjeneste for søkere til videregående opplæring, 2013). The students in my study have chosen R1 and R2 mathematics.

As mentioned before, students in Sixth Form in England choose generally four subjects in Year 12 and three subjects in Year 13. There are two mathematics A levels; the regular Mathematics A level and Further Mathematics A level with an extended curriculum. Further mathematics is not taught in all schools (Smith, 2010). The students in my study have chosen either both of these or regular mathematics A level.

This illustrates how in Norway there is a focus on late specialization, while in England the focus is on early specialization. It reflects how the educational ideologies of the two school systems are significantly different, and they position students differently.

2.1.5 What doors does choosing mathematics open?

In Norway there are some university pathways that require specific subjects or grades: for example to study engineering, universities require mathematics R1 and R2 and physics 1 (Fylkenes informasjonstjeneste for søkere til videregående opplæring, 2013) and a parallel situation also holds in England (Noyes, 2009). So for both groups of students, they will need mathematics to be able to study STEM subjects. If students opt out of mathematics, then they also opt out of studying STEM subjects in higher education. The students have to plan ahead when they choose subjects, but it is generally fairly easy to retake or take subjects after they have finished upper secondary school or in Sixth Form, although this delays university

studies. Noyes and Sealey (2009) write about how many students in England choose subjects strategically to get the grades they need for university admission, resulting in, for some students, that when mathematics is not required for their course, the students opt out of it and focus on subjects where they know they will get the grades that are required.

2.1.6 To sum up

The description which I have given of the two different school systems is the underlying context of my study, and all of these things say something important about the discourses and practices which the students in my study participate within and are a part of. For example the emphasis on ability grouping and testing is very much indicative of the educational ethos in England, while late specialization and how school is organized is very much indicative of the educational ethos in Norway. There are historically different ideologies and they are played out in some very different ways resulting in different experiences of schooling. Two of the most significant and fundamental differences between the educational systems in Norway and England are: 1) the focus on when the students pick their specializations and 2) the focus on ability grouping in England and how this is seen as a norm and how structurally streaming pupils permanently by achievements and perceived knowledge is illegal in Norway.

Two central issues in mathematics education research are gender with stereotypes of girls and boys and who does mathematics; and the choice of continuing with mathematics or not post-compulsory. I will discuss these two issues in relation to recent research in the next section 2.2.

2.2 Central issues of mathematics education research on choice and gender

Here I will describe two key issues of mathematics education research: one on the choice of continuing with mathematics post-compulsory and the other on how gender is seen as an issue in mathematics education.

2.2.1 Choice

What does it mean to make a choice and how do we reason our choices? As mentioned above, what subjects students choose to continue with in upper secondary school and sixth from and how students reason their subject choices is an issue in recent mathematical education research.

A large recent study done in Norway is the ‘Lily’ study reported in Bøe (2012). In the ‘Lily’ study the researchers used an ‘expectancy-value model of educational choices’ to study the

choices made by students in upper secondary school. Using questionnaires the researchers behind the 'Lily' study wanted to generalize knowledge about why students chose science subjects or not in upper secondary school. The theory behind the expectancy-value model says that 'choice, persistence, and performance can be explained by beliefs about how well the individual will perform in a particular activity and the extent to which that individual values the activity' (Bøe, 2012, p. 4). Students make their educational choices not in a vacuum but in a 'complex social context' (Bøe, 2012, p. 4) where they have a huge amount of options all expected to have different impact on their lives, and these choices are based on how successful the students think they will be in this subject and on the value the student see in the subject. The 'model predicts that the expectation of success and subjective task value are the result of several psychological and social/cultural parameters, for example, self-concept of abilities and personal goals, as well as the cultural milieu and the socialisers' behavior' (Bøe, 2012, p. 5). The expectation of success refers to the student's or individual's expectations of their achievements in the subject. The subjective task value is built on 'interest-enjoyment value, attainment value, utility value, and relative cost' (Bøe, 2012, p. 5). The interest-enjoyment value deals with the interest and enjoyment of the subject, the attainment value deals with how the student identifies with the subject, utility value deals with how the subject can be used as a tool to reach goals, and relative costs deals with the negative aspects of educational choice (Bøe, 2012).

But can subject choices be explained by simply categorizing reasons and checking for similarities, or is subject choices more complex than this? Should we as researchers take into account much more when we try to explain why, not we, but others choose what they choose? It could seem as though the 'Lily' study has a type of positivist approach to the students' reasons for subject choice. Israel (1973) wrote about three risks of this approach to social studies. First, there is a focus on 'here and now' and with this focus the historical conditions as a means of understanding the society is reduced. Second, social change is also reduced as a factor; the focus becomes static and focuses on what is 'given'. Third, this type of approach to social studies assumes that individuals in society can be studied as things and treats the individual as an object. Wacquant (1989, p. 45) wrote that 'we can always say that the individual makes choices, as long as we do not forget that they do not choose the principles of their choices'. Taking into account what both Wacquant and Israel wrote, subject choices are probably more complex.

Giddens (1991) calls the society that we live in late modernity, and it places detraditionalisation and individualization as central. Detraditionalisation refers to the idea that 'authorities and tradition have lost much of their influence', and this results in individualization: the cultural and traditional liberation of the individual and 'freedom to take control of one's own life and the task of making the best of it' (Bøe, 2012, p. 8). Today's youth have what seems to be the 'freedom of choice': they can choose what they want to study, who they want to be and who they are. 'In late modernity it is suggested that we can engage in the project of the self, writing our own identities' (Lerman, 2006, p. 8). We are 'freed' from tradition: we no longer have to become a tailor just because our father was, and authority: we all have the same rights, but critiquing this Lerman argues that we are still consciously or sub-consciously constrained and our choices limited by society and ideas of for example gender and class. An example of this limitation, although small, but related to subject choices, is that the schools cluster subjects, and this can have an impact on the student's choice of subjects to study if the timetables for the subject prevent the students from being able to choose freely. Other factors limiting the students' 'freedom of choice' are 'parents, friends, teachers and the careers service as well as [being affected] by the particular social milieu in which they have grown up' (Noyes & Sealey, 2009, p. 8).

In the section on ability grouping in 2.1.3, I wrote about how students with different social backgrounds are positioned differently by the pedagogy and teaching in schools and how they are affected by the particular social milieu in which they have grown up. When it comes to 'freedom of choice' theorists such as Bourdieu, influenced by Marx, would argue that we can never or rarely overcome our origins and the economic and linguistic capital makes a difference. Bourdieu (Israel, 1973) would argue that through the arbitrariness of what is valued in education the working class will always be disadvantaged, because the middle class always fixes the goals to their own advantage. The hierarchy of economic capital and cultural capital will always put students from middle class backgrounds on the top, disadvantaging students from poorer backgrounds. The social milieu and the background which the students grow up in and the economic, linguistic and cultural capital they have limits and constraints their 'freedom of choice' (Israel, 1973; Store norske leksikon).

'Significant others' as a term describes the people who mean something special to an individual. It was Mead who first used this term in his sociology of how humans develop the self, their self-image and self-awareness. The self consists of I and Me, where the I is active

and initiates action while Me is the object and adjusts the actions of I through the mirroring of others – others response to I. But not all others can change how I act: it is only the mirroring of significant others that can do this (Israel, 1973). Significant others have a great effect on students' subject choices. They can for example be parents, friends, teachers and siblings (Noyes & Sealey, 2009). When it comes to significant others in the students' lives: parents and their attitudes toward mathematics are, consciously or sub-consciously, significant factors in the students' subject choices.

> 'Although the parents' role is often described as being one of guidance, advice and reassurance it is much more influential, albeit this influence is often difficult to recognise. In some cases parents have limited knowledge of current educational practices but we expect that most have some personal sense of the relative status of different subjects. […] The students report that parents' input into the decision-making process is often quite general […]. However, […] the students' embodied dispositions (which make them more or less likely to select certain courses of study) have already been shaped by their home environment.'
>
> (Noyes & Sealey, 2009, p. 8)

In some schools in Norway, it is still normal that one teacher continues with one class from Year 1 through Year 7 (Braathe & Ongstad, 2001). Alan Bishop (2001) raises the issue of values taught in school by teachers, reminding us that teachers are not only for example mathematics teachers, but they are also 'value carriers' and 'value mediators'. Through the choices you make as a teacher, you are implicitly shaping the values of your students. Hence, teachers are, just as parents, significant people in students' lives, and therefore they are, consciously or sub-consciously important in the students' narratives of choice and their mathematical identities. When students between the age of 9-11 and 12-14 are asked to talk about mathematics, they cannot do it without speaking of their teacher (Solomon, 2009). This illustrates the important role teachers have as significant other in the students' experiences with school.

2.2.2 Gender

As described earlier, the educational ideology of the Norwegian school system values equality, and gender equality is a major aim in the Norwegian school system:

> ‘Education and training are to be organised so that everyone can choose an educational path and a vocation that suits their own interests and abilities, irrespective of traditional gender role expectations.’
>
> (Ministry of Education and Research, 2007, p. 22)

In a report on the national recruitment to study science subjects in upper secondary school in Norway, Bjørkeng (2011) writes that girls get better grades than boys in science subjects. Boys have a higher percentage of failure on the exam in mathematics R2 (equivalent to A2 mathematics/further mathematics), and girls get an average of a half grade better than boys on the exam. These findings are based on the exam results from 2006-2009 (Bjørkeng, 2011). Despite this gender and mathematics is reflected in very few studies in Norway and Denmark, and Wedege reminds us of one reason why: ‘whether the issue is gender difference or gender equity, in the Nordic countries the underlying issue will always be equal opportunity’ (Wedege, 2007, p. 2).

When it comes to attainment on GCSE or in Sixth Form, there are very few gendered differences, however the decision to continue with mathematics post-compulsory and in higher education is highly gendered in favor of boys in England (Mendick, 2005b). Paechter (2001) discusses what it is about mathematics that makes girls not want to choose it when it becomes an option, being concerned with that by opting out of mathematics, girls close the doors to careers within STEM. She looks at this through four different lenses: ‘the nature of mathematics’, ‘the decontextualisation of mathematics’, ‘anxiety and emotions’ and ‘structural barriers’. Traditional and stereotypical views of mathematics are that it is masculine and based on reason, and that this is in conflict with the emotional intelligence of females. When students come to choose their subjects, this view of mathematics may be in conflict with girls’ identity as for example feminine (Paechter, 2001). The nature of mathematics as definite with only one right answer has been reported as a reason for students to choose to continue with mathematics and students to choose not to continue with mathematics (Black, Mendick, Rodd, Solomon, & Brown, 2009). Because students at the age of 16 are in the stage of ‘finding their own identity’, only girls who have ‘developed a strong sense of personal, including gender, identity’ (Paechter, 2001, p. 55) will feel able to choose mathematics despite traditional and stereotypical views (Paechter, 2001).

Paechter (2001) argues that the decontextualisation of mathematics aspect is connected to how men and women are seen to find solutions to and work on problems, and it is connected to how mathematics is presented and taught in school. There is an emphasis on speed, product and competition in school mathematics, and this emphasis conflicts with girls' desire to understand concepts and work collaboratively on tasks. This conflict can cause anxiety that prohibits learning and also cause girls to be less confident in their ability of mathematics, leading to fewer girls wanting to pursue mathematics further. The structural issues have to do with the exam system of mathematics, and how this restricts who gets to go on to study mathematics after GCSE (Paechter, 2001).

Wedege (2007) writes about how there has been a turn from seeing girls as the object of the research to seeing mathematics education as the object of the research. One can relate this to how one has shifted from seeing learning as acquisition to seeing it as participation in a social practice. In Norwegian the word gender (kjønn) can be referred to as a biological aspect of human beings as for example male and female, in English this would be referred to as 'sex', or one can refer to gender as sociological aspects such as masculine and feminine (Wedege, 2007). That there is only one word for gender in Norwegian and two words for the same in English can be seen as an illustration of the focus being on equality rather than gender equality as described earlier in this section.

Many researchers use the term 'doing gender' when they speak of 'the interactional work involved in being a gendered person in society' (Wedege, 2007, p. 252). Put simply, this means characterizing differences between the different sexes through socially constructed characteristics such as masculine and feminine. Gender is not only characteristics of people, but it is also something people do through participation in social practices (Wedege, 2007). The concept of gender is complex, and it 'is always a product of an ongoing interaction between "gender in the head" and "gender in the world"'(Wedege, 2007, p. 253).

Wedege (2007) writes about four ways of doing gender; structural, symbolic, personal and interactional. 'Structural and symbolic gender tells us what is normal and what is deviant for men and women, girls and boys whether we personally consent to these norms or not' (Wedege, 2007, p. 253). The social structure is built around and on gender and gender roles in society. For example more men than women study mathematics at a higher level or men make more money than women do. When participating in social practices with structural gender people form gender symbols. Historically there has been formed an image of mathematics as

masculine and logical and because of this more boys than girls choose mathematics. And there has also been formed a dichotomy between feminine and masculine, between girls and boys. Gender structure and gender symbols make mathematics masculine (Wedege, 2007). Personal gender is how we position ourselves to the structural and symbolic perspectives and norms in discourses of gender. Interactional gender is '[w]hen people interact they continuously negotiate who they are and who others are. They position themselves and others as gendered, and they get feedback on these positions' (Wedege, 2007, p. 254). This way of explaining gender also explains the negotiation between 'gender in the head' and 'gender in the world'.

Heather Mendick (2006) researched how one can argue that 'doing mathematics is doing masculinity' by interviewing and observing students who have chosen to continue with mathematics post-compulsory in the United Kingdom. Taking a Foucauldian perspective, she argues 'that gender is a project and one that is achieved in interactions with others […] [and] that seeing 'doing mathematics' as 'doing masculinity' is a productive way of understanding why mathematics is so male dominated' (2005b, p. 235). Mendick wants to avoid ''the problem of girls and mathematics' as residing within the girls' (2005b, p. 237), and rather look at 'masculinity and femininity […] as fluid properties of practices not people' (2005b, p. 238). To understand this, I find it useful to look at how Cathy Smith describes this reflexivity (subjectivity) of discourse – 'Choosing mathematics allows them to express something about themselves and, in performing that chosen identity, they use and reproduce knowledge that associates mathematics – powerfully – with men' (Smith, 2010, p. 101). Mendick's research reflects how gender is seen as an issue in mathematics education in the UK, and her research is very much influenced by the context in which she is researching.

2.2.3 To sum up

In section 2.2, I have described how choice and gender are key issues in mathematics education research. Choice is very much linked to, for example, who the students are, who they perceive themselves as, and their cultural, economic and linguistic capital. Stereotypical views of gender and gender 'roles' positions mathematics and those who choose mathematics as different. As I understand how gender is part of research within mathematics education, it limits and constraints the possibility of the outcome of the research. By using it as a starting point in research on choice of mathematics, it 'boxes' or categorizes the students as for

example feminine, masculine, logical, rational or intelligent. I understand subject choices as much more complex than this, and I see it as part of the students' mathematical identities.

The construction of identity and identity as such can be understood and described in many ways. Bøe (2012) stresses how society affects the youth of today, and that we today live in a society (referring to the Nordic countries) where tradition no longer prescribes us an identity and we are free to choose who we are or who we want to be. It is debatable how 'free' we are, but never the less, she sees identity as important in relation to students' subject choice. Other researchers such as Boaler and Greeno (2000), Lerman (2006), Wedege (2007) and Paechter (2001) also discuss the search for identity by young people. Braathe (2011) states that 'identities are something that people *do* which is embedded in some social activity, and not something they *are*' (2011, p. 2, italics in original). Through Braathe's 'definition' of identity one can say that mathematical identities are something that students enact in the mathematical practices in which they participate. This means that to be able to interpret or analyse students' accounts of choosing mathematics, one has to take into account their identities as students of mathematics. In the next chapter, I will describe my theoretical standpoint and discuss the issue of identity through this theory.

3.0 Identities as students of mathematics – Theoretical framework

The questions that arise from the previous chapter cause me to ask about identities, how those identities relate to particular cultures and how one can interpret accounts of choosing post-compulsory mathematics. In this chapter, I will describe how theorists and researchers have talked about and theorized the issues presented in the previous chapter. I position myself within sociocultural theories, and I will describe how these theories can be used as tools for exploring and interpreting accounts of choosing mathematics as narratives of identities.

3.1 Identity

There is a growing interest in how identity is linked to learning and to knowledge (Lerman, 2006), and also how it is linked to the choice of continuing with specific subjects, where mathematics is a 'special' subject perceived as difficult and hard (Boaler & Greeno, 2000). Boaler (1997) discusses the experience of doing mathematics in contrasting classrooms, and she makes a point that the context in which you learn has an effect on how you see yourself as a mathematics student.

> 'students of mathematics who had predominantly worked through textbooks found it difficult to use their mathematics in new and varied situations that required a different set of practices. Students who had engaged in practices of negotiation and interpretation in the mathematics classroom were more able to use mathematics in different situations that required such practices. […] Their knowledge was co-constituted by the practices of their learning and therefore differentially useful […]. […] [S]ituated theories […] focus on the patterns of participation that constitute learning gives insight into the nature and extent of identification and belonging that students develop as they learn to *be* mathematics learners'
>
> (Boaler & Greeno, 2000, p. 172, italics in original)

Boaler and Greeno (2000) positions themselves within sociocultural theory. '[Sociocultural theories] see meaning, thinking, and reasoning as products of social activity' (Lerman, 2000). Sociocultural theories understand learning as something which goes from the social to the individual – 'from the 'outward' to the 'inward', or […] from the intersubjective to the intrasubjective' (Walshaw, 2007, p. 32). The object of my study is students' narratives of choice, and the choice of studying post-compulsory mathematics is connected to a person's identity and vice versa, and identity development is explained as learning or becoming a

participant of social practices. Thus, I take a sociocultural perspective in this study. I will here through a review of research on identity and mathematics describe how different researchers and theories explain identity and how these theories make it possible to talk about identities.

Lerman says that 'identity is […] produced in discourses and the notion of subjectivity captures that regulation' (2006, p. 4), and subjectivity is the way that individuals are both the subject of and subjected by the discourse which they act within. The discourse provides positions for the individual at the same time as it offers limitations and possibilities to the individual. Subjectivity can be used to describe the relationship between choice and identity. We are subjects (individuals) who make choices, but we make these choices in a context with discursive limitations and opportunities (Smith, 2010).

3.2 Identity in figured worlds

Boaler and Greeno present in their article 'new data […] that challenged this view [of mathematics as for the clever core] through a representation of learning as a process of identity formation in "figured worlds"' (2000, p. 171). Learning mathematics can be understood as participating in mathematical practices, and this learning can be described as a 'trajectory of participation'. The way the students participate in mathematical practices and communities are how they adapt to the limitations and possibilities within that environment. Boaler and Greeno (2000) describe these environments that the students participate in with the notion of figured worlds (borrowed from Holland, Lachicotte, Skinner, & Cain, 1998). Figured worlds are environments where the participants act together and create meaning, and within these figured worlds the participants can take on/be put in different positions as agents. Figured worlds are subjectively experienced worlds which are dependent of the participants.

> 'The mathematics classroom may be thought of as a particular social setting – that is, a figured world – in which children and teachers take on certain roles that help define who they are'
>
> (Boaler & Greeno, 2000, p. 173).

Individuals position themselves (and are positioned) within the figured worlds. The concept of positional identity refers to 'the way in which people comprehend and enact their positions in the worlds in which they live' (Boaler & Greeno, 2000, p. 173). Through agency and improvisation the participants can respond to their positioning and the figured worlds they live in with what is referred to as the 'space of authoring'. The space of authoring captures

how ‘the world must be answered – authorship is not a choice’ (Boaler & Greeno, 2000, p. 173). I will come back to ‘the space of authoring’ in section 3.4.

Boaler and Greeno (2000) wrote about students in contrasting mathematics classrooms and they’ve used sociocultural theory to explain why some students want to continue with mathematics and why some students do not want to continue studying mathematics. They looked at differences between the social practices the students participated in, the teaching they received and gender differences. In their study of interviews with 48 students in high school studying calculus in USA, Boaler and Greeno (2000) found that the pedagogy practices used in the classrooms could be divided into two: ecologies of didactic teaching and ecologies of discussion-based teaching. The students portrayed the first for example as highly ritualized with the same pattern of teaching in every lesson, they worked from the textbook and most questions could be solved with reproducing a procedure without thinking, they were not encouraged to discuss or collaborate on questions hence the students worked individually. The second type of practice was for example described with more positive words, and the students were encouraged to discuss and their role as students was to help each other to a shared and increased understanding through collaboration, and the students can be described as active agents.

Boaler and Greeno (2000) described the students as received knowers and connected knowers. These terms are borrowed from Belencky, Clinchy, Goldberger, and Tarule (1986) and they are used to distinguish between different *ways of knowing*. They suggest that there are four ways of how individuals consider and describe their knowing: received, subjective, separate and connected. Received knowing is when you receive knowledge from an authority passively. Subjected knowing is when you yourself react to the new information and make it yours. Separate knowing is when ‘the individual considers her knowledge as primarily being constructed to comply with rules that establish validity and to be defensible against challenges based on rules for validating knowledge’ (Boaler & Greeno, 2000, p. 174). When one participates in social practices and negotiate meaning, much like how the students worked in the discussion based classes, the students develop connected knowing (Boaler & Greeno, 2000).

One reason for why some of the students in the more didactic classrooms decided not to continue with mathematics, could be because of ‘the lack of opportunities they received to develop a deep, relational, and connected understanding of mathematics’ (Boaler & Greeno,

2000, p. 184). This lack of opportunity alienated mostly girls, because they wanted to understand why, while the students who said they liked this type of mathematics teaching, mostly boys, liked mathematics exactly because they liked not having to think and understand why and only having right or wrong answers – 'they wanted to be received knowers' (Boaler & Greeno, 2000, p. 185) (also reported in Boaler, 2002).

Other reasons for why students rejected mathematics was because the pedagogy used was not compatible with their characterisation of who they were or who they wanted to be – their developing identity – as for example a creative and verbal person, and 'because they wanted to pursue subjects that offered opportunities for expression, interpretation, and agency' (Boaler & Greeno, 2000, p. 187). It is important to remember that these students were successful students and they did not reject mathematics because of the nature of the subject, but because of the pedagogical practice used to teach mathematics. 8 out of 10 students asked in the discussion based classes said that they wanted to continue studying mathematics at a higher level, and the students in the discussion based classes had a more positive identification with mathematics (Boaler & Greeno, 2000). 'It is probable that many able students who could become world-class mathematicians leave mathematics because they do not want to author their identities as passive receivers of knowledge' (Boaler & Greeno, 2000, pp. 188-189).

It could be suggested that students may not want to continue studying mathematics as soon as they can stop, because they actually have been made to feel that they're not good at it. Boaler and Greeno (2000) are writing about students in the USA. The educational ethos in the USA is more compatible with the educational ethos in England rather than in Norway, because there is an emphasis on ability, getting marks, comparison with others and competition.

3.3 Identities as narratives

When Sfard and Prusak (2005a, 2005b) were reflecting and analyzing the learning practices and narratives about these learning practices from two groups of students in Israel, one group of immigrant students from the former Soviet Union and one group of native Israelis, they found that although 'identity' was a popular concept, there was no definition of it that was operationalized well enough for them to speak of the identity differences between the two groups of students. They came up with a definition of *identity as narratives*.

> ‘We suggest that identities may be defined as collections of stories about persons or, more specifically, as those narratives about individuals that are *reifying*, *endorsable*, and *significant*.’
>
> (Sfard & Prusak, 2005a, italics in original)

The most important feature of these narratives is that they ‘freeze the picture’. It makes it possible ‘to overcome the fluidity of change’ (Sfard & Prusak, 2005b, p. 16) in people in relation to themselves, other people and the world, and pinpoint something through their narratives (2005a, 2005b). Defining identity as narratives can be critiqued by those who see identity as an experience because it reduces identity to text or merely words, but Sfard and Prusak claims that ‘it is our *vision* of our own or other people’s experience, and not the experiences as such, that constitutes identities. Rather than viewing identities as entities residing in the world itself, our narrative definition presents them as *discursive counterparts* of one’s lived experiences’ (2005b, p. 17, italics in original).

In their study, Sfard and Prusak (2005b) studied a mathematics class with two groups of students, as mentioned above. They called the native Israeli group ‘OldTimers’ and the former Soviet Union immigrants ‘NewComers’. The students were interviewed as well as their parents and their teachers. Because there were many similarities within the groups and differences between the groups, Sfard and Prusak (2005b) used two girls to represent the groups: Leah, representing the OldTimers and Sonya, representing the NewComers. Sfard and Prusak (2005b, p. 21, italics in original) wanted to answer the questions ‘*Why do different individuals act differently in the same situation? And why, differences notwithstanding, do different individuals’ actions often reveal a distinct family resemblance?*’

3.3.1 Learning and identity

Being very much influenced by sociocultural theory, Sfard and Prusak (2005b) explain identity as the most important link between learning and the sociocultural context where learning takes place: learning as developing one’s own discourses. Sfard and Prusak (2005b, p. 19) write that ‘Only insufficiencies of imagination may account for the down-to-earth nature of the majority of stories about “who one is supposed to be”’. Learning can close the gap between our actual and our designated identity, and learning in mathematics is about developing one’s own mathematical discourse through participating in mathematical discourses with others.

> "The different types of communication that bring some people together while excluding some others are called discourses. Given this definition, any human society may be divided into partially overlapping communities of discourse" (Sfard, 2007, p. 571).

Ritualized and substantial learning is about how one initiates the rules of the discourse. Ritualized learning is much like received knowing used by Boaler and Greeno (2000). One participates in the discourse in a ritualized and episodic way and not for one self but for others, while substantial learning is about a long lasting change of one's own discourse (Sfard & Prusak, 2005a).

> 'Substantial learning may be defined as one that results in turning the new discourse from its initial status of a *discourse-for-others* into a *discourse-for-oneself*, that is, into a discourse in which this person is likely to engage spontaneously while solving problems and trying to answer self-posed questions. This special kind of learning has a lasting effect on one's communication with oneself, that is, on this person's thinking.'
>
> (Sfard & Prusak, 2005a, p. 42, italics in original)

In relation to their study, the OldTimers' learning could be characterized as ritualized learning and the NewComers' learning could be characterized as substantial learning. Leah's ritualized learning was more for her teacher than for herself, while Sonya's substantial learning was for herself and to be able to re-use what she learned later (Sfard & Prusak, 2005b).

3.3.2 Actual and designated identities

One can divide the identifying narratives about a person into actual and designated identities, where the actual identity is part of the reifying and significant narrative identifying the person right now presented as facts, while the designated identity is the part describing how the person is expected to be identified in the future (Sfard & Prusak, 2005b). For example it can be possible that students of mathematics say that 'I enjoy mathematics' which is a narrative describing the actual identity, while they may also say 'I wish to study mathematics at University' which is a narrative of who the student wants to be in the future – designated identity.

'Critical' stories are central to the identity of a person, and changing these stories would change the whole identity of a person. Designated identities are always understood by the identified person as binding. They are not always based on rational choice, but affects ones

actions and are expectations of ones future. Designated identities are often endorsed by people with authority and power in the person's life and 'A person may be led to endorse certain narratives about herself without realizing that these are "just stories" and that there are alternatives' (Sfard & Prusak, 2005b, p. 18). I can use myself as an example. I have always been told by people close to me such as my parents, my friends and especially my kinder garden and primary school teachers that I should become a teacher, that I have always loved taking care of other children and that I am good at explaining mathematics to my friends. I am now a mathematics teacher. The stories told about me to me or others by me or others describing my future occupation as a teacher have to me been binding, significant, endorsable and reifying even though they are 'just stories'.

3.3.3 Significant narrators and narrative diffusion

Our designated identity is made up of narratives of many authors not just one. 'Identities are products of discursive diffusion – of our proclivity to recycle strips of things said by others even if we are unaware of these texts' origin' (Sfard & Prusak, 2005b, p. 18). There is a negotiation of identities between stories told by different authors and to different recipients, and we constantly take up stories told by others and ourselves into our own narratives. The narratives feed of each other, and therefore we ourselves are not the only authors of our identities.

> 'Either by animating other speakers or by converting their stories about us to the first person, we incorporate our second- and third-person identities into our self-addressed designated identities.'
>
> (Sfard & Prusak, 2005b, p. 18)

Significant narrators are those storytellers whose stories have the greatest effect on our designated identity (Sfard & Prusak, 2005b). Narrative diffusion is about how narratives take on a life of their own once they are told and spread out and is separated from the authors of the narrative. The longer a story connected to a person's designated identity has been spreading, the more deep roots it gets and thus it get harder to change. Actual identities are often affected by the designated identity, but it can also go the other way.

> 'On their way into designated identities, tales of one's repeated success are likely to reincarnate into stories of special "aptitude," "gift," or "talent," whereas those of

> repeated failure evolve into motifs of "slowness," "incapacity," or even "permanent disability."'
>
> (Sfard & Prusak, 2005b, p. 18)

Through narrative diffusion and significant narrators' stories, the designated identities can be said to come from 'collective storytelling' in communities the identified participate in (Sfard & Prusak, 2005b). In their study Sfard and Prusak (2005b) showed how the cultural background of the two groups of students affected the stories told about them, how stories around the students told by parents, grandparents and teachers entered their stories of themselves and how the students saw themselves in the future – designated identities – as 'being happy' for Leah and 'being a complete person' for Sonya. Skills in mathematics constituted a 'critical' story for the NewComers because their future relied on it, while for the OldTimers mathematics could be used as a subject that opened doors to higher education. This could be used as part of the explanation for why the OldTimers' learning could be characterized as ritualized, while the NewComers' learning could be characterized as substantial (Sfard & Prusak, 2005b).

3.4 Narratives of subject choice

The concept of figured worlds which I have described earlier in this chapter (see section 3.1) is very much influenced by 'Bakhtinian genre theory, where *figured worlds, positioning and authoring* are used to explain how, through their perception and understandings of the *figured worlds* in which they participate, subjects indicate their *positionings* and reflect their *authoring* of identities' (Braathe, 2011, italics in original). The process of self-authoring is about how we through meaning making as participants of figured worlds answer and address the world through preexisting words and artifacts, and 'we also represent ourselves to ourselves from the vantage point (the words) of others, and […] those representations are significant to our experience of ourselves' (Braathe, 2011, p. 11). Bakhtin had the idea of self-authoring: drawing on the tools in our culture to explain ourselves to ourselves and others (1981, 1986). What Sfard and Prusak (2005a, 2005b) add is that they point out how we don't just self-author, that part of that self-authoring is coming from how we are talked about by people who are close to us like our teachers and our families.

> 'Bakhtin's focus on the fact that "the word in language is half someone else's" means that "it exists in other people's mouths, in other people's concrete contexts, serving

> other people's intentions: it is from there that one must take the word, and make it one's own (Bakhtin, 1981, pp. 293-294).' (Solomon, 2012, p. 4)

The idea is that the words that we use are never only our words, they have always come from somewhere else and they come through us again. Identities are never fixed or determined by discourse, but they are dependent upon the context of communication and the social relations (Braathe, 2011). We also position ourselves in relation to others. The idea of 'othering' is that 'who I am' is in terms of others, and it is often in a negative way in terms of others' failings saying 'I am better than other people'. It is about a constant comparison (Damarin, 2000; Mendick, 2005a). Earlier, I've discussed how understanding identities as narratives can let us 'freeze the picture' and interpret these narrative as they were told at that exact moment in the interview, Bakhtinian methodology also suggests that these identities can only be from that moment.

3.5 Drawing on cultural models in narratives of choice

Gee (2012) writes about how any language is constituted by many sub-languages which he calls 'social languages', and whenever we speak we must always make it clear '*who* we are' and '*what* we are doing', because we are 'different *whos* in different contexts' and the same *what* can be different in different contexts (2012, p. 87, italics in original).

> 'It is a crucial point […] that the *who* we are and that *what* we are doing is really enacted through a three-way simultaneous interaction among (a) our social or cultural group memberships […]; (b) a particular social language or mixture of them […]; and (c) a particular context, that is, a configuration of people, objects, and a location […]'
>
> (Gee, 2012, p. 90, italics in original).

Mixing social languages is called, by Bakhtin, 'heteroglossia' and means multiple voices (Gee, 2012). Stories or utterances we tell, how we tell, to whom we tell them and in what context we tell them are filled with multiple voices of social language. Theories used in everyday life to interpret meaning from utterances are made from and through experiences, and they describe through for example metaphors and narratives what is normal and typical; they are 'simplified views of the world' (Gee, 2012, p. 98). Gee (2012) calls these theories 'cultural models' and he uses this interchangeably with the concept of figured worlds:

> ‘A cultural model or figured world is a picture of a simplified world that captures what is taken to be typical or normal. What is taken to be typical or normal, of course, varies by context and by people’s social and cultural group […].’
>
> (Gee, 2012, p. 99)

Whenever we speak or interpret meaning we draw on these theories. We draw on these cultural models. In relation to my study and interviews, I am asking students to tell stories about their mathematical identities and through these theories on language and identity I will have to expect that different social languages will be used and we will draw on different cultural models.

4.0 Research question

In the last two chapters, I have explained the context of my study and where I position my study theoretically. I have explained how fundamentally different the school systems in Norway and England are, the different cultural concerns in these two countries, and how this positions the students differently with significantly different experiences of school and of subject choice. Further, through my theoretical framework I have explained how Sfard and Prusak (2005a, 2005b) defines narratives as identities, and I have explained how identity is about self-authoring through drawing on stories, cultural models and discourses.

Given that when we tell the stories of ourselves to ourselves and others we draw on cultural models and social practices which we experience and are part of. My research questions are:

> *What cultural differences and similarities are visible in Norwegian and English students' accounts of choosing mathematics post-compulsory?*
>
> - *What cultural models of gender and education do they draw on?*
> - *How do they self-author as students of mathematics?*

In the next chapter I will explain the methodological stance I take up and the methods which I have used to collect data for my study and for analyzing that data.

5.0 Methodology

In this study I wanted to listen to students' stories about their choice of continuing with post-compulsory mathematics to answer my research questions which are:

> *What cultural differences and similarities are visible in Norwegian and English students' accounts of choosing mathematics?*
>
> - *What cultural models of gender and education do they draw on?*
> - *How do they self-author as students of mathematics?*

The issue of choice is very much about identities, as described in chapter 2 and 3, and how students describe, self-author and tell stories about themselves as students of mathematics. With sociocultural theory in mind, I take the view that we live the story of who we are, and that we keep telling that story by drawing on cultural tools and models to do so.

In social science what we are studying is people and among other things their opinions and understandings of themselves and others. There are two overall ways of doing this, through quantitative or qualitative methods. Kleve (2007, p. 48) writes that 'Quantitative research "embodies a view of social reality as an external objective reality", whereas qualitative research "embodies a view of social reality as a constantly shifting emergent property of individuals' creations" (Bryman, 2001, p. 20)'. My research paradigm is based on my view of students' stories as constantly shifting emergent properties of individuals' creations: I am looking at students' subjective expressions of who they are.

I aim to interpret what these students have tried to say to me and to capture the subjective expressions through their stories. Drawing on Gee (2012), Bakhtin (1981, 1986) and Sfard and Prusak (2005a, 2005b) , I will analyze how they draw on different cultural models or tools in their stories and how they self-author as students of mathematics, based on a discourse analysis of transcripts of the interviews.

In this chapter I will describe my choices regarding method and analytical framework, and I will discuss my role as a researcher and ethical issues in this study.

5.1 Methodology

Methodology is about what I as a researcher think that I can know and what I can find out in my work. It is about the stance I take up as a researcher. Epistemology is the study of knowledge in terms of what knowledge is and how I can claim to know something. As

described above, my paradigm is that I am looking at people's subjective expressions of who they are and I am interpreting what they have said to me to try and capture those subjective expressions through their stories. Ontology is about what I am looking at in terms of what the unit of my analysis is, and in this study I am looking at people's stories (Johannessen, Tufte, & Christoffersen, 2010; Mason, 2002). By using Sfard and Prusak's (2005a, 2005b) theory as a lens or a tool, I take the view that there is no truth or reality and actually it is only the stories that people tell. I am not concerned to find out whether those stories are true or not, because ontologically that does not make sense because what I am studying, the unit of my analysis is the stories. Methodologically this means that in my analysis I try to recognize that these are stories and recognize that this is about drawing on cultural models and cultural tools. Methodology is also about me as a part of the equation and recognizing my own position (Mason, 2002). I will come back to this in section 5.3.

5.2 Method

5.2.1 The qualitative interview

Johannessen et al. (2010) describe how in social science research the unit of analysis is the way people understand the world which they live in. If you have participated in a wedding and you're asked to describe how it was, it is impossible to convey everything about that wedding; the only thing you can mediate is your experience of that wedding. The same goes for the stories, the unit of analysis, in my study. It is impossible to mediate everything and there is no truth or reality, but only the stories people tell.

Qualitative interviews can be described as a conversation with a special structure and theme or topic. The structure can be connected to the power relation between the interviewer and the interviewee. It is the interviewer who has decided what that theme of the conversation is, who asks the questions and who controls the situation. The area of focus in the interview is often about describing, unfolding or interpreting a special theme or topic (Johannessen et al., 2010; Kvale & Brinkmann, 2009). The area of focus in my interviews was stories about why the students had chosen to continue with mathematics. To get rich description of this and the depth needed to look at what the students said, and to recognize and interpret the cultural models which they drew on in their stories, I chose to do semi-structured interviews. This type of interviews has a loose structure, and I describe how I did the interview and the interview guides I used in section 5.2.2.

Johannessen et al. (2010) write about reasons for choosing qualitative interviewing versus other methods for collecting data. For example, there is more freedom in a qualitative interview for expressing feelings and stories about the particular topic than in questionnaires. Interviewing is a unique way of taking into account the complexity and many nuances of people's stories about their subjective experiences. Another reason for choosing interviewing rather than questionnaires is that the researcher can 'fit' the interview to each interviewee. I was interested in the feelings and stories about mathematics that the students had, and I wanted to be able to follow up every student's account in a way that fitted them and their story, but I also had other reasons for choosing qualitative interviews.

First of all, I wanted to make sure that my questions were not misunderstood and I wanted to be able to ask different questions about the same topics or be able to rephrase the questions to make sure that the complexity and different nuances in the students' stories came through. This would be something that could not have been solved or even recognized in a large scale quantitative research questionnaire. This was also connected to my limited experience as an interviewer in terms of, for example, how to ask open questions, but also to my abilities in speaking English. In the interviews with the Norwegian students this was not such an issue, but with the English students it became very clear that not having English as my first language affected the interview and the nature of our conversation. My English vocabulary did not reach as far as I had hoped, and when discussing the interviews afterwards with my supervisor there were many small, but maybe important or significant, parts of the students' stories which I had not understood or recognized during the interview. This became very clear when I transcribed the interview with Ravi, because I had missed out on following up a gender differentiation which he mentioned.

Another reason for choosing interviews over questionnaires is that being a girl who had chosen post-compulsory mathematics myself was part of why I had wanted to do this study in the first place, at this point in my research career. I felt that 'hiding' this aspect from my interviewees by doing questionnaires would have most likely changed the outcome of my study, and I would not have been able to get as close to the interviewees as I did. I will come back to my position in this study in section 5.3.

5.2.2 Interview guide

In semi-structured interviews, it is possible to use an interview guide where the focus of the interview is described. It can include examples of questions or topics which the researcher

wants to ask about (Johannessen et al., 2010; Kvale & Brinkmann, 2009). By using an interview guide and not having a strict structure for the interview which I needed to follow, I could easily follow up topics which the interviewees talked about and I could make sure that I covered all the topics which I set out to do. The interview guide gives structure and flexibility (Johannessen et al., 2010), and I tried to ensure that I captured the individual stories of every interviewee about, for example, choosing mathematics, but that I also got their stories about particular topics such as how they saw gender as an issue or not in mathematics education. This was important for me, because I wanted to do two things in this research: I wanted to listen to individuals' accounts of choosing mathematics and I wanted to do a comparative study of students' stories from two different cultures. Standardizing interviews and questions can, however, restrict and limit the freedom and the stories in an interview (Johannessen et al., 2010). While I used the interview guide as a tool for standardizing the interviews, making sure that we talked about some of the same topics in each interview in order to make sure that I could do the comparative study afterwards, I tried not to let the interview guide restrict and limit what an interviewee could talk about to make sure that the individuality of every interviewee's story came through.

During the interviews I used two interview guides. I had one with my initial research questions and at the end of every interview, I checked to see if we had covered the research questions (see appendix 6). In the process of interviewing and analyzing the data, I have changed my research questions to be more focused and more closely related to the theory around cultural models, self-authoring and identities as narratives (Bakhtin, 1981, 1986; Gee, 2012; Sfard and Prusak, 2005a, 2005b). The other interview guide I used included information about the interview and ethical guidelines (see section 5.5), what topic I wanted to start the interview with, examples of questions to ask within each topic and how I wanted to end the interview. This interview guide was written in Norwegian for the interviews in Norway and in English for the interviews in England. The English version is attached as appendix 7.

Johannessen et al. (2010) recommend that the interview should start with questions which are easy for the interviewee to answer. This can be questions about their family or what they like to do on their free time. In this part of the interview it is important to create a bond of trust between the interviewer and the interviewee, and provoking questions should be avoided. I started all my interviews with asking about the students family situations such as the

occupation of their parents and if they have any siblings. I chose to ask about their family situation, because it is easy to talk about and also because it could be relevant for my study if their parents have higher education related to mathematics or if they have any education at all. I also wanted to ask about family because, as discussed in section 2.2.1, significant others such as parents often , consciously or subconsciously, have great influence on students' subject choices.

After talking about their family, I asked the students if they could tell me about why they had chosen mathematics. This question could be considered as what Johannessen et al. (2010, p. 141, italics in original, my translation) calls a '*transition question*' which both introduces the main topic of the interview, but also leads the progress of the interview from '*opening question's* to '*key questions'*. All these types of questions should be included in an interview guide. The key questions on my interview guide were divided into four groups: *choosing mathematics*, *mathematical history*, *lessons in school* and *the future etc*. In the *choosing mathematics* group I had questions asking about reasons for choosing mathematics for themselves and others, about being good at mathematics and ability, and about friends, family and gender. In the *mathematical history* group I had questions concerning memories of teachers and mathematics, people close to the students and their relationship with mathematics and support from friends, family and teachers. The two next groups included questions about their plans for the future, about ability grouping, about gender differences in school and in subject choices, about grades, tests and lessons in mathematics.

I chose to use the question about why they had chosen mathematics as a *transition question*, because it could be understood as a relatively simple question to answer. Their answer could be that it is a rational choice because they 'like it' or because they 'need it for further education', and this question could be a good place to start when unpacking further stories about choice. The *key questions* was designed to reveal further stories surrounding the students' reason for choosing mathematics, such as how the students related to discourses about mathematics or discourses about gender. How the students in their narratives of choice drew on cultural models and various discourses to self-author, could help me in interpreting and comparing their identities as students of mathematics. Because I wanted to compare the stories from the Norwegian and the English students, I needed stories which could be related to the different cultures, backgrounds, school systems and educational ideologies.

Kvale and Brinkmann (2009) write that the goal of the qualitative interview is to create knowledge and that this is constructed in the communicational relationship between the interviewee and the interviewer. The participants in an interview share their views of a particular topic, and by doing that they create knowledge about the topic. The focus in my interviews was to get stories about the students' choice of continuing with mathematics, and through all the questions I asked, which were very similar in all the interviews, together we created knowledge about the interviewee's relationship with mathematics. This could further be used to compare the stories within and between the two groups of students and interpret their stories in relation to my research questions.

Johannessen et al. (2010) write that it is important to end the interview in a neat way, clear up any misunderstandings or questions, and to give the interviewee a chance to give a last remark on anything which he or she feels should be made more clear. The last thing on my interview guide was a reminder of asking if I had understood the answers correctly, ask if there was anything the interviewee wanted to add and sum up the interview.

5.2.3 Data in this study

What counts as data and what data should be included in the analysis? This is not always straight forward and the researcher has to make choices about this (Johannessen et al., 2010). I have chosen to mostly only use the transcribed words from the interviews. In some interviews, the interviewees used their hands to illustrate what they meant when they talked and some of them also laughed. In those cases, their illustrations and laughter have affected how I have interpreted what the interviewee told me. I am unable to include a systematic analysis of the use of gesture as I only have audio data, but the gestures done by the interviewees or I influenced the course of the conversation and also my interpretation afterwards.

In my analysis I have translated data from the Norwegian interviews into English, and quotes are given in English, with the Norwegian original in footnotes. Translation can result in disappearance or change of meaning, so in order to maintain as much rigour in my analysis as possible; I have supplied the original Norwegian which provides an option for Norwegian-speaking readers to check their own understanding of the data and also to alert readers to potential alternative interpretations of it.

5.3 Me as a researcher

Every person meets the world with their own experiences and individual understandings of the world, and researchers are no different from other people (Johannessen et al., 2010). It is important to recognise this and I have already described the theoretical position I take, but there are also other things about me which are important when it comes to the process of interviewing. Like the interviewees, I also chose to study post-compulsory mathematics and this has influenced the choices which I have made regarding higher education. I finished four years of teacher education in Norway that has given me 'inside' knowledge of, among other things, the educational system and about social practices the students participate in. Everything which is brought up in the interviews is filtered through me as a researcher, but also as a mathematics teacher and as an individual with my own experiences and understandings of choosing mathematics post-compulsory.

Kvale and Brinkmann (2009) write that researchers doing research across cultural borders need to reflect on what might affect the relationship between interviewer-interviewee and the interview. The interviewer should in advance of the interview study and learn about the culture of the interviewee and notice the cultural differences. As described in chapter 2, there are significant differences between Norway and England. During my teacher education, I studied English and I learned about the school system in England, and through the master programme with my supervisor as a teacher, I learned more about the English school system. I felt that I was prepared for the interviews, but not being a native English speaker and coming from a different culture affected me during the interview. This changed the experience of the interviews for me together with the fact that the interviews in England were not private and that, even though I considered myself as fairly good at speaking English, I did not necessarily follow through on everything the interviewees said because I could not understand fast enough.

Even though I can recognize cultural differences between me and the interviewees, I can never move outside of who I am. In section 3.4, I wrote about the process of self-authoring as how we through meaning making as participants of figured worlds answer and address the world through drawing on the tools in our culture to explain ourselves to ourselves and others (Braathe, 2011). Bakhtin had the idea of self-authoring, but Sfard and Prusak (2005b) add that part of self-authoring comes from how we are talked about by people who are close to us. These ideas say that even though I am the questioner I am still a part of the equation of the

discussion that was going on in the interviews. The English students were trying to communicate some things to me, but they knew that I was an 'outsider'. They could have had some kind of image of who I was or they might not even have thought about that. They might have been assuming that I know everything because it is the same where I come from, for example, in terms of how school is organized. The Norwegian students knew that I was an 'insider' and they might have been assuming other things about me. This illustrates how the interviewees from both countries might have been assuming things about me as either an 'outsider' from or an 'insider' in their culture (Mason, 2002).

5.4 Research participants

When finding participants for the research the choices one makes are particularly important. How many participants are needed to answer the research questions and how and what are the criteria for recruiting participants (Johannessen et al., 2010)? I wanted to make sure that I had enough students from both countries to be able to answer my research questions, but because of the limited time for this study I could not recruit too many either. Therefore, I decided that I wanted to try to get 6-8 students from each country. The students would have to be over the age of 18 and they would have to have chosen to continue with mathematics in their last year of upper secondary school in Norway or Sixth Form in England. I will here describe how I went about to get in touch with the participants and schools in the two countries. To protect students and the schools anonymity, I have given them all pseudonyms.

5.4.1 The Norwegian participants

To get in touch with students in Norway, I had to contact each school and talk to either the head of the mathematics department or the headmaster. I got in touch with three schools where either the headmaster or the head of the mathematics department was positive about the idea of participating. The schools I ended up with were three schools in different parts of Oslo, and I have named the school on the basis of where they were located: East, Middle and West.

At East, I got in contact with the head of the mathematics department and we set a date where I could come and ask in one of the mathematics classes if anyone would like to participate in my study. I was asked to observe the first 15 minutes in class, and then talk about my study. I was asked to observe because they were starting on a new topic, and the teacher wanted all the students to get the introduction before the interviews. Two students volunteered for my study: Camilla and Mathias. In the interviews when the students were talking about their

teachers in mathematics, they used examples from the introduction which I had observed. That I had been in the class for 15 minutes seemed to have a positive effect on how the interviewees talked to me and on the interviewee-interviewer relationship.

At Middle, I got in contact with the headmaster of the school who was also teaching mathematics in Year 13. At this school, the teacher wanted to talk to the students and inform them about the study and my email-address was given to those who were interested. Two girls from this school volunteered to participate in my study: Cecilie and Sara. The girls themselves chose when they wanted to be interviewed and we ended up doing the interview right after they got out of school, in a room at their school. Cecilie and Sara were friends and knew each other well, and there was two weeks between the first and the second interview. This means that Sara, who was the first to be interviewed, might have talked to Cecilie about how the interview was and what we talked about. This might have been something Cecilie thought about before being interviewed.

At West, I got in contact with the head of the mathematics department and I was asked to come and talk about my study in one of the mathematics classes. The teacher introduced me and encouraged all the students to participate and to support young researcher generally. I spoke about my research project, and at this school four boys and one girl volunteered to participate in my study: Bjarne, Ruben, Rune, Jonatan and Louise. All the interviews were held at the school that same day. That their teacher was positive about my research project might have been a factor in that so many students volunteered.

5.4.2 The English participants

In England, my introduction to the school and the students was very different from my introduction in Norway. To get interviewees in England, my supervisor contacted a teacher educator colleague. She worked with the school on behalf of MMU, Manchester Metropolitan University, who supplied student teachers to the school as part of the teacher educator programme. The students were selected before I arrived. I interviewed three girls and three boys: Annie, Kaitlin, Emily, Kevin, Tarik and Ravi. It was the students' mathematics teacher who set up rooms and times for the interviews, and it was also their teacher who asked if they wanted to participate in the study. I am not sure how the teacher picked who to ask to participate in the study, but because they were all slightly doing different subjects and had different backgrounds, it seemed as though they were picked to create diversity in the student group. For example Annie and Kevin were studying further mathematics, while Kaitlin, Tarik

and Ravi were doing mathematics. To be able to interview students alone at schools in England, I would have needed a CRB clearance, which I did not have. I will explain this and how it affected the interviews more closely in section 5.5.

It wasn't planned that Emily would be interviewed, but because of some misunderstandings we were late for one interview. To make up for the lost interview, the teacher asked Emily if she would like to participate in my study. She was asked right after one of the mathematics classes had ended and it was unexpected for Emily to be asked. This might have affected the relationship between Emily and myself as interviewee-interviewer, but because I had been invited earlier that day to observe their class and talk to the students, she already knew who I was and what I was doing at their school. Kvale and Brinkmann (2009) write that it is important that the informants feel that the interview has been a positive experience, and this was important to me in all the interviews, but especially important for me during and after the interview with Emily, because she might have felt like she was forced into the interview because she was asked unexpectedly and 'at the last minute'.

5.5 Ethical issues

The qualitative interview is filled with ethical questions which the researcher needs to address and think about before, after and during the interview process (Kvale & Brinkmann, 2009). Through the interviews I wanted to get the interviewees' stories, and because I was asking the students about their personal relationship with mathematics and their reflections on this, it was important that I informed them about their anonymity in this research. That they were informed about their anonymity was also important because when people talk about choice they often talk about their families and the interviews can get personal and sensitive (see section 2.2.1). The informants' names and the names of their schools have been changed in this report to secure confidentiality and anonymity. The way I contacted the schools and the interviewees, the guarantee of confidentiality form, the consent form and the interview guide have been approved by Norwegian Social Science Data Services (NSD) (appendix 5). In the guarantee of confidentiality (appendix 2 & 4) I informed the interviewees about their anonymity, that I would be recording the interview and about who would have access to the recordings, that when the report has been handed in the recording will be deleted, that they could at any time during or after the interview withdraw from the study and how they could go about doing this and that the study have been approved by the NSD in Norway. I signed the guarantee of confidentiality and the interviewees kept that form. The informed consent

form (appendix 1 & 3) was signed by the interviewees to consent that they had received information about the formalities of the study and the interview and to consent that the information they gave me could be used in this study.

As described in section 5.2.1, the structure of the interview shows the power relationship between the interviewer and interviewee. Johannessen et al. (2010) write that where the interview is held is a factor and the best thing to do is to find a place where the interviewee can feel comfortable about the interview situation. In both countries, all my interviews were held at the schools where the students study. In Norway this was because the interviews were done during the school day. In England the time and place of the interviews were set by the students' mathematics teacher. As briefly described in section 5.4.2, one needs a CRB check in England to be allowed to interview students alone without supervisors (Disclosure and Barring Service, 2013), therefore my supervisor was in the room during four of the interviews and my supervisor's contact at the school was in the room during two interviews. It was only me and the interviewee who talked during the recorded interview. That other people who the students did not know were in the same room as us might have affected the interviewees, but I don't know to what extent or if they thought about it at all. This might have altered what the students said and it made the interviews less private than the interviews in Norway, and it changed the circumstances and the experience of the interview radically for me.

How the interviewee perceives or understand the interviewer is something Johannessen et al. (2010, p. 143, my translation) calls the 'interview effect'. This can be things like the age and sex of the interviewer, the clothes the interviewer wears, the self-confidence and extent of interviewing experience. The age difference between me and the interviewees was only 7 years, so I might have been perceived as young to them, or conversely old. In Norway many of the students knew that I was a student myself and some of them, like Mathias, responded to this in the interview.

Because I wanted the interviewees to feel comfortable about the recording of the interview, I never recorded our conversation about the information and different forms needed to be signed. In every interview I used two recording devices to make sure that at least one of them was working. I informed the interviewees about this and that I therefore would not be taking notes during the interview. Another reason for choosing not to take notes during the interviews was that it would let me focus more closely on what the interviewees were telling

me. This was especially important in England where the interviews were done in English because this is not my first language (see section 5.2.1).

5.6 Analytical framework

5.6.1 Approach to analysis

In chapter 3, I placed my study within the sociocultural theoretical tradition and my research questions are

> *What cultural differences and similarities are visible in English and Norwegian students' accounts of choosing mathematics?*
>
> - *What cultural models of gender and education do they draw on?*
> - *How do they self-author as mathematics students?*

These questions draw on theory from Gee (2012), Bakhtin (1981, 1986) and Sfard and Prusak (2005a, 2005b) as presented in chapter 3. Because these theorists talk about narratives, identities, cultural models and discourses, I have chosen to call my analysis a discourse analysis. Winther Jørgensen and Phillips (1999) write that discourse analysis fits with sociocultural theory and can be useful to analyse communication in different social settings; through the use of discourse one is always reminded that language and utterances are never neutral. In this study I am interpreting the subjective expressions of who the students are and how they draw on different cultural models to self-author as students of mathematics, and how these stories are potentially different between the two groups of students. Therefore, I will call my analysis a discourse analysis.

5.6.2 Narratives as carriers of ideology

Interviews about subject choices position the interviewer and the interviewee in a specific context and in this context accounts of subject choices are produced through communication. Bakhtin was a literary theorist interested in how literature enters our world and enters our accounts of ourselves (1981, 1986). Braathe (2011), drawing on Bakhtin, states that we communicate through the use of utterances and he defines utterances as 'any sufficiently closed use of sign that makes sense' (2011, p. 6). Further he writes that 'utterances are produced and interpreted in relation to expectations of genres, i.e. contexts that help us understand the utterance. Genres are ideological, i.e. they give tacit premises for the participants' positioning in the communication. […] Ideology is […] something we think

from, not on. Genres are therefore carriers of ideology' (Braathe, 2011, p. 6, italics in original) and therefore utterances are also carriers of ideology. Ongstad (2006) writes about how there are three aspects to the utterance's positioning: one expressive, connecting the utterance to the utterer; one referential, connecting the utterance to the world; and one addressing which connects the utterance to others or to the recipient of the utterance. These aspects are also connected to the genre or context where the utterance is uttered. 'Positioning becomes both a process (-ing) and a product (position-s) where the utterers position themselves, the world and the others semiotically by the utterance' (Braathe, 2011, p. 7). The positioning gives meaning to the utterance (Braathe, 2011). The narratives of subject choices in my interviews draw on expectations of the specific interview context and they also draw on ideologies of for example education, because the topic is very much centered around the students experiences and understanding of school and subjects. Through understanding utterances as this, the students' identities can be described as something they do through communication.

5.6.3 Studying narratives as identifying stories

Identifying stories can be understood differently by different people, they can be told differently, and they can also be contradictory. Sfard and Prusak (2005b) emphasize that this depends on who is telling the story, who the story is for and who the story is identifying, and that 'every identifying story may be represented by a triple ${}_{B}A_{C}$, where A is the identified person, B is the author, and C is the recipient' (2005b, p. 17). Different types of triples can tell us about the relationship between the identified person, the author and the recipient and about the different identities of an individual.

- ${}_{A}A_{C}$: a story told by the identified person called A's *first-person* identity (1st P)
- ${}_{B}A_{A}$: a story told to its main character called *second-person* identity (2nd P)
- ${}_{B}A_{C}$: a story told by a third party to a third party called *third-person identity* (3rd P).

(Sfard and Prusak, 2005b, p. 17, italics in original)

During my interviews the identifying story had the triple of ${}_{A}A_{C}$ – 'an identifying story told by the identified person herself' (Sfard & Prusak, 2005b, p. 17) to a third part. The identifying stories the students told me are reifying through the words they used, they are endorsed through that this is what the interviewee choose to tell as the truth about their relationship with mathematics and they are significant because '[the stories] imply one's membership in, or exclusions from, various communities' (Sfard & Prusak, 2005b, p. 17). The stories told to

me as a researcher will be *stories about stories* (Sfard & Prusak, 2005b), which means that I as the researcher will be retelling the narratives told to me as a researcher of interviewees about themselves to you as a reader of this report.

Sfard and Prusak (2005b) define identities as collections of stories about people that include stories which are *reifying*, *endorsable* and *significant*. Reifying narratives have the quality of 'turning properties of actions into properties of actors' (Sfard & Prusak, 2005b, p. 16) through 'is-sentences' with verbs like be, have and can and adverbs like always, regularly and usually etc. The most important feature of the reifying narratives for my research is that these sentences or narratives 'freeze the picture' and give me a glimpse of who the interviewees are at exactly that moment. As mentioned in section 3.3, it gives me the chance 'to overcome the fluidity of change' (Sfard & Prusak, 2005b, p. 16) in people in relation to themselves, other people and the world, and pinpoint something through the narratives of repeating actions. Endorsable narratives are stories that come across as mirroring the truth and a significant narrative is one of emotional importance (Sfard & Prusak, 2005a, 2005b). In relation to the stories from students, endorsable narratives are those that mirror the 'truth' about how the students see him/herself as for example good at mathematics through stories from his/her teacher and through being predicted good grades. A significant narrative would be one told by for example significant others such as parents and that includes or excludes the identified person within or outside of a community.

Because identities are constructed in discourse, and because they can be understood as narratives, I can access the identities of the students in my study and investigate them as they were told to me at the time of the interviews. In my analysis, I have looked at the students' accounts of choosing mathematics in terms of stories about their actual and designated identities, and I have identified cultural models of gender and education which they draw on. I have also identified discourses of what mathematics is and discourses of ability, equality and competition in their stories. In the analysis, I have focused on how the students position themselves and others and are positioned by the social practices they participate in and the discourses and cultural models they draw on. The focus has also been on showing how the students' answers increase in complexity from initial and seemingly rational answers of why they have chosen mathematics, to more complex stories revealing prevalent and sometimes contradicting discourses and influence from cultural models and significant others.

5.7 Validity and reliability

Validity concerns the extent to which we can say that we are studying what we intend to study or claim we are studying, while reliability concerns the accuracy of the data and results (Johannessen et al., 2010; Mason, 2002). Reliability and validity are connected to each other and feed off each other.

5.7.1 Reliability

In quantitative research the reliability of a study is more critical than in a qualitative study. Johannessen et al. (2010) states three reasons for this; first of all it is the conversation in the interview rather than the technique of data collection which determines what type of data the researcher gets. The second reason is that data in a qualitative research study is dependent on the context and that means that it is very difficult for another researcher to 'retest' the data and the study. The last reason is that in a qualitative research study, the researcher uses himself/herself as an instrument in the process of collecting, analyzing and interpreting the data, and since every person is different with different background, no one else can interpret in the exact same way. To strengthen the reliability of a qualitative research study, the researcher needs to describe the process before, in and after the interview in detail (Johannessen et al., 2010). Through the detailed description of the context, theory and method in this and the previous chapters, I hope to have strengthened the reliability of my study.

5.7.2 Validity

To be able to talk about the validity of this study, I want to return to my research questions because validity is about whether or not the researcher studies what he/she says he/she is studying.

> *What cultural differences and similarities are visible in English and Norwegian students' accounts of choosing mathematics?*

- *What cultural models of gender and education do they draw on?*
- *How do they self-author as mathematics students?*

Throughout my analysis, I have been looking at how the students draw on cultural models and prevalent discourses, and I have noticed the differences and similarities between how the individual students and the two groups use, position themselves in relation to, are positioned by, juggle and work the discourses and draw on cultural models. Also, because I understand narratives as identities and because all the individual stories the individual student told me

were interconnected, I have focused most of my analysis on telling the 'full' story of individual students with focus on different issues or themes in their stories. In this way, I have tried to ensure that my study and results are valid.

Validity can also be about how generalizable the results are and how the result can be 'transferred' to other studies (Johannessen et al., 2010). The number of participants in my research is not large enough for generalizing anything from the study or results, and this is not the intention of my study either. Because I use sociocultural theories on identity (see chapter 3) and understand identities as narratives, it is not possible to say for certain that the same result can be achieved with other students or other researchers later. However, by explaining my study thoroughly in this report and, for example, giving the quotes from the Norwegian students in both the original and my translation into English throughout the analysis, it can be possible for readers of this report to evaluate my results in relation to my data and the theory which I have used.

6.0 Analysis: Stories of increasing complexity

In this analysis, I will answer my research questions through interpreting and retelling the stories the students I interviewed told me. I will be both cutting across the stories to show diversity and uniformity between the students and between the two groups, and looking within individual stories with a focus on different themes to show how they self-author as students of mathematics. My research questions are:

> *What cultural differences and similarities are visible in English and Norwegian students' accounts of choosing mathematics?*
>
> - *What cultural models of gender and education do they draw on?*
> - *How do they self-author as mathematics students?*

The stories the students tell reveals stories about identity, about assumptions of what mathematics and ability is, about other people, about gender and about competing discourses and contradictions. Through interpreting and retelling the students' stories with a focus on these multiple themes and issues, I will show how choice cannot be seen as separate from these issues, but rather as interconnected, highly dependent on, and very much influenced by them. This connectedness takes us almost to the point where we can ask whether there is a choice at all, because in many ways students make choices in a very constrained set of circumstances, and what they see as a choice is, rather, a product of a negotiation with, and navigation through, different discourses.

First, I will present a meta-story of the students' first responses to the question of why they chose mathematics, these responses were very much the same for both groups of students. Through this initial, more literal, analysis, I will show that asking further questions and looking beneath the surface of their first 'easy' answers, reveals a more complex story of the students' choice. In the subsequent sections, I will take a closer look at how different issues are included in accounts of choice, and how they make the stories of choice more complex. In each section, I have chosen stories which illustrate these different issues related to choice.

6.1 Why choose mathematics: a meta-story

One of the first questions I asked in the interviews was why the students had chosen to continue with mathematics post-compulsory. At first, they told a simple story of 'it's a good thing for the future' and 'I like it'. These answers seem straightforward, sensible and very rational, but as the interviews progressed, and raised issues of family and friends, more complex stories emerged. Things started to unfold as I probed the students for more answers which showed that choice is more complicated than those first easy stories. The students drew on particular discourses of, for example, what mathematics is and what sort of person studies mathematics, and their stories began to show that actually choice is not just a question of 'I'm doing this because it's good for my career' but 'I'm doing this because of the person I am'.

6.1.1 Choosing for the future

Many of the students talked in terms of what they were going to do next when I asked them why they had chosen mathematics. This can be understood as a type of easy or superficial reason for choosing mathematics, because they might want to give the answer which they think I want to hear or because they want their choice to be rational. It could also be because they are well rehearsed reasons which dominate in school discussion and in family too. For Louise, Mathias and Camilla, choosing mathematics was important because they knew what they wanted to study after upper secondary school. For example, Mathias said that he wants to study engineering at NTNU, and he has based his subject choices on this:

> *Mathias: yes, well you need that – I think you have to have R1, R2 and physics 1, and then you also have to have chemistry 1 I think, and so I just chose – I think those are the subjects that are required, and so I just chose them.*[1]

Other Norwegian students, including Bjarne, said that they had chosen mathematics to keep all the doors open to further education because they did not know what they wanted to do after upper secondary school:

> *Bjarne: first and foremost because it opens so many doors – I'm not really certain of what I want to do in the future – but then again I don't lose anything on it – I stand – I stand strongly and it is a very good experience and you learn very much*[2]

[1] Mathias: ja, altså du må ha den der – jeg tror du må ha R1, R2 og fysikk 1, og så må du ha kjemi 1 tror jeg, og så jeg bare valgte – jeg tror det er de fagene som kreves da, og så bare valgte jeg det.
[2] Bjarne: først og fremst fordi det åpner såpass mange dører – jeg er ikke helt sikker på hva jeg vil fremover – men allikevel så taper jeg jo ikke noe på det – jeg står jo – jeg stiller jo sterkt og det er veldig god erfaring og man lærer utrolig mye.

Mathias tells an identifying story of how he sees himself in the future, describing a designated identity (Sfard & Prusak, 2005a, 2005b) as an engineer, and Bjarne invests in a discourse of education where mathematics provides more opportunities in the future than choosing other subjects. Some of the students commented that they thought students choose mathematics because they think they will need it later on in life:

> *Sara: I think most choose mathematics because they think they might need it when it comes to higher education, and it gives points – and then mathematics is quite important, so.*[3]

Like the Norwegian students, the English students also talked about choosing mathematics in relation to the future. Kevin, Emily, Tarik and Annie say that students simply choose mathematics as part of their sixth form studies, but Kaitlin and Ravi talked about how some might choose mathematics because they know they will need it for further education, as they have done.

> *Ravi: I reckon a lot of people will pick it because of what they can do at university later.*

Kaitlin is more extreme than the other students. She tells a similar story about the future, but describes her 'choice' in more extreme terms than the other students. She wants to study medicine, and she describes her choice of studying mathematics as not a choice at all. Kaitlin's story about the future, about her designated identity, describes a future which is binding, and it almost 'forces' her to choose mathematics:

> *Kaitlin: yeah, yeah I think, yeah. I think for me, because maths is all about the course of getting into university, I enjoy it as well, but it really feels like that's fine there, and then in the maths lessons, I'm enjoying them, but I'm in them to get the grades, and to get the results – and so that's my goal overall, and it's not just a direction to be going in, but it's the purpose – it's the purpose of studying maths is to do well on these exams.*

[3] Sara: jeg tror de fleste har valgt det fordi at de tror de kan trenge det når det gjelder studier, og så gir det poeng – og så er matte ganske viktig, så.

6.1.2 Choosing mathematics 'because I like it'

The students also drew on stories about the intrinsic qualities of doing mathematics to explain their choice. This included stories about enjoying, liking, being good at and being interested in mathematics and how this eliminated other subjects. Mathias said that as a mathematics student you have to be stubborn and not give up too soon, reflecting an image of mathematics students as different from students who choose other subjects:

> *Mathias: so I would say that it has to do with interest in doing it, and maybe it has to do with how willing you are to not give up, how stubborn you are, because those who don't do it, they might have given up too soon, and don't care to try, or they are not interested in it. And those who choose it are interested in it.*[4]

Camilla approached the question about who chooses and who does not choose to continue with mathematics in slightly a different way. She related it more to being good at mathematics or not: if you don't need mathematics for your future choices, then why should you choose to continue with it when you're not good at it? In arguing this way, she also draws on a natural ability discourse:

> *Camilla: I think both because either you don't need it and want to study a different subject that you might have more use for, or because people have different ability for mathematics […]. So I think people have different abilities in it, and some can't do it and some can do it. That's the way it is in all subjects. So I understand why they don't want to continue with it, and especially if you don't need it, then it's not necessary.*[5]

Cecilie also reflects this view of how it is natural to choose a subject on the basis of being good at it or not, and if it is needed for higher education, but she also adds in a reference to a prevalent view (which she says she does not agree with) of mathematics as difficult subject:

> *Cecilie: it might be a lot about if you master it, and you do see that those who haven't been very good at mathematics also don't choose it, and that seems quite natural. In addition it seems maybe – maybe many think that mathematics is really hard, at least*

[4] Mathias: altså jeg vil si at det har med interesse å gjøre da, og kanskje det med hvor villig man er til å ikke gi opp da, hvor sta du er, fordi de som ikke gjør det, de har kanskje gitt opp for tidlig, og ikke gidde å prøve, eller så er de rett og slett ikke interesserte i det. Og de som velger det er jo interesserte i det.

[5] Camilla: jeg tror både fordi enten så trenger man det ikke og har lyst til å gå et annet fag som man kanskje har mer bruk for, eller fordi folk har forskjellige forståelse for matte […] så tror jeg liksom folk har helt forskjellig forståelse for det, og noen klarer det ikke og noen klarer det liksom. Sånn er det jo i alle fag. Og da har jeg jo forståelse for at de ikke har lyst til å fortsette med det, og spesielt hvis de ikke trenger det også, så er det ikke noe nødvendig for det.

in year 13, that it's a bit intimidating. That maybe they think that the level is raised a lot, but it is actually not, it's not a big leap.[6]

All of the English students, except perhaps Kaitlin, said that they had chosen to continue with mathematics because they like it and they enjoy working with it. Tarik says that he has always been at the top of the class throughout high school, and talked about how he should continue with something which he is good at, and he wants to study medicine:

Tarik: well, I was really – I don't know – I've always like really enjoyed maths and was good at maths. I feel like – I was always at the top of the class throughout high school, and I thought you need to carry on to A levels, and I mean to study medicine so a science subject like maths would be quite helpful, but not like required but I just choose it because I knew that I liked it and I knew that I would do OK in it.

Emily and Annie talked about how they had always liked mathematics from when they were little, but that they also enjoy the challenges they meet through it. They have both chosen to study single mathematics and further mathematics in order to be challenged even more, they say. Emily expresses her love for mathematics throughout the interview. She wants to be a chemical engineer, while Annie wants to take a university degree in mathematics:

Emily: I have always enjoyed it from when I was a little kid, and it's always just been fun, […] and then as it got harder, I sort of liked the challenge. Say it was another subject, I find it hard and like I don't want to do that, maths I just genuinely love it.
Annie: I think, I got like obviously most people have always like who study maths now have always enjoyed it.

6.1.3 Summary

All the reasons the students give for choosing mathematics are connected to each other and to each individual student's story of choice. Underneath the stories, however, it is possible to discern further stories about what is important in that student's choice. Beyond the straightforward stories told by both groups that choice is based on enjoyment and interest, there are hints that choosing mathematics is a part of what defines the 'good' student who is, for example, hardworking and always ready to take on challenges. Educational ideologies of early or late specialization are also part of their stories in terms of how they depict the future.

[6] Cecilie: det handler vel mye om man mestrer det, og man ser jo at de som ikke har vært så gode i matte også ikke velger det videre, og det virker jo ganske naturlig da. I tillegg så virker det kanskje som at – kanskje mange tror at matte er veldig vanskelig da, men det er på en måte like jevnt som tidligere, det er ikke sånn kjempe hopp heller.

As I will show, significant others as parents, friends and teachers are also included in the student's stories, for some students, their inclusion raises questions about how far the students are really making their own choice, or if their parents have made it for them. Further, references to ability discourses in mathematics and discourses about mathematics are very much connected to their school situation and family's situation. Through all of these stories the students position themselves and others, draw on cultural models and the ideas and discourses surrounding them as they self-author their identities.

In the following sections of this chapter, I will return to many of these stories of choice, focusing on individual students' accounts of choosing mathematics to illustrate particular aspects. As I have tried to show through this meta-story of the students' accounts of choosing mathematics, the students and their stories cannot be separated or divided into pieces.

6.2 A story of choice: portraying rational choice

At first glance, the students' stories portray continuing with mathematics as a clearly rational choice. However, as the interviews went on, the stories increased in complexity as it became apparent that the students drew on discourses of mathematics, ability and gender.

Emily appears to have an unproblematic relationship with various discourses about mathematics. She subscribes to the idea of natural ability in mathematics, and that ability grouping works as motivation for all students, regardless of ability. Apparently influenced by the educational ideology in England, and also discourses about mathematics, she invests in these discourses and uses them to advantage in her story. Emily rejects discourses about gender. She can be seen as a stereotypical student of mathematics who chooses it for all the 'right' reasons. However, when unpacking Emily's story further we can start to ask questions, because the issues around choice which she introduces, including family, gender and ability return in other interviews, but sometimes in forms that makes those issues seem problematic rather than unproblematic.

Emily

Emily tells a story of how she sees her choice of continuing with mathematics as very natural because she has always been good at it, and because she has always been good at it, she has worked harder on it and therefore been 'consistently' good at mathematics. Emily buys into discourses of ability in mathematics as a natural talent. She makes that discourse work for her as a student who is good at mathematics:

Me: When did you realize that you were good at maths?

Emily: I don't want to sound big headed, but ever since I was a little kid – the thing is when you like something, you put more work into it – so I've always been consistently good at maths, so yeah

Emily loves mathematics and everything about it, especially how it challenges her to work hard and use all her knowledge. She says that mathematics is '*Lots of numbers having fun*'. Emily also likes the idea of the definite nature of mathematics, and she explains her choice of dropping biology and wanting to study chemical engineering in terms of how it allows her to do her own work, instead of repeating other people's work:

Emily: […] I decided to go for maths because I genuinely enjoyed maths and I don't find it hard enough, and I wanted to do further maths cause it would help me with engineering, cause that's what I'm applying for. And I didn't like memorizing stuff so much, so that's why I dropped biology, and I quite like thinking on the spot and doing problems, that's why I chose maths.

Emily: you learn maths, you can't really memorize it cause it's more of understanding what you're doing and then being able to use it again and again throughout the whole course, rather than actually memorizing – I did psychology for GCSE, we basically had to memorize some guys study, what he did, and write about what he did, what he found out and how it was used. I'd much rather do that myself – I'd much rather be the guy who did the study, and do all the stuff by myself and figure something out, rather than learning about the person who did it

Me: and maths enables you to do that?

Emily: yeah

Emily has a very strong wish to be the best, and through this wish she reflects the important discourses of ability and competition of the dominant educational ideology in England. Emily is a 'winner' in her participation in school. In both Norway and England, choosing mathematics is seen as a good choice for the future, and mathematics works as a marker of cleverness for those who choose it. This works for Emily and the story of her choice, since choosing mathematics 'marks her as clever', as part of a rational choice story in which she can believe that she can be the best, this not unreasonable. Emily says that she believes that

the practice of ability grouping and grade prediction will motivate all students to work harder and get better grades:

> *Emily: I think it's a really good system, because people lower down in the set, they'd sort of get annoyed that they weren't higher up, so that's made some of the people work harder, and people in the top set would think I'm good enough, so I can work harder – so I really like that system*
> *Int: so it kind of motivates everyone?*
> *Emily: yeah*

Emily is predicted A for chemistry and further mathematics and A* for mathematics, and she says that being predicted an A motivates her to work hard, beat those As and aim for an A* in all three subjects. Emily says that '*you could be naturally good at maths, but only so far, you'd have to work for it – so practice makes perfect really*', and she works hard every day to be the best:

> *Emily: it's sort of – it puts everything together for me, it's like putting the jigsaw together. You solve problems in maths, it's sort of I don't know, it just sort of helps with life in a way, it sounds really weird, but you're constantly solving problems, when the problem gets harder, and you know you have to solve it, it like, it sort of gives you that confidence to solve any problem, cause not everyone can solve the hardest problem*

Emily talked about how her family likes mathematics, and that both her parents and her sisters encourage her in her choice of studying chemical engineering:

> *Int: How does it feel to have all this support?*
>
> *Emily: it's motivating I'd say, cause sometimes when you do some work, cause they know it's not the easiest thing ever, and it gets hard and you think "you know what? There's so many people believing in you, man I'm gonna do it for them". So it helps.*

She tells the story of how, before going in to take her mathematics GCSE, Emily's teacher told her to remember that '*graphs make you happy*', and Emily has kept this with her since then. Emily tells me that whenever she tells this to her friends, they say that she is a 'weirdo' and that she is 'crazily in love' with mathematics. When I ask her about women and mathematics, Emily says that everyone keeps saying that there is a difference between girls

and boys, but she doesn't think that there is, and by saying this she rejects gender discourses about stereotypes:

> *Emily: I'd say - before it was sort of like the media, and people just generally like "oh, girls are more into that textilesy stuff, English, talk about their feelings", "guys are more logical thinking, just doing maths, science", I wouldn't say that stereotype exists anymore, cause I don't see it as much, it's sort of equal opportunity, if a girl does maths it's like "yeah, cool", if a guy's gonna do English, it's "yeah, cool". No one really does any sort of stereotyping anymore.*

Summing up Emily's story

Emily's story is a simple one, and it seems as though she invests in various discourses surrounding her, which work to underline her own advantageous position in mathematics, and the possibility that she might improve still further. But Emily's use of discourses of gender, ability and competition, and her positive account of the influence of teachers and parents draw attention to issues which are not problematic for Emily, but might be for many of the other students, indicating the potential for further are complexities in the students' stories of choice.

6.3 Significant others: circulating stories and powerful voices

In section 2.2.1, I wrote about significant others as those people who mean something special to an individual and how we may mirror ourselves in the responses significant people give us. Significant others such as parents, teachers and close friends have powerful voices that can influence our choices (Israel, 1973) and our narratives of choice. Sfard and Prusak (2005b) write about the positioning power of the stories which are told by significant others, and how we 'capture' these narratives and include them in our identities because they are told by people with authority and power such as parents, teachers and close friends. Further, we use the words of others to describe ourselves to ourselves and to others; the stories the students tell include words and stories told by others. Sfard and Prusak (2005b) describe how stories circulate in a process of 'narrative diffusion', taking on a life of their own once they are told, extending beyond the original telling so that eventually they are separated from the original authors. The longer a story is connected to a person's identity, the deeper it gets and thus it gets harder to change.

Many of the students, in both Norway and in England, talked about their parents, their friends and their teachers. Most of the Norwegian students talked explicitly about how their parents

influenced their choice of continuing with mathematics while only one of the English students, Kaitlin, discussed the influence of significant others on her choice as clearly. However, some of the English students' stories implied that they came from 'mathy' families or that it was in their family's 'nature' to choose natural sciences and mathematics. Most 'claimed' that despite this it was their own choice to continue with mathematics: they based their choice, they said, on interest or that they had always been good at mathematics, rather than that their parents had advised them to continue with mathematics. One of the Norwegian students, Rune, said that his parents had influenced him and his story is the focus in this section. He tells a story in which the influence of significant others in the shape of his parents and sisters are very important; this raises issue about the complexity of choice, and whether or not Rune or his parents have made his choice of continuing with mathematics post-compulsory. Rune seems to be very focused on how he is positioned and how he positions himself in respect to other people who are very important to him.

Rune

Rune said that he chose his subjects to keep all the doors open to higher education, and he chose them because he wanted a challenge and wants to be good at it. But mathematics is not his favorite subject:

> *Rune: […] mathematics is ok – it is a bit more, it is something that I focus on – something which I will be happy that I got through, and something that will be good for me, so it's a bit more – a bit more medicine, if you understand what I mean, a bit more something that I have to get through. […] mathematics R2 is something I feel I will need – it might not be the most entertaining subject, but I will need it and it is probably important that I can do it […]*[7]

As his story continues, Rune starts to disclose various things about why he is doing mathematics, which suggests a much greater complexity about the situation. His portrayal of mathematics as an (unpleasant) medicine which he just has to take might suggest something about the importance for him of choosing 'realfag'[8] in contrast to other subjects which can be waste of time. Rune's choice of words here is very telling of his relationship with mathematics, indicating that mathematics is just something he has to get through, but what

[7] Rune: […]matematikk er greit – det er litt mer, det er noe jeg fokuserer på – noe som jeg kommer til å være glad for at jeg kom gjennom, og noe som jeg har godt av, så det er litt mer medisin, hvis du skjønner hva jeg mener, litt mer en ting jeg må gjennom […] matematikk R2 er noe jeg føler at jeg kommer til å ha bruk for – det er kanskje ikke det morsomste faget, men jeg får bruk for det, og det er viktig at jeg kan det sannsynligvis […]

[8] 'Realfag' in Norwegian refers to the subject mathematics, natural science, physics, chemistry, ICT, geo-subjects and biology

comes next in his story indicates that he is not just being instrumental and thinking about the future; he goes on to talk about the power and influence of his parents:

> *Rune: I think that many choose it with influence from parents – I would say that I am one of them […]*[9]
> *Rune: it is my choice; of course it is from influence of parents and so on, since they have always said that it is important to have mathematics and so on […]*[10]
> *Rune: […] so for them I can be anything I want, at least they say so. But they have been very clear on that I should, that they think that I should keep all the options open, so that I can become anything I want, that mathematics and other things won't limit me. […]*[11]

From this point of view, when thinking about choice, one can ask in what sense is Rune really choosing mathematics or is the choice made for him by his parents? In the quote above, Rune says that his parents have claimed that it is his choice, but he tells us that it is not his choice. Despite this, and despite his view that mathematics is medicine, Rune goes on to justify his choice by saying that it is an important subject internationally, gives facts about the world, widens one's perspective, and is exciting:

> *Rune: I feel that mathematics give you hard facts, gives you a little – at the same time it gives you perspectives on things […] and well it gives you a bit more understanding – so I actually think mathematics – mathematics is pretty exciting*[12]

Rune talked about how mathematics is important in everyday life, and how having a good understanding of mathematics can help you when you move out from your parent's house:

> *Rune: well, you meet it all over, […] when you move out from home it becomes very important, when you're going to do your taxes or you're going to buy an apartment and all of that, so it's very important to have mathematical understanding.* [13]

[9] Rune: jeg tror mange velger det med påvirkning fra forelde – jeg vil jo si at jeg er vel en av de hovedsakelig […]
[10] Rune: det er mine valg, selvfølgelig er det fra påvirkning fra foreldre og så videre, siden de har alltid sagt at det er viktig å ha matematikk og så videre […]
[11] Rune: altså for dem kan jeg bli det meste jeg vil, i alle fall det sier de. Men at de er veldig klar på at jeg burde, at de har lyst til at jeg skal ha alle muligheter åpne, sånn at jeg kan bli hva jeg vil, at ikke matte eller andre ting skal begrense meg […]
[12] Rune: jeg føler at matte gir deg litt harde fakta, gir deg litt – samtidig gir deg litt perspektiv på ting […] og så gir det deg litt mer forståelse – så jeg syns egentlig at matte – matte er ganske spennende
[13] Rune: altså du støter jo på det over alt, […] gjerne når du flytter hjemmefra blir det jo veldig viktig, når du skal drive å sette opp selvangivelse eller skal kjøpe leilighet eller alt mulig sånt, så er det viktig å ha matematisk forståelse

These arguments that Rune uses can be seen as very weak arguments, because for example a high level of mathematics is not really necessary to complete a tax form or buy an apartment. One interpretation is that Rune is telling these stories as self-protection or justification for choosing a subject which he does not like, because maybe his choice is not really his choice. Rune has a twin sister, and she is good at mathematics and they study it together. They also have a younger sister:

> *Rune: She does better than me, and she is getting 6 now, and yes she does well. She has also had very good teachers, and so she worked – she has worked a bit with me and my twin sister, well like sitting beside us when we have worked, and we have helped her a bit, so I think she has a very good relationship with mathematics, and she has very good understanding.*[14]

It is almost like the stories he tells about his sisters being good at mathematics, makes him also want to be good at it. Maybe Rune is competing with his sisters? He says that his twin sister is better at other things in mathematics than he is.

Summing up Rune's story

Rune's parents and his sisters appear to play a very powerful part in his story of choice, and it is almost as though their stories of him about his future and his abilities in mathematics conceal who he really thinks he is. Rune clearly states that he is influenced by his parents; while he says that he has chosen mathematics because it opens many doors to further education, and that it's a smart choice, we can argue that underneath his parents' voices shine through. Rune is maybe trying to be the person his parents wants him to be, except that maybe he doesn't really want to be that person.

6.4 Investment in identities and self-positioning: who am I?

When the students talked about their choice of mathematics and described themselves as students of mathematics, they positioned themselves and others through their stories, drawing, consciously or sub-consciously on cultural models of gender and education, and discourses about mathematics. In section 3.5, I wrote about how Gee defines cultural models:

[14] Hun får det til bedre enn meg, og hun ligger på en 6'er nå, og ja, hun får det til bra. Hun har også hatt veldig mye gode lærere, og så jobber hun – hun har jobbet litt sammen med meg og sammen med min tvillingsøster, ja altså bare vært ved siden av oss mens vi har arbeidet, og vi har hjulpet henne litt, så jeg tror hun har fått et ganske godt forhold til matten, og hun har veldig god forståelse

> ‘A cultural model or figured world is a picture of a simplified world that captures what is taken to be typical or normal. What is taken to be typical or normal, of course, varies by context and by people’s social and cultural group […].’
>
> (Gee, 2012, p. 99)

The students from both countries drew on different cultural models to position themselves. While both groups of students drew on almost the same discourses of mathematics as definite, they related to their educational systems differently, reflecting the different educational systems and ideologies in their countries. The Norwegian students were very careful when they talked about differences because equality in choice and opportunities is very important in the Norwegian educational ethos. In contrast, the educational discourses of ability and competition are very evident in the English students’ stories. The students I interviewed were ‘winners’ in their school system, having almost always been in the top sets in mathematics, positioned in the school system as good at mathematics on the basis of receiving good grades with opportunities to study mathematics further.

This section on how the students invest in particular identities and self-position is divided into three. In the two last sub-sections, I will explore how the students position themselves within the discourses of gender and ability, and through ‘othering’. I will come back to this, but first, I will focus on Ruben’s story about how his teacher’s encouragement motivated him to continue with mathematics. He uses his teacher’s words to justify who he is and who he wants to be: his actual and designated identity. In contrast to Rune’s story above, Ruben’s story about his teacher’s influence is much more positive, expressing a kind of affirmation through his teacher about who he is. Ruben talks about this significant other – his teacher - in a different kind of way from Rune who we can see as trying to be the person his parents want him to be, but as reluctant to be that person. Ruben’s story is that he has changed who he wants to be because of some kind of inspiration or motivation from a teacher. His response to his teacher and what that teacher has done is the focus of Ruben’s storying of self.

Ruben

Ruben says that he has always been good at mathematics, always understood it well, but was bored of it before he met his current teacher who encouraged him to continue with mathematics and told him about what he could use it for. Ruben talked about how his teacher affected him in wanting to continue with mathematics post-compulsory, and this has led to

him wanting to continue studying mathematics and physics. Rubens identity as good at mathematics is deeply rooted in stories of his abilities which have circulated for many years, but perhaps his designated identity has changed as a result of his teacher's advice that he should continue with mathematics.

> *Ruben: I have always liked mathematics because I've understood it since I was little, so in primary school, I had mathematics with the year above me the last three four years of primary school. And I liked it more and more, and then I started – but then I wasn't – after high school I wasn't so motivated for mathematics – I was looking forward to taking the easy mathematics and get it over with, but then I chose 1T just so that I wouldn't close any doors, and then that went really well, so I thought that I should choose R1 just to not close any doors, and then we had XX as a teacher, and he was the coolest and best teacher I've ever had. So it was really him that got me to continue with mathematics and work hard on it, and also choose physics. I didn't really choose physics in year 12, so I – I switched over to it pretty fast, and it is probably him that have made me want to continue with studying mathematics further.* [15]

Ruben gets 6 in mathematics now. He talked about how mathematics is fun and difficult, and how he was fascinated by everything that mathematicians have figured out before him. He has sometimes thought about whether he could 'invent' something in mathematics, but he's not sure if he can:

> *Me: do you think you can figure something out?*
> *Ruben: no, I've thought about it a lot – maybe*

The discovery of mathematics that Ruben talks about is similar to how other students talked about mathematics as a source of feeling smart and intellectual when mastered, drawing on an idea about being good at mathematics as a marker of cleverness. It appears that mastering a difficult task confirms Ruben's identity as a student who is good at mathematics: he rejects the stereotype of a nerd with no social life, maintaining that a mathematician is simply someone who is good at mathematics, creative and knowledgeable, with qualities such as

[15] Ruben: jeg har alltid likt matte for jeg har tatt det veldig greit helt fra jeg var liten, så på barneskolen så gikk jeg – hadde jeg matte med trinnet over, siste tre fire årene i hvert fall av barneskolen. Og jeg har likt det mer og mer, og så begynte jeg i – men så var jeg ikke – etter ungdomskolen så var jeg ikke så motivert for matte – jeg gledet meg til lissom å ta den litt enkle matte og bli ferdig med det, men så valgte jeg da 1T bare sånn for å ikke lukke noen dører, og så gikk det veldig bra, så tenkte jeg at jeg velger også R1 for å ikke lukke noen dører, og da hadde vi da Jan som lærer, og han er den kuleste og beste læreren jeg har hatt noen gang, så det er vel egentlig han som har fått meg til å da fortsette med matte og jobbe mye med det, og også velge fysikk – jeg valgte egentlig ikke fysikk i andre klasse, så jeg – men jeg byttet over til det ganske fort, og det er vel egentlig han som har gjort at jeg har lyst til å studere videre med matte også

being good at solving problems in everyday life. Ruben identifies with his own story about mathematicians:

> *Ruben: but what is a mathematician – I don't know – I guess in a way I am – I think it's fun and interesting and I like working with it*[16]

His teacher has told him what he can use mathematics for when it comes to higher education, and Ruben hypothesises about those who choose mathematics, including references to gender. He says that more boys choose mathematics and physics, but that some still choose traditionally, which might be rather gendered. Ruben thinks that many girls are concerned with getting a good degree from university, and that is why some girls choose mathematics. He said '*it's kind of their dream*'. But either way, if they are boys or girls, Ruben says that those who choose mathematics have ambitions for their future, and he is one of them. He draws on the idea that mathematics is important in society and that choosing mathematics is a secure choice and a clever choice:

> *Ruben: I think that there are more who chooses mathematics who know want they want to become and what they want to work with, at least within a certain area, a bit isolated area – I think those who don't choose mathematics, many of them have no clue – […] those who have mathematics are more focused on school, so they are more focused on what they want to do later […]*[17]

It seems as though Ruben uses his teacher's words about how choosing mathematics is important and that those who choose mathematics know where they are going in life, in contrast to those who do not. Ruben suggests that his friends who are not good at mathematics and who are not interested in it, might be jealous about how those who choose mathematics are so certain in what they want to study further:

> *Ruben: I think they, maybe they are jealous – that they say that they wished they were good at mathematics or had an interest in it – i think maybe they are a bit like – that maybe they are a bit nervous because they think that 'oh, they have mathematics, and they know what they want and they are probably going to get a good education' and*

[16] Ruben: men liksom hva er en matematiker – jeg vet ikke jeg – jo, jeg er vel på en måte det – jeg syns det er gøy og interessant og jeg liker å jobbe med det

[17] Ruben: jeg tror det er flere som velger matte, som vet hva de vil bli og jobbe med, hver fall innenfor et visst område, et litt avgrenset område – jeg tror de som velger bort matte, mange av de har null peiling – […] de som har matte da, er mer fokusert på skolen, så de har også da mer fokus på hva de har lyst til å gjøre senere […]

those kind of things, while they walk around and don't really know – and maybe that 'I have to pick up some subjects after school' – that they are maybe a bit jealous of that[18]

Ruben also relates these ideas to the requirement for mathematics in prestige occupations like medicine or engineering, placing himself in this group in the future. However he also says that there are a lot of higher education subjects which do not require mathematics, reflecting an equality discourse. Nevertheless, he projects a story of himself as someone with a prestigious education in the future.

Ruben: no, absolutely not! There is a lot of higher education that doesn't require mathematics at all, but those who you maybe think of as prestigious occupations such as doctor and maybe engineering and those things requires a lot of mathematics – but like my brother, he doesn't have any mathematics at all, but he has a bachelor in business administration[19]

Ruben appears very conscious of the desirability of not devaluing those who do not choose mathematics. Maybe that is because one of his brothers and his father have not studied mathematics, or maybe he is drawing on the Norwegian equality ideology. For example, he says that getting lower grades does not automatically make someone bad at mathematics, because maybe they understand more mathematics than those who are good at memorizing and cramming before tests:

Ruben: […] because there are many who cram a lot and knows the answers to the questions in the book, but they don't know why it's like that – so maybe there are many who sit there and maybe are on a 3 or 4 that can do those 'problemsolvings' better than many others[20]

He tells me that his current teacher doesn't only count the points students get on a test, but sees the overall situation of a student's knowledge and is tolerant if they have a bad day on a test and gives them extra chances to show what they know. His teacher wants to help all the students to do their best on every topic. This is clearly very important for Ruben, because he

[18] Ruben: jeg tror de, kanskje de er misunnelige – at de sier de skulle ønske de var gode i matte eller hadde interesse for det – tror jeg kanskje de blir litt mer sånn - at de kanskje er litt nervøse da for de tenker at «å de har matte, og de vet hva de vil og de kommer sikkert til å få en god utdannelse» og sånne ting, mens de selv går og ikke helt vet – og vet at kanskje jeg må ta opp noen fag etter skolen – at de kanskje er litt misunnelige på akkurat det da

[19] Ruben: nei, absolutt ikke! Det er mange utdannelser som ikke krever matte i det hele tatt, men de man kanskje tenker på som sånn prestisje yrker da som lege og kanskje ingeniør og sånne ting krever jo mye matte […] – sånn som mellomste broren min, han har ikke noen særlige mattefag i det hele tatt, men han har jo tatt en bachelor i business administration

[20] Ruben: For det er mange som er veldig puggehester og kan svaret på de oppgavene i boken, men de vet ikke hvorfor det blir sånn – så det er kanskje mange som sitter der og kanskje ligger på en 3'er eller 4'er som klarer de problemløsningene bedre enn mange andre

has chosen to continue with mathematics because of his teacher. There are stories about Ruben which affects how he tells the story of who he is as a mathematics student and why he has chosen mathematics, and his teacher's voice is very powerful in his story. The Norwegian educational ideology is also very evident in his story as a powerful discourse.

Summing up Ruben's story

Ruben's story is a very positive one focusing on how he gets some kind of affirmation through his teacher's words about who he is and who he wants to be: his actual and designated identity. The importance of the teacher lies in Ruben's appropriation of his teacher's words to justify who he is. It is his teacher show has told him what he can use mathematics for, and we can conjecture that this involves something about mathematics being important for society, for securing a good job, as leading to a good education and being generally useful. Ruben appears to believe all of this and draws on these ideas to underline the idea that choosing mathematics is important and that not to choose mathematics is not really making a good choice. The contribution of the teacher has been to give Ruben a direction resulting in him now telling a strong story about who he is and where he wants to go.

6.4.1 Who am I? Positioning within discourses of ability and gender

Stories about choice are part of how people identify in terms of doing mathematics, and this identification can be done in relation to ability and gender discourses. In my study, discourses of ability and gender are experienced and drawn on differently by the Norwegian and English students, who participate in different educational ideologies.

In Norway, the discourse of equality and equal opportunities for all students is very important, and this is reflected in the students' stories. At the same time that they draw on the discourse of mathematics as a marker of cleverness to position themselves as 'smart and intellectual', they also refer to concepts of equality. It appears as though they are influenced by both the equality discourse and the Law of Jante (see section 2.1.3) telling them that they are not 'allowed' to say that they are better than others. The students are very aware of and reflect on discourses about gender in relation to abilities in mathematics and traditional roles in society, but they always keep hold of the discourse of equality, trying not to devaluate those who do not choose mathematics.

In England, ability and competition in terms of comparison with others is central to school discourses, and all the students draw on them to position themselves. Almost all of the

English students said that they had always been good at mathematics, been placed in the top sets in high school, and were now getting good grades in mathematics. They are winners in the system, and they use the discourse of ability to position themselves in this way. Gender discourses, and responses to them, are not as clearly evident in the English students' stories as in the Norwegian students' stories. Some claim that they do not know anything about gender differences, while Emily rejects the concept, saying that 'nobody really does any type of stereotyping anymore'. It may be that the English students sometimes lack a language to talk about gender issues, and that more powerful discourses of ability and competition take over and perhaps bury gender issues.

In both groups of students, many work the discourses to their own advantage. In this section, I will tell the stories of three Norwegian students, Cecilie, Louise and Bjarne, and one English student, Tarik to illustrate how they draw on them in their positionings of self.

Cecilie

Discourses of gender and ability are clearly evident in Cecilie's story and her positioning of self. When asked about gender differences in mathematics, she draws on a discourse of boys being better at mathematics to hypothesise about male genius, building a story of herself as a girl who works hard, who is a role model for other students and who earns the good grades she gets:

> *Cecilie: when it comes to mathematics I think that those who are the very best are boys, for example, but those who are in a way – those who come next under that, who are very good are girls, and then it is those who are maybe a bit worse are boys. […]*
>
> *Me: why do you think boys are on the top and girls are in the middle?*
>
> *Cecilie: well, you can wonder about that – it is also there I feel the 'genius things' comes in, because it is often those who are the very best are in a way maybe also extremely good at very many things, just understands everything very easy, and I don't really have any explanation for why that is boys. That girls come in the middle has probably more to do with their work ethic – with working a lot with mathematics.*[21]

[21]Cecilie: når det kommer til matte så tror jeg på en måte at de aller aller beste ofte er gutter, for eksempel, men at de som på en måte er – de som kommer under der igjen da, som er ganske gode er jenter, og så er det de som kanskje er litt dårligere igjen er gutter. Int: hvorfor tror du guttene liksom er på toppen og jentene er i midten?
Cecilie: det kan man jo lure på da – det er også føler jeg litt det der genigreiene komme inn, for det er ofte liksom de som er aller best er på en måte kanskje også de som er sånn ekstremt flinke i veldig mye, som tar bare alt veldig lett og at det er gutter det har jeg egentlig ikke noen god forklaring på. At jentene kommer i midten er vel mer det at de kanskje har litt mer sånn arbeidsmoral da, med å jobbe mye med matten.

Cecilie believes in natural ability, but she also believes (in contradiction) in hard work, which she needs in order to position herself as good at mathematics, despite being a girl. Other students position her as a role model, or maybe she does it herself, but her story is that she's not sure about that, suggesting that she is struggling to balance the equality discourse with her knowledge that hard work is needed to be able to be a 'winner' in the Norwegian school system:

> *Cecilie: you can feel a bit of sympathy with those who get bad grades, at least if you know that they have worked really hard for it and they don't get it in the end, but there are many who you understand that in a way don't care to try or use their abilities and then it is kind of their own fault. And those who get good grades, of course, you look up to them, and they are maybe people who you measure yourself with, and so they become kind of role models within that subject.*
> *Me: are you a role model?*
> *Cecilie: I don't know if I would say that myself, but there are many who knows that I do well in mathematics, so in a way maybe a bit more are concerned with what I get than what others get, which can both be annoying and nice*[22]

There are powerful discourses of educational opportunity, gender and ability evident in her story of subject choice and in how she has chosen subjects because she is good at them. A question that arises in Cecilie's story is how can she argue for future specialization within subject areas when she is good at everything? Cecilie gets top grades in every subjects and she believes that she uses the same kind of skills in all types of subjects like history, mathematics and language:

> *Cecilie: I don't know – I like multiple subjects, so I feel in a way that I enjoy German and history as much as mathematics and physics*[23]
> *Cecilie: no, it is almost like I am unsure about if I should choose social sciences or realfag*[24]

[22] Cecilie: man kan jo kanskje ha litt medfølelse med de som får dårlig karakter, i alle fall, hvis de på en måte man vet at de har arbeidet veldig mye for det og ikke får det til, men det er mange man skjønner også på en måte ikke bare gidder eller ikke bruker evnene sine og da er det på en måte sånn, ja, da er det deres egen feil. Og de som får gode karakterer, selvfølgelig så, ser man jo kanskje opp til dem, og det er jo kanskje noen personer som folk måler seg litt med også da, sånn som de blir kanskje litt forbilder innenfor faget
Int: er du et forbilde?
Cecilie: det vet jeg ikke om jeg selv ville si, men det er mange som vet at jeg gjør det bra i matte, så det er på en måte kanskje litt flere som bryr seg om hva jeg får enn hva andre får, som både kan være irriterende og fint
[23] Cecilie: jeg vet ikke – jeg like flere fag da, så jeg føler på en måte jeg er like glad i sånn tysk og historie som jeg er i matte og fysikk
[24] Cecilie: nei, det er nesten så jeg er på en måte usikker på om jeg skal velge noe samfunnsfaglig eller realfag

Significant people are telling her that she is good at many things: her teachers confirm her identity as a good student when she gets good grades, and her classmates look up to her (which she claims to have mixed feeling about) because she is at the top. When it comes to choosing, she indicates that her have parents encouraged her to continue with natural sciences and mathematics; even though she claims that 'realfag'[25] is her choice, she says that she would have been 'allowed' to choose other subjects :

> *Cecilie: yes, it is I who have chosen it – I probably would be allowed to choose something else, but it has been pretty natural, since I master many natural science subjects […]* [26]

Maybe Cecilie has too many choices, and because of this her parent's encouragement to study mathematics and natural sciences guides her through those difficulties?

Louise

Louise's greatest wish for her future is to be able to study architecture and she talks a lot about how she will need creativity, perseverance, and motivation to get good grades and to persist with this ambition.

> *Me: why have you chosen mathematics?*
> *Louise: because I am going to be an architect*
> *Me: and then you need it…*
> *Louise: yes*[27]

This is how Louise sees herself in the future – her designated identity – and it is built upon her telling the story that she has always wanted to be an architect, but she also draws on discourses about gender, and ability and a cultural model of the 'good student'. Louise implies various things about herself as she hypothesizes about girls working more and harder and concentrating more on school than boys. She connects this to how she herself works hard on getting good grades now, so that she can become an architect:

[25] 'Realfag' in Norwegian refers to the subject mathematics, natural science, physics, chemistry, ICT, geo-subjects and biology
[26] Cecilie: ja, det er jo jeg som har valgt det – jeg hadde vel fått lov til å velge noe annet, men det falt jo på en måte ganske naturlig da, siden jeg mestrer på en måte flere realfag […]
[27] Int: hvorfor har du valgt matte?
Louise: fordi jeg skal bli arkitekt
Int: og da trenger du det
Louise: ja

Louise: yes, I think at least at our age, girls work more than boys. I feel that girls do more homework, they do more tasks, and work a bit more than boys do now, but that later on when they start studying and when they've figured out what they want to specialize in, then I think they will work even harder. But I think that more girls work more now, that is why there are more – at least I feel in our class that very many girls are better than the boys. [28]

Louise talks about grades and working hard to get the grades that she needs to get to study architecture, and this is more important than understanding mathematics. She seems highly instrumental in her choice of mathematics and in how she works. Grades matter a great deal for getting accepted at university and Louise knows what grades she will be required to have, and therefore she works towards those grades. In opposition to this competitive situation, the Law of Jante says that you are not supposed to be different or better than others, and it seems as though Louise draws on this when she says that other students also work in order to get good grades for university entrance rather than for understanding.

Louise: I think grades matter a great deal, I think very many work to get to good grades instead of understanding it – or I don't know – more to get good grades, to get into the education one wants.
Me: does that matter to you?
Louise: yes, I work to get good grades to get to study architecture[29]

Mathematics is seen by many of the students as a marker of cleverness and Louise also refers to this when she talks about other students who do not study mathematics, and how they might understand and describe those who do:

Louise: no, I think they think that "you're smart" or they think it is a bit impressive that you have R2, because it is a very difficult subject – it's a common view that it is the most difficult in year 13, so I don't know, I think it is actually is a bit cool just that you have it

[28] Louise: ja, jeg tror hvert fall i den alderen vi er nå, så jobber jenter mer enn det gutter gjør. Jeg føler at jenter gjør mer lekser, de gjør flere oppgaver, og jobber litt mer enn det gutter gjør nå, men at senere sånn når de begynner på studiene og når de på en måte har funnet ut hva de virkelig vil spesialisere seg i, så tror jeg de jobber nesten mer. Mens jeg tror mange jenter jobber mer nå, det er derfor det er flest – jeg føler i hvert fall i klassen vår at det er veldig mange jenter som er flinkere enn gutter.

[29] Louise: jeg tror karakterer spiller veldig stor rolle, jeg tror veldig mange jobber for å få gode karakterer, men ikke for å kunne det – eller jeg vet ikke jeg – mer for å få gode karakterer, for å da komme inn på studiet man vil.
Int: har det noen rolle for deg?
Louise: ja, jeg jobber jo for å få gode karakterer, for å komme inn på arkitekt så

Studying mathematics R2 is for Louise seen as impressive and cool, but she laughs when she said 'you're smart' indicating that maybe she shouldn't talk about herself as smart - here she is perhaps drawing on the Law of Jante again. Louise positions herself in terms of choosing mathematics and her approach to its significance in her life through her hypotheses about gender and mathematics as a marker of cleverness. The discourses of gender and ability work for Louise and she can position herself as a type of 'winner' in the Norwegian school system.

Bjarne

Bjarne is quite a bit different from Louise and Cecilie, but he still positions himself in relation to gender and ability discourses. While Cecilie gets good grades, Bjarne gets average grades of 4 or 5. In contrast to Louise who works hard to get good grades to get into university, Bjarne says that he works with mathematics out of interest in it. To Bjarne it is important that he understands and is interested in mathematics and that he can use it in everyday life. He talks about how there is so much that mathematics can be applied to and that it is fun and something he is good at:

> *Bjarne: I enjoy working on my own and finding out stuff myself*[30]

Bjarne tells a story about how in early high school he started to understand mathematics more, instead of just answering the questions, and that what is fun about mathematics is understanding what you're doing when you're solving a problem. He thinks that he is on his way to becoming a mathematician. Although in his head a mathematician is a 'crazy professor with glasses and a weird hairdo', he knows that that is probably not how it is in real life:

> *Bjarne: but it's probably – probably see many mathematicians in the streets everyday – who are completely normal people – who are very smart – very interested in the subject and good people really – how they look can be anything*[31]

He tells a story about how last summer he had used mathematics and physics to build a water ski jump, and that it is those little things that you don't know why you learn, but suddenly one day you can use it to solve an everyday problem:

> *Bjarne: in contrast to algebra which is first and foremost numbers and you sit and look at numbers – you learn later how you're supposed to use it if you choose that*

[30] Bjarne: jeg er glad i å jobbe alene og finne ut av ting selv
[31] Bjarne: men det er nok – ser nok mange matematikere på gaten hver eneste dag som – som er helt normale mennesker – som er veldig kloke – veldig interesserte i faget og flinke folk rett og slett – hvordan de ser ut kan være så mangt

route, but right now I see more connections to everyday life with functions, so I think that helps – it makes it a bit more exciting[32]

Bjarne clearly identifies himself as a mathematician in these stories, drawing on the importance of mathematics for solving problems in society and the idea of mathematics as a foundation for understanding the world. To Bjarne, a mathematician is a male and that discourse works for him, because he is a boy, and maybe this can be further understood in terms of how he describes girls' ability in mathematics. Although he suggests that he knows he 'should not' say so (because it is wrong to make gendered generalisations), he connects mathematics to boys and language and social science subjects to girls:

Bjarne: I don't dare to say that they don't have the head for it, but there is probably more engagement from boys when it comes to things like mathematics – it is more natural with boys[33]

Bjarne connects (or justifies) this hypothesis with the idea of enjoyment: those who enjoy mathematics and those who enjoy social science subjects. However, being good at mathematics maybe requires a (natural) 'eye' for mathematics or a mathematical mindset:

Bjarne: what separates people who are interested in mathematics and social science people is that they look for it, instead of settling with that is just how it is and I can't do anything about that – instead you're looking at what can you do with it further and what is special about it [34]

Through these stories, Bjarne is implicitly placing girls as less naturally good at mathematics, and himself as a mathematician with good abilities in mathematics, even though he gets average grades. One idea in the Norwegian school system is that it is much more important that students learn, understand and are interested in subjects instead of getting good grades in the end, and Bjarne draws on this idea.

[32] Bjarne: i motsetning til algebra som først og fremst er tall og du sitter og ser på tall – man lærer jo senere hvordan man skal bruke det hvis man går retningen, men nå ser jeg mer sammenhenger i hverdagen med funksjoner da, så det synes jeg hjelper litt på – det gjør det litt mer spennende

[33] Bjarne: jeg tørr ikke å si at de ikke har hode for det, […] men det er nok litt mer engasjementet rundt en ting som matte – det er mer naturlig hos gutter da

[34] Bjarne: det som skille matematisk interesserte mennesker fra samfunnsvitenskapelige mennesker er jo det at man leter etter det istedenfor å slå seg til ro med at sånn er det bare og det kan ikke jeg gjøre noe med – istedenfor at man ser hva man kan gjøre videre og ser hva som ligger i det

Tarik

Like many students, Tarik's initial explanation for his choice of mathematics is an uncomplicated one which is based on its usefulness for the future and the grades he gets: it is a rational choice. Thus he is actually interested in subjects such as history, but he did not choose it because he is not good at essay based exams. He chose his subjects for two reasons which automatically rules out subjects such as history:

> *Tarik: yeah, I have mostly chosen these subjects because I actually enjoy them, and yeah they are useful for my university choices*

He wants to study medicine and he says that he expects that in university he will have to be '*independent, so you don't really get spoon fed with information'*. He has chosen to study statistics instead of mechanics, because one of his teachers in Year 11 had said that he was surprised by '*how little doctors knew of basic statistics*'.

However, Tarik's story reveals further complexity in relation to discourses of ability and gender. Like many of the other English students, Tarik says that he does not think there is any difference between girls and boys in mathematics:

> *Tarik: like there will be girls that are really good at maths and really bad at maths, and there'll be boys that are really good at maths and really bad at maths*

Perhaps this reflects the dominance of an educational ideology of ability and competition in England, rather than equality and gender as in Norway. Tarik says that ability in mathematics could be a 'genetic thing', and also that '*certain people – they just enjoy it more, and they are better at it than others*'. The connection between being good at mathematics and enjoying working with it describes Tarik's own relationship with mathematics. He says that he had always been good at mathematics and had been placed in top sets throughout primary and high school, but he goes on to reflect on how students are affected by this system:

> *Tarik: I think – they are useful in some sense that they can categorize people so that you can be with similar people of level of maths, so that you can like thrive together, but I think it is sort of like labeling people, and for the sets lower down feel like they're like stuck there and they can't like accomplish more, so in that sense it's not great*

In this quote, it seems that Tarik is trying to critique the ability grouping system in England, and he draws on a kind of equality discourse at the same time as he draws on the discourse of

ability and competition. But ability grouping is not a problem for him personally, and his main focus is on enjoyment of the challenge of problem solving: mathematics is "*the manipulation of numbers to solve problems*", and he likes this and how it makes him feel:

> *Tarik: yeah, I think I enjoy it because it's a challenge, there would be like a question - it would be like a challenge, and I think mostly it's like the self-gratification of you've used your own knowledge to solve a problem, like you've applied it […] – like you just there's a hurdle and you just try to work it out*
> *Tarik: I'm not sure – I think it's just like when you get to complete a question, like a sigh of relief and you're truly happy, and I think you just keep going, and you can do like loads and loads*

The discourses of mathematics and mathematical ability work to Tariks' advantage, enabling him to identify and describe who he is and who he expects to be in the future.

Summing up positioning within discourses of ability and gender

These four students, Cecilie, Louise, Bjarne and Tarik, reflect how many of the students in this study positioned themselves within discourses of ability and gender. Both the Norwegian and English students can be described as 'winners' in their respective systems, in that they study mathematics, which is seen as important in society and for future choices. They are all positioned in terms of strong abilities within mathematics and for many this position or narrative appears to be stronger than the gender discourse. Therefore, for many of the girls, the discourse of gender and girls traditionally not studying mathematics appears not to be a threat to their choice of studying mathematics post-compulsory or in the future. Bjarne perhaps has to work harder in order to position himself as winner, and his use of gender discourses as a means to underline his ability as mathematician plays a particular role for him.

6.4.2 Who am I? Othering

The idea of othering is that 'who I am' is in terms of others, and it is often in a negative way in terms of others' failings saying 'I am better than other people'. Othering is about how you locate yourself with respect to others, and see yourself as maybe better than others. It is about a constant comparison (Damarin, 2000; Mendick, 2005a). When the students tell their stories they frequently position themselves with respect to others. They draw up differences and separate themselves from other people by drawing on discourses of mathematics, of ability, of

specialness and mathematics being a marker of cleverness. They are 'othering' by making themselves different and special.

In this section I will look at how three students, one Norwegian, Jonatan, and two English, Annie and Kevin, position themselves with respect to others by drawing on discourses and cultural models.

Jonatan

Jonatan uses a variety of different discourses to position himself in relation to others. One discourse which is very evident in his story is ability in mathematics. In Year 12 at West the students were divided in their mathematics class into two groups, one for the high achievers and one for the low achievers, and Jonatan was placed in the higher group. The grouping was meant to be dynamic, and the students could choose to change from one group to another if they wanted to. Jonatan uses this experience with ability grouping to distance himself from students who get grade 4 or less:

> *Me: you said it was motivating to be in the higher group, how do you think it was for those who were placed in the lower group?*
>
> *Jonatan: well, it depends really – it is both motivating and not motivating in a way – you maybe feel in a way ok then you can't get a 5 or 6, if you're in that group – at the same time what they learned was easier, so that those who maybe had some difficulties with what we went through, […] when they went to the group where they were learning a bit less complicated things, then maybe they understood most of it, and then that motivates because they actually learned what we were doing*[35]

Jonatan connects ability in mathematics to enjoying the subject, and speculates that maybe those who don't like mathematics and its definite nature like other subjects and are good at those subjects because they enjoy working with them:

[35] Meg: du sa at det var motiverende å være i den høye gruppa, hvordan tror du det var for de som ble satt i den lave gruppa?
Jonatan: det kommer litt an på for så vidt – det er jo både motiverende og umotiverende på en måte – man føler på en måte ok da kan man ikke få 5 og 6 hvis man er i den gruppa – samtidig så var jo det de lærte lettere, så det var jo folk som kanskje hadde litt problemer med det vi gikk gjennom da […] når de da kommer i den gruppen hvor de skulle lære litt mindre kompliserte ting, så skjønte de jo kanskje det aller meste, og da virker jo det motiverende igjen for at de faktisk lærte det vi drev med

Jonatan: I think it has to do with that you learn different things and that you enjoy different things – I who like mathematics, I learn it easier because I think it's fun to work with[36]

Jonatan: […] while in mathematics it's like you're either right or not, and you feel if you can do it or not, and I think it's a lot easier – I think it's a lot more fun to work when you know you're right or not. [37]

By drawing on the discourse of mathematics as definite, and emphasizing how he enjoys this, he separates himself from other students. He invests in a type of differentiation discourse because it suits him to do this: it affirms how he is different from others and it identifies him with the hard working students who make good choices for the future:

Jonatan: those who have the easier mathematics is of course somebody that do not have big ambitions, and don't think far enough ahead and you feel that in the group I am in which is the hardest there is – everyone has targets and everyone knows what they want [38]

Jonatan also said that he had to admit that he has based most of his subject choices on getting the full extra credit of 4 points.

Jonatan: so I get the 4 extra points which is the maximum […][39]

Could it be that Jonatan, because he is not sure what he wants to study further and because he has chosen subjects based 'purely' on extra credit, is insecure in his choices. Jonatan contradicts himself a bit by implicitly critiquing those who aren't ambitious, but he seems to have no clear ambitions himself by having chosen subjects for the extra credit only. Jonatan also connects high ambitions to gender issues, noting that fewer girls choose mathematics post-compulsory even though they usually have better results than boys in school; while he deduces that this is because they are less ambitious, he notes the contradictions in his position:

Jonatan: I think that of course they have the exact same opportunities, but I feel that more boys have ambitions to get into more demanding education, at least in our

[36] Jonatan: jeg tror det bare er at man lærer forskjellige ting og man liker andre ting – jeg som liker matte, jeg har jo lettere for å lære det fordi jeg syns det er gøy å jobbe med
[37] Jonatan: men i metten er det sånn du har enten riktig eller ikke og du merker det da om du kan det eller ikke, og jeg synes det er mye lettere da – jeg synes det er mye morsommere å jobbe når du vet selv om du har riktig eller ikke.
[38] Jonatan: De som har den lettere matten er jo selvfølgelig noen som ikke har så store ambisjoner, og ikke tenker så lang fremover og det merker man jo i den gruppen som jeg er i nå med den vanskeligste er det jo – alle har jo mål og alle vet hva de vil.
[39] Jonatan: så jeg får da de 4 ekstra poengene som er det maksimale […]

school. But I think it's kind of weird, because ever since primary school, it is kind of the girls who are always the best[40]

Annie

Annie uses othering to position herself as special, using the discourses around her to do important identity work. She identifies very strongly with the 'hard working student' of mathematics in contrast to her friends who do not do mathematics:

Annie: I think I'm a bit more hard working than them, because I guess maths is a subject where you have to work a lot harder than some of the others that they do. So I probably work a bit more

She explains the difference between herself and her friends as resulting from the fact that she has always liked mathematics but they have hated it, and that is the reason why she works harder:

Annie: they'll call me a little maths geek, 'cause some of my friends, well my friends group don't really like maths that much, it's just me, but yeah, I think they all know that I like it a lot
Annie: I've always enjoyed it so I've always kind of like wanted to do more maths, and I'm probably better at it because I've wanted to do it. Some people from, you know, from year 7 have hated it, and have wanted to get rid of it as soon as possible, and have never really tried, and when people enjoy it more, they try harder and will probably do better and yeah

Annie uses these stories to separate herself from her 'ordinary' friends and identify herself as special. She plans on doing a degree in mathematics at university and '*wants a job working with numbers*'; mathematics is really important and a lot of jobs use it:

Annie: I really want to get a good degree in maths, especially from a good uni as well. I mean […] a lot of careers like maths degrees, cause it doesn't just show that you're good at maths, but there's a lot of skills that are involved in maths, that like bring on a good character
Int: what kind of skills does maths give you?

[40] Jonatan: jeg tenker jo at de selvfølgelig har akkurat de samme mulighetene, men føler jo at det er flere gutter som har ambisjoner om å komme inn på et vanskelig studie, i hvert fall her på skolen, og det syns jeg egentlig er litt rart – det har jo alltid vært sånn at på barneskolen og sånt, så er det på en måte jentene som alltid flinkest

Annie: […] problem skills, […] you can work with problems and stuff like that, it's quite, I think it shows you got a good train of thought, in the sense that you'll think about things in a lot of detail, which I think would be useful for a lot of things

Discourses about mathematics and who does mathematics strongly separate mathematicians from other people, and Annie identifies herself as a mathematician in the future by saying she would like to '*be known as a clever maths person*', although she claims that a woman can never be a mathematician:

Annie: for some reason I always picture a man, and never a woman, when I think of a mathematician, I don't know why, but yeah for some reason it's a man
Annie: I don't know, it makes – you just think of mathematician of really academic people, and they are a lot higher than a lot of other people in like society, so I don't know – it's someone you kind of like, someone knowledgeable, it makes you feel like you've worked hard, and you got a lot out of what you've been doing if you're classed as a good mathematician

There are contradictions in Annie's story about what a mathematician is and who she would like to be in the future – her designated identity. The words that she uses shift from describing someone else 'out there' as a mathematician to connecting the hard work of a mathematician to herself: *'you've worked hard, and you got a lot out of what you've been doing if you're classed as a good mathematician'*. Annie talks about how it is easy to get an A in mathematics, and that to be in the top you need to do better. She describes herself as "pretty decent" in mathematics, being predicted an A* for mathematics and an A for further mathematics. She feels like she is being challenged by her teachers to do her very best, and '*everyone's always up for a challenge*'. Being predicted high grades makes you work a lot harder, than being predicted lower grades, but it also puts pressure on you because you are expected to get those high grades:

Annie: it's a bit scary, because that's what they think you should, and if you don't get it you feel like you failed them, but I guess the people that have predicted you the grades kind of know how you work in class, so I mean it's a challenge to get a high grade, but if the teachers have given you that, they think you're capable of it, so it's not too bad

In her talk about predicted grades and challenges, Annie invests in her position as different from those who are not the best. Through these identifying narratives, she describes who she is in relation to her own success and to the failure of others, locating herself as better than them.

Kevin

Kevin talks a lot about girls and how low self-esteem in mathematics can restrict their possibilities:

> *Int: do you think that girls' confidence can like restrict their possibilities in maths? Kevin: probably yeah, cause [my girlfriend] enjoys it and she doesn't think she'll do as well – her target's an A, but she doesn't think she'll get that, whereas my sister's confident, she knows she can so she'll try – well not try harder, but I think she is more likely to want to do maths, cause she thinks she can do it because she is more confident.*

At the same time that he buys in to this version of equality and equal opportunities discourses, he draws on discourses of cleverness to explain who is good at mathematics. Kevin has two sisters who he talked about during the interview who are both younger than him. About his younger sister he says:

> *Kevin: she's clever, but not quite as clever as us two, which I think sometimes can upset her a bit. She's quite good at maths, I think she either got an A or an A* when she did her GCSE statistics, but my sister is in the year below the first year to do that, one of my sisters got an A*, the other one got either got an A or an A*, so she's not bad but I think sometimes she doesn't get it quite as fast as we do, but she's still quite good, so*

He also describes how the sister closest to him in age is good at mathematics, even sometimes a bit better than him, and he justifies this with the claim that she has always tried harder. He also talks about his father who is very good at mathematics and can help Kevin and his sisters whenever they need help. Here, Kevin describes ability in mathematics as partly natural but also connected to the environment where you grow up.

> *Kevin: yeah, I think it must be partly that, cause yeah, all my family seem to be quite clever at maths, but yeah, so we probably got some a bit natural, but then yeah, it*

might also be how you grow up, cause if my dad's good at maths, he might have sort of encouraged us more at maths than other things, but yeah

In these stories about his family, Kevin separates them from other families where mathematics is not part of their culture. Kevin uses his 'mathy' family to invest in his own identity as a natural talent in mathematics:

Me: are you good at maths?
Kevin: I think so

Mathematics is Kevin's favorite subject because he prefers "*numbers to words*", and he says that algebra is probably his favorite area. He describes mathematics as fun, enjoyable, challenging and very useful. I asked him if he could tell me why it is fun:

Kevin: probably cause I can do it, so I find it easy so – when I'm doing it, I'm getting things right, which is better than getting things – doing things and getting them wrong, cause you get frustrated, so when you can do it, I find I enjoy it more
Me: does maths make you feel anything?
Kevin: it's nice when you stop, when you answer a hard question and you got it right.

Kevin buys into the idea that mathematics is definite with only one right answer, and he uses this to separate mathematics from other subjects that are more 'wordy'. He might be suggesting that it is easier in mathematics than in 'wordy' subjects to know if you can do it or not. Kevin wants to get a degree in mathematics from a university, but he doesn't know what he wants to do afterwards. He thinks that doing a degree in mathematics will secure many good options in the future:

Kevin: I'm not sure what I'll do afterwards yet. I think a degree in maths can have quite a lot of sort of options afterwards, but I have not really, well, I don't know what I want to do afterwards yet so

6.5 Juggling competing discourses of equality, ability and competition

In section 3.4, I wrote about the process of self-authoring as how we answer and address others as participants in figured worlds. The students are positioned, and position themselves, through their participation in figured worlds within different and often competing discourses. Some of the students, such as Emily, Cecilie, Louise and Tarik, make these discourses work for them to explain who they are and who they want to be in an unproblematic way, as

described in the previous sections. Other students struggle more to juggle competing discourses, both working and sometimes resisting them, in order to explain who they are, who they want to be and to make sense of themselves. In this section I will describe how two Norwegian students, Sara and Camilla, and one English student, Kaitlin, juggle competing discourses of equality, ability and competition.

Sara

Sara goes to Middle, a school in which girls are overrepresented. She hypothesizes about how this affects the boys' subject choices: when there are fewer boys than girls, she suggests, the boys tend to choose the same subjects because they don't want to stand out of the crowd. This hypothesis can be connected to the Law of Jante and how it states that one should not be different from others:

> *Sara: Yes, there is a difference. At least there are more boys than girls doing mathematics in year 13. But then Middle – Middle is a school where girls are overrepresented.*
> *Me: yes, do you think it matters that there are more girls than boys?*
> *Sara: yes, I think it counts. Yes, in most of my subjects there are more girls. I think – it might not matter that much for us girls, but maybe a bit for the boys. I don't know.*
> *Me: how?*
> *Sara: That they – when there's not that many, so in a way – so in a way it might be more important to be like the other or like – do like – not do as the others, but it is kind of primary school, but yeah.* [41]

Sara develops her hypothesis further, splitting the boys into two groups: one where the boys choose mathematics because they like it and are interested in it, and one where they choose it in order not to stand out from the crowd. When she talks about the girls, on the other hand, and why they choose mathematics, she said that it is purely because they are interested in it. However, she also says that mathematics is a subject which is more closely related to boys than girls, and language is one of the subjects which are more related to girls. Sara herself has chosen both mathematics and language among other subjects:

[41] Sara: ja, det er vel en forskjell. Det er i hvert fall mange flere gutter som tar matte nå i tredje enn jenter. Men nå er jo Middle – Middle er jo en skole hvor det er overrepresentert av jenter.
Me: ja, tror du det har noe å si at det er flere jenter enn gutter?
Sara: ja, jeg tror det har en del å si. Ja, i de fleste fagene mine så er det flest jenter. jeg tror – det har kanskje ikke så mye å si for oss jenter, men kanskje litt for guttene. Vet ikke jeg.
Me: hvordan da?
Sara: at de – når det ikke er så mange, så på en måte – så blir det kanskje viktigere å være som de andre eller som – gjøre som – ikke gjøre som de andre da, men det blir litt barneskoleaktig, men ja.

Sara: I actually like all of them a lot – that's why I chose four subjects, and not three subjects – if not I would have dropped one[42]

She places herself on both sides of this gender divide by choosing both mathematics and language, and she tries to juggle discourses and stereotypical views of gender to make the facts fit her identity as a female student who enjoys both types of subjects. In this way Sara can justify her subject choices. Sara also relates her hypothesis to how boys and girls decide on what they want to continue studying after upper secondary school: girls are certain of their choice before they apply to university, while boys take a chance. However, she is sure not to devalue the boys in her mathematics class, by saying that those who choose mathematics will become something important:

Sara: I feel that some boys maybe just go and study without really knowing what they want to do, and then they just use their education for something, while girls have to kind of find the perfect education before they start studying[43]
Sara: yes – I think those who choose mathematics – they are going to take a long term education[44]
Sara: yes, they are going to become something important. But those who – those who don't choose mathematics – they rather want to become something – something I don't know – something with a shorter education – a bit easier – not easier, but you know'.[45]

Sara thus juggles the gender discourse to fit who she is. She also juggles competing discourses of equality and cleverness; in section 6.1.1 I wrote about how she thinks that many students choose mathematics because they might need it for higher education, because it gives extra credit and it is important. When I asked Sara to elaborate on the importance of mathematics, she inserted into her answer a comment on how doing mathematics makes her feel intellectual and smart. She thus differentiates herself from students who don't study mathematics, mixing this perhaps less socially desirable reason with a number of others:

Me: In what ways?

[42] Sara: Jeg liker egentlig alle ganske godt – det er derfor jeg har valgt fire fag, ikke tre fag - hvis ikke så hadde jeg droppet et.
[43] Sara: jeg føler at noen gutter kanskje bare går og studerer selv om de egentlig ikke vet hva de skal, så bare bruker de det til noe, mens jenter må på en måte finne det perfekte studie før de går og studerer.
[44] Sara: ja – jeg tenker de som velger matte – de skal ha lang utdannelse.
[45] Sara: ja, de skal bli noe viktig. Men de som har – de som ikke velger matte – de vil heller bli noe – noe jeg vet ikke jeg – noe med kortere utdannelse – litt enklere – ikke lettere, men du vet.

Sara: that it is kind of – it is very intellectual – you feel quite smart if you can do it – even though it sounds a bit stupid – so I don't know – and it pays off too – there are a lot of studies that need it – and you get points.[46]

Sara also tells me that she has participated in mathematics groups for specially gifted students where they worked outside of the normal book and curriculum for high school students. When I ask her to reflect on how ability grouping affects students, she says that for the higher achievers it is good to be challenged in this way and not to have to wait for the lower achievers, but that taking the students who are good and interested in mathematics out of the class might lower the motivation of the other students. Sara's response reflects the Norwegian school system's emphasis on equality and equal opportunities for all students:

Sara: I felt actually in a way it can be a bit bad, especially for those who are really good – but at the same time for those who are average or those who are bad – I don't really know if they get a lot better when they don't have others around that are interested – that maybe can give a bit motivation to get better – I think it's good with differences[47]

Sara says that mathematics is in the nature of her family and in her nature; in fact, her father would have thought it was weird if she had chosen not to continue with mathematics because she has done well in it.

"*So I feel that most of my family see me as science-minded – they think that 'she will become something like that*"[48].

They tell stories about her being a science-minded person who should become something within mathematics, but she herself has not yet decided on this. She has also chosen other subjects, such as French, physics and economics. That is a wide range of topics, which suggests that she might not only be science-minded, but for example a humanities person as well, which perhaps fits with her hypothesis on gender and subject choices.

[46] Sara: jeg tror de fleste har valgt det fordi at de tror de kan trenge det når det gjelder studier, og så gir det poeng – og så er matte ganske viktig, så.
Meg: på hvilke måter?
Sara: at det er på en måte – det er veldig intellektuelt – man føler seg ganske smart hvis man får det til – selv om det høres litt dumt ut – så jeg vet ikke jeg – og så lønner det seg også – det er mye studier som trenger det – og så får man poeng.
[47] Sara: jeg følte egentlig at det på en måte kan være litt dumt, spesielt for de som er veldig flinke – men samtidig for de som er middels eller dårlige da – jeg vet ikke helt om de blir så mye bedre når de ikke har noen andre som er interesserte – som kanskje gir en viss motivasjon for å blir bedre – jeg synes godt det kan være litt forskjeller
[48] Sara: så jeg føler vel at de fleste i familien min ser på meg som realist – de tenker at hun kommer til å bli et eller annet sånn aktig.

Camilla

Camilla's story is both about her actual identity and about her designated identity. It is what Sfard and Prusak (2005b) call a critical story because it is deeply rooted in how she identifies, and invests in this identity. Her account of choosing mathematics is much more complex than many of the other students' stories, and she has to juggle many discourses, sometimes giving in to them and sometimes working hard to resist them. Camilla is also trying to resist many stories about her, while at the same time living up to the expectations of significant people around her. The circulating identifying narratives about her might be different from who she thinks she is. One can almost ask if Camilla chooses mathematics because she likes it and because she wants to choose it, or if she chooses it because it is expected of her.

Camilla initially tells a simple story of how she has always been good at mathematics, and had chosen it because it had always been her subject and because she wants to become an engineer:

> *Camilla: because I know mathematics better than other subjects – I don't know, or it has kind of always been my subject, even though it has gotten more difficult through the years, but also because I need it for education later – I have to have it, because I want to study engineering, hopefully*[49]

Camilla subscribes to the cultural model of mathematics as definite and logical, and she identifies with this as a logical person:

> *Camilla: well I am better at thinking logically and finding the answer from that, and I like it better that there is one right answer instead of having to think so far away from here and now*[50]

Camilla says that she realized that she was good at mathematics in primary school. She talks about how she never studied for tests in high school and that she always got 6 on everything in mathematics. Although she gets lower grades now, she explains this by telling a story of how she was spoiled with good grades in high school despite not working hard, and has developed a bad habit of thinking that she doesn't have to work hard:

[49] Camilla: fordi jeg kan matte bedre enn andre fag, jeg vet ikke, eller det har liksom alltid vært mitt fag, selv om det har blitt litt vanskeligere opp gjennom, men også fordi jeg skal ha det til utdanning senere, jeg må ha det, for jeg vil inn på ingeniørstudier, forhåpentligvis

[50] Camilla: altså jeg er bedre på å tenke logisk og finne svarene ut fra det og så liker jeg bedre at det er et fasitsvar i stedet for at du må tenke deg sånn sykt lang unna det som liksom er her og nå

Camilla: But I got a really bad habit out of it, in high school I never studied for tests, because I knew that I would do good anyway. I finished high school with 6, and I had never studied for a single test. And then when I got to upper secondary school, yeah, the transfer was a bit rough, because then you have to study […]. [51]

Camilla's parents are very powerful voices in her story. She says that she has always told her parents that she wants to study engineering and her parents know that she has always been better at mathematics than other subjects. Because of this, she says, when Camilla was choosing subjects for Year 13, her parents advised her to continue with mathematics instead of choosing what Camilla call 'chill' subjects, where she wouldn't have to work as hard.

Camilla: such as 'outdoor life', I thought about that, and there wasn't as good respons, because I won't be able to use it later, and I had actually thought about taking a 'chill' subject[52]

Camilla: mom and dad have been very on about that I should continue with mathematics – they know that it is what I manage the best – so they have kind of been on that I should continue with it – and also they know that I want to study engineering too so they say that 'yeah, you have to do that' and that I shouldn't quit mathematics
Me: why do you think that?
Camilla: no, I think it has to do with that I say that I want to do that, and they just say 'well then you have to do that' – but there are also subjects that I've thought about studying which I have gotten a worse response on like 'no, I don't think you should study that' because they are very strict on that I should get a good education, or a higher education[53]

There are also other significant people in Camilla's story with powerful voices: Camilla tells me about how she remembers having met her teacher from primary school and the only thing this teacher had asked her about was how she was doing with mathematics. Camilla tells me

[51] Camilla: men jeg har jo fått veldig dårlig vane ut av det, sånn som på ungdomsskolen så øvde jo jeg aldri til prøver, fordi jeg visste at jeg fikk bra uansett. Jeg gikk jo ut med 6'er og jeg hadde ikke øvd på en eneste prøve. Og når jeg kom til videregående da, da, ja, den overgangen var litt tøff, for da må man øve.
[52] Camilla: sånn som friluftsliv og sånn, vurderte jo jeg, og det var liksom ikke like bra respons, fordi det får ikke jeg noe ut av senere, og jeg hadde jo egentlig tenkt å ta det fordi at det blir sett på som et chille fag
[53] Camilla: mamma og pappa har jo vært veldig på at jeg skal fortsette med matte – de vet jo at det er det jeg klarer best også – så de har vært litt på det at, det må jeg fortsette med – pluss at de vet at jeg har lyst til å gå ingeniør også så de sier jo at 'ja, da må du jo gå det' og at det skal jeg ikke slutte med, så, ja
Int: hvorfor tror du det?
Camilla: nei, jeg tror det egentlig har noe med at jeg selv sier at jeg vil gå det, og så sier de bare 'ja, men da går du det' – men det er jo også fag som jeg har vurdert å ta, som jeg også har fått dårligere respons på, sånn 'nei, det syns jeg ikke du skal ta', fordi de er veldig viktig på at jeg skal få meg veldig god, eller at jeg skal ta høyere utdanning da

that she thought, in an ironic tone '*thank you for remembering me*'. She talks a lot about how her friends call her crazy because she has chosen all these difficult subjects, and that her friends have chosen subjects other than mathematics because they don't understand it

> *Me: if I asked your friends that don't understand it, what would they say about you and your choice of mathematics?*
> *Camilla: that I am crazy*[54]

Camilla also has to deal with discourses about gender, because her female friends are those who tell her that she is crazy and because choosing mathematics and engineering is choosing to go into a male dominated area. She defends her choice with the fact that NTNU gives extra credit to girls who apply to study engineering. Camilla also says that she knows many boys who are really good at mathematics but she also knows many girls who are really good at mathematics, so she doesn't see that there are any differences. She knows that she has chosen subjects that are 'dominated' by boys, but she argues that subjects such as mathematics have become more and more popular for girls as well:

> *Camilla: I think that engineering and things like that are more male dominated, that is why NTNU have to give extra points for girls, but I know that there is a lot of girls who apply there now, and that it has become more popular for girls, but there is of course subjects that are more dominated by gender than others.*[55]

The stories circulating about Camilla as mathematically bright and crazy because she chooses mathematics are very powerful. They position her as different and special because of an idea about mathematics as difficult and only for natural talented students, and maybe it can seem as though Camilla tries to resist this through having wanted to choose other subjects or through her justification of her bad grades as results of a bad habit. In addition, Camilla seems to resist the gender discourse. She has a problem with the 'masculine mathematics' story, and she has to get around this problem by doing identity work. That Camilla has to juggle all these discourses and stories about her, makes her story seem problematic.

[54] Int: hvis jeg skulle snakket med disse venninnene dine som ikke forstår det, hva tror du de ville sagt om deg og ditt valg av matte? Camilla: at jeg er gal

[55] Camilla: jeg vil jo tro at sånn ingeniørfag og sånn er litt mer mannsdomierende, det er jo derfor også NTNU har to ekstra poeng for jenter også, men jeg vet jo at det er veldig mange jenter som søker det nå, at det har blitt mer populært for jenter, men det fins jo forskjellige fag som er mer kjønnsdominerende enn andre

Kaitlin

Kaitlin's story includes many of the same complexities as Camilla's story above, but how Kaitlin juggles the discourses and the circulating stories about her ends in an unproblematic story rather than a problematic one. Kaitlin's story is different from many of the other students, because there are so many stories about her, about who she should be and who she wants to be, surrounding her and her choices.

There are many contradictions in Kaitlin's story. She is predicted good grades, but she doesn't work at her target level. She is a girl, but she likes mathematics. She was tested for dyslexia, but she worked her way up to the top sets in high school. Her parents don't think she works hard enough, and neither do her teachers, but she is a girl so she has to work a lot to understand and she has to put both the time and effort in – she'll succeed in the end. The stereotypical mathematician is a male, but there should be more female role models. Her friend is naturally good at mathematics, but that doesn't fit the idea that mathematicians are male. All these contradictions surround Kaitlin and how she juggles these competing discourse makes her different from many of the other students.
Kaitlin says that she wants to study medicine, and she describes her choice of studying mathematics as not a choice at all. Her story about the future, about her designated identity, is very binding to her and it almost 'forces' her to choose mathematics:

> *Kaitlin: yeah, yeah I think, yeah. I think for me, because maths is all about the course of getting into university, I enjoy it as well, but it really feels like that's fine there, and then in the maths lessons, I'm enjoying them, but I'm in them to get the grades, and to get the results – and so that's my goal overall, and it's not just a direction to be going in, but it's the purpose – it's the purpose of studying maths is to do well on these exams.*
> *Kaitlin: […] I think it didn't seem like a choice to me because of what I want to study at university.*

Kaitlin tries to explain her choice of studying mathematics and medicine as rational and sensible choices for the future, because she doesn't want her career to be based on childhood dreams and luck, but rather on hard work and paying back to society. A strong theme in Kaitlin's story is that her choices for the future are based on the idea that she can be an asset for society:

Kaitlin: I chose medicine cause – three years ago I wanted to be a fashion designer – […] [but] amongst the most important things, there's so much luck involved. I really wanted to go for a career where it wouldn't be one in a million, actually if I put the time and effort in I would be successful. […] So I also liked working to offer a service to other people, so maths is maybe not so much a service, but medicine I do see as a service […] [and] I really wanted to be able to give something back, so I see putting my time into these difficult subjects [and] we're always gonna need doctors – doctors and teachers, and things like this you know, fashions designers – we don't always need fashion designers you know, so I think it's a really good choice, because I'll be able to put something back in, and it will seem like hard work and I think that is I'm successful it will really feel like it's down to me

In the middle of this speech, Kaitlin refers to fashion designers. This seems rather strange, but it turns out that she would quite like to be one, and had considered that in the past. However, Kaitlin says, mathematics is more predictable than other subjects and if you work hard enough it is failsafe. She invests in a discourse of mathematics as definite and as a means of securing a good job or education in the future. She also positions herself as a student who likes the challenge of mathematics and who enjoys working hard, drawing on the cultural model of the mathematics student as hard working:

Kaitlin: I think I quite enjoy studying subjects that seem like work. Textiles, I dropped now, it just seemed like foolish. I think, studying things like English or philosophy, it's really nice, you enjoy it, you can go in, have a good sit down and think, but when you study sciences and maths, it's something you have to work at hard, and I quite like the work ethic that come along with it. So I like the idea that to do well, you haven't just sat for a long time and thought about something, you know, you've really practiced

Kaitlin also draws on gender discourses and discourses about mathematics and how it is different from other subjects, when she explains what mathematics is and who chooses it. She describes mathematics as a language, and she explains how mathematics is seen as a subject that suits boys better than girls, because boys are 'naturally good at it' while girls are determined and hard working. However, Kaitlin weaves these ideas about gender, ability and mathematics to argue for how she can be a girl and like mathematics at the same time:

Kaitlin: I think maths it's like language management, it's like speaking another language – the language of letters and numbers
Kaitlin: I think boys maybe feel more comfortable doing maths, I don't think girls feel uncomfortable, but I think, I'm not sure if it's true, but ideas of how the brain works, it sort of fits better into boys' psychology to be able to do maths, rules, laws[…] maybe it's the people who it comes easier to are generally the boys, maybe the girls are the ones who have to put more effort in to get there, but you know girls are determined, we'll put the effort in

Kaitlin talks about how the stereotype of a mathematician is a male, and, as mentioned above, those who often are naturally good at mathematics are male. Therefore, Kaitlin finds her friend Annie's 'natural talent' in mathematics as an 'utter oxymoron' - it doesn't fit her model of the world. Maybe for Kaitlin Annie's talent helps her to resist the idea of mathematics as more connected to boys than girls, or maybe it tells Kaitlin that only the 'naturally good' can ever be brilliant and that working hard doesn't pay off in terms of 'great' success in mathematics – it is 'unfair':

Kaitlin: my friend Annie, you know, she's a girl and it comes natural to her – it just seem like an utter oxymoron, it seems unfair.

Kaitlin tells me how her father supports her in her choices of studying mathematics and medicine, and motivates and encourages her through telling her about projects on gender equality in sciences and mathematics. This might help Kaitlin in resisting the stereotype of a science student as male:

Kaitlin: there's a charity […] called "Science Girl", which my dad told me about, which you know the influence of my dad, and it's sort of a charity that support girls studying science subjects and it goes to primary school, and I think that's a really good thing […] and they have some images of scientists and these clever girls who are gorgeous looking as well as clever, and this is really nice […] [and] maybe there should be more famous female mathematicians who look they are gorgeous and awesome at maths at the same time.

Kaitlin has experienced not being able in mathematics, but she has worked hard and succeeded and this has given her an important personal experience. She tells me how her experience of being labeled as not good in mathematics, as dyslexic and as a weak student

caused her confidence level to be very low in primary school, and this still causes her to say that she is not good at mathematics:

> *Kaitlin: in year five and six I was like a weaker student at school, and my parents thought I was dyslexic, I had a tutor, I worked really really hard [...] and I think when I was a child it did make a difference, and it didn't make me feel very good about myself, and it was so explicit as well – […] like numbered tables and everyone is in the same room so you could see that people were doing different work, […], but then I really did work very hard, so when it got to end of year six I was at the top table, and I got there, so maybe this is work ethic or I don't know, my philosophy, and then when I came to high school, I think all the work I'd done through year five and six meant I immediately went into all the top sets […] so, I think that was a success, all three sets, but I was in the top set, and I was really relieved being in the top set*

But she has also overcome this labeling, which makes her highly reflective of her own and others' situation and positioning. Possibly because of this Kaitlin has actually chosen herself to study mathematics and medicine:

> *Me: why would you say that you're not good at maths?*
> *Kaitlin: I know, I know – […] – sometimes I still think I'm dyslexic, and […] for me you know problems just seem so big in the beginning, and then I put lots of work in, and all of the sudden they're really easy, but it takes all that work*

It appears that Kaitlin's earlier problems may have led to a level of reflection which enables her to resist to some discourses – for instance, that girls cannot do mathematics – and to find her way through competing discourses to make a choice which is more complex than she first suggests.

6.6 To sum up

In this chapter, I have analysed the stories the students told me in the interviews by interpreting and retelling them to answer my research questions. The analysis has revealed how stories about choice which initially seem 'straight forward' and 'easy', cannot be separated from stories about identity, about assumptions of what mathematics and ability is, about other people, about gender and about competing discourses and contradictions. In the next chapter, I will summarize my results and answer my research questions and conclude the research report.

7.0 Conclusion

In this chapter, I will conclude my research report by giving a brief summary of the issues that led to this study and how I chose to address those issues. I will also summarize my findings from the analysis and revisit my research questions. This chapter will conclude with some reflections on the study and on its implications for our understanding of how students choosing post-compulsory mathematics.

7.1 The issues and how I chose to address them

In the second chapter of this report, I wrote about the different educational contexts of Norway and England, and how these related to some key issues in mathematics education research. Both Norway and England are concerned about the low number of students choosing to continue with post-compulsory mathematics and the study of STEM subjects in higher education. Further, I wrote about how the two school systems are based on very different ideologies: the Norwegian school system sees equality as a central concern, and permanent differentiation of students based on their perceived abilities is not allowed, while in England a focus on competition and ability leads to widespread acceptance of ability grouping which is seen as a norm. In section 2.2, I wrote about the key issues of choice and gender in mathematics education research. Research suggests that choosing post-compulsory mathematics is connected to who students are in terms of their socio-economic background and cultural capital, what kind of person they perceive themselves to be, and to the role of significant people (teachers, parents and peers) in their lives. As I wrote in section 2.2.3, I see a focus on gender as constraining the interpretation of the outcome of research on choice in mathematics education. I will discuss this issue of gender in research later in this chapter.

I chose to investigate these issues by comparing stories from students who have chosen post-compulsory mathematics in England and Norway, using concepts from Sfard and Prusak's (2005a, 2005b) theory on narratives as identity, Gee's (2012) definition of cultural models and Bakhtin's theory (Bakhtin, 1981, 1986) on how we self-author ourselves and enact our identities through drawing on the tools of our culture.

In a qualitative study like this one, the purpose is not to generalize, but to look closer at the issues and to explore them further. It is not my intention to say something about all the students in the world and their subject choices, but to interpret these fifteen students' stories in order to be able to say something about the role of cultural differences and similarities in their accounts of choosing post-compulsory mathematics.

7.2 Answering the research questions

The research questions which this study therefore sought to answer were:

> *What cultural differences and similarities are visible in English and Norwegian students' accounts of choosing mathematics?*
>
> - *What cultural models of gender and education do they draw on?*
> - *How do they self-author as students of mathematics?*

One similarity which emerged from my analysis of the students' stories was that they all drew on 'international' ideas and discourses about what mathematics is, who does mathematics and what 'ability' in mathematics is. For all of the students, mathematics is difficult, challenging and definite. Many drew on the idea that you can work hard and be good at mathematics, but only those who are born good at mathematics can be 'brilliant'.

There were, however, many cultural differences which were visible in the students' accounts of choosing mathematics, reflecting their different cultural backgrounds and their experience of growing up in two fundamentally different educational systems. The impact of these educational systems and their ideologies were very evident in the stories. This was expected, because as Gee (2012), Bakhtin (1981, 1986) and Sfard and Prusak (2005a, 2005b) tell us, we draw on discourses and cultural models in our culture to explain ourselves to ourselves and others, and because, as I wrote in section 3.4, utterances (stories) are carriers of ideology and ideologies are something which we think from (Braathe, 2011).

I found that ability and competition discourses were more powerful in the English students' stories, than in the Norwegian students' stories. That was not very surprising because 1) the English school system in mathematics education is heavily based on ability-related practices, whereas it is not in Norway, but also 2) the wider cultural context of education in England is strongly connected to neoliberal ideas of individual ability and responsibility, and institutional accountability and competition. The English students drew on discourses from their school system and culture. They talked about ability grouping and about the competition in the educational system. In their culture ability grouping is the norm, and this shows in their stories and their self-authoring as students of mathematics. Most of the English students had always been in the top sets in mathematics, positioned in the school system as good at

mathematics on the basis of receiving good grades with opportunities to study mathematics further.

The Norwegian students were very careful when they talked about differences because equality in choice and opportunities is very important in the Norwegian educational ethos. Drawing on discourses of equality and the Law of Jante, the students in Norway were careful not to devalue other students and other subjects, even though they drew on the 'international' discourse of mathematics as a marker of cleverness. This meant that the Norwegian students in particular had to 'juggle' these competing discourses. Both the Norwegian and English students can be described as 'winners' in their respective systems, in that they study mathematics, which is seen as important in society and for future choices. Their stories reflect the interplay between important discourses of ability, competition and equality of the dominant educational ideologies in their countries.

In the analysis, I showed how the students' initial responses to the question of why they had chosen mathematics can be understood as a type of easy or superficial reason for their choice. In these answers, the students drew on cultural models of education connected to mathematics, for example, the idea of the' good student' as making smart choices for the future and choosing mathematics (because it is hard, 'intellectual' and needed for high-status degree courses and professions) is a smart choice. The students used this model to position themselves as different from other students and as potentially able to train for 'prestigious' occupations in the future. In these answers, many of the students invested in a discourse of education where mathematics provides more opportunities in the future than other subjects.

In their stories about the intrinsic qualities of doing mathematics as an explanation for their choice, many of the students reflected an image of the mathematics student as different from students who choose other subjects. Many of them connected the perceived intrinsic qualities of mathematics (it is hard) to a discourse of natural ability in mathematics: so choosing mathematics is a natural choice if you are good at it. Some of the students used 'othering' to position themselves with respect to others, making themselves different and special. Discourses about mathematics and who does mathematics strongly separate mathematicians from other people, and some of the students invested in this idea by clearly identifying themselves as mathematicians in their stories. They drew on the importance of mathematics for solving problems in society and the idea of mathematics as a foundation for understanding the world, and on discourses of gender in relation to who can be an expert mathematician.

In terms of intrinsic reasons for why they had chosen mathematics, there were more similarities than differences. The most important similarity in all the students' stories was that they had chosen it because it is part of their own and other's idea of who they are – it is a part of their actual and designated identities. Sfard and Prusak's (2005a, 2005b) theory suggests that part of our self-authoring comes from how we are talked about by people who are close to us, such as our teachers and our families. Many of the students talked about how their families were 'mathy' families: it was in the nature of their families to study mathematics or to be good at and like mathematics. Some students made hypotheses about how being born into this type of family resulted in them being interested in mathematics from an early age, and that this interest meant that they worked harder and became good at mathematics and ergo more interested in it than other students from other families. They also talked about how their families supported their choice of continuing with mathematics and encouraged them. One difference between the Norwegian and the English students stories was that the Norwegian students talked explicitly about how their parents influenced their choice of continuing with mathematics, while only one of the English students discussed the influence of significant others in such clear terms. Most of the English students claimed that despite coming from a 'mathy' family, their choice was their own, and was based on interest and their ability in mathematics.

The Norwegian students were very aware of and reflected on discourses about gender in relation to abilities in mathematics and traditional roles in society, but they always kept hold of the discourse of equality, trying not to devaluate those who do not choose mathematics. Gender discourses, and responses to them, were not as clearly evident in the English students' stories. Some claimed that they did not know anything about gender differences, while Emily even rejected the concept altogether, saying that 'nobody really does any type of stereotyping anymore'. It may be that the English students sometimes lack a language to talk about gender issues, and that more powerful discourses of ability and competition overwhelm and perhaps bury gender issues.

Nevertheless, the students in this study, both Norwegian and English, clearly positioned themselves within discourses of ability and gender. They all positioned themselves in terms of their possession of strong abilities within mathematics, and for many this position or narrative appeared to be stronger than the gender discourse. Therefore, for many of the girls, the gender discourse which suggests that girls do not traditionally study mathematics appears not to be a

threat in their choice of studying mathematics post-compulsory or in the future. Some of the girls, like Sara, positioned herself on both sides of a gender divide by choosing both mathematics and language as subjects, and she tried to juggle discourse and stereotypical views of gender to make the facts fit with her identity as a female student who enjoys both types of subjects. In this way she could justify her subject choices.

In the students' stories about 'always' having been good at mathematics, we see how they drew on particular cultural models of education: in England, where competition and ability discourses are very evident, and in Norway, where equality discourses are important. The students' actual identities as good at mathematics and how they tell the story of themselves as always liking, being good at and enjoying mathematics, can be seen as a result of what Sfard and Prusak (2005b) call narrative diffusion: circulating stories about oneself with many authors such as teachers, friends and family, which blend with ability, competition and equality discourses to become more and more part of one's own identifying narrative. Stories about themselves as good at mathematics, sometimes including words such as 'always' are what Sfard and Prusak (2005b) calls reifying, endorsable and significant identifying narratives. In their stories, the students drew on the discourse of mathematics as definite and an idea of ability in mathematics as natural and not for everybody to give a reason for why they had chosen mathematics.

Summing up

My further analysis of the students' stories shows that actually choice is not just a question of 'I'm doing this because it's good for my career' but 'I'm doing this because of the person I am'. The students drew on cultural models and discourses to explain who they 'are' as mathematics students. Some made discourses work for them to explain who they are and who they want to be in an unproblematic way, while others struggled more to juggle competing discourses, both working and sometimes resisting them, in order to explain who they are, who they want to be and to make sense of themselves. The differences which are visible in the students' stories are products of the culture and social settings they participate in; how the students draw on these different cultural models and discourses shows that choice is not simply something rational, but heavily socially situated. I have shown through a focus on all of these multiple themes and issues that choice is made in a constrained set of circumstances and it is a product of negotiation with, and navigation through, different discourses. This

connectedness in all the students' stories takes us almost to the point where we can ask whether there is a choice at all.

7.3 Reflections

The first answer the students gave to my question 'why choose mathematics?' was a kind of answer that one might see in the Lily-study (see section 2.2.1 and Bøe, 2012): straight forward, simple and rational. They like it or they need it for their future, or both of these answers. The answers seem to reflect rational choice. But when probing futher, more complex stories came through, and my analysis has shown that choice is far more complex than the Lily study suggests. It is not a rational choice situation even though many of the students portray their choice as rational.

Further, my analysis has also shown that questions can be raised about using gender as a starting point in research on choice of mathematics, such as Mendick's (see section 2.2.2) (2005b, 2006), because it 'boxes' or categorizes the students as for example feminine, masculine, logical, rational or intelligent. I have shown how subject choices are much more complex than this. A focus on gender can act as a restrictive lens in research of choice, as it eliminates or sidelines other factors which tell us how subject choice is highly socially situated and the 'whole' context around the student plays a role.

This study is a small study, and it could have been improved by using more than one school in England to reflect the different schools in Norway. I could also have included stories from people who have rejected mathematics to be able to look at the differences between students who choose it and those who do not. It could maybe have made my argument about how choice is very complex stronger, but because of the time limit on this study I chose not to do this.

Writing this report in English and interviewing the English students myself has both been a strength but also a weakness in this study. As I have discussed earlier, I sometimes could not understand quickly enough in English to be able to recognize everything in the English students' stories and to follow up what they said. However, the English students knew that I was not connected to their school, and this might have contributed to them being open and explaining more about their school system. For example, they explained what predicted grades were and they explained the process of applying to university. I have learned a great deal of English through this process and I have learned a lot about the English school system,

but having done this cross-cultural study has also taught me a lot about my own culture and school system. It has given me a unique perspective on how choice is very socially dependent, and this is a strength that I can take with me when I start working as a teacher of mathematics.

In section 2.2.1, I quoted Wacquant (1989, p. 45) who wrote that ‘we can always say that the individual makes choices, as long as we do not forget that they do not choose the principles of their choices’. In this report I have shown that Wacquant is right, but to be very honest I think my data has shown that choice is far more complex than anybody says. Maybe it is so complex that in a way it doesn’t make any sense to talk about or use the word choice at all?

Bibliography

Andersen, P. T. (2012). *Norsk litteraturhistorie*. Oslo: Universitetsforl.

Andrews, P. (2001). Comparing international practice in the teaching of mathematics. In P. Gates (Ed.), *Issues in mathematics teaching*. London: Routledge Falmer.

Bakhtin, M. (1981). *The dialogic imagination: Four essays by M. M. Bakhtin* (C. Emerson & M. Holquist, Trans.). Austin, TX: University of Texas Press.

Bakhtin, M. (1986). *Speech genres and other late essays* (V. W. McGee, Trans.). Austin, TX: University of Texas Press.

Belencky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1986). *Women's ways of knowing: The development of self, voice and mind*. New York: Basic Books.

Bernstein, B. (2000). *Pedagogy, Symbolic Control and Identity* (revised ed.). Maryland: Rowman and Littlefield.

Bishop, A. (2001). What values do *you* teach when you teach mathematics? In P. Gates (Ed.), *Issues in mathematics teaching*. London: Routledge Falmer.

Bjørkeng, B. (2011). *Jenter og realfag i videregående opplæring*. Oslo: Statistisk sentralbyrå.

Black, L., Mendick, H., Rodd, M., Solomon, Y., & Brown, M. (2009). Pain, Pleasure, and Power: Selecting and Assessing Defended Subjects. In L. Black, H. Mendick & Y. Solomon (Eds.), *Mathematical Relationships in Education* New York: Routledge.

Boaler, J. (1997). *Experiencing school mathematics: Teaching styles, sex and setting*. Buckingham, UK: Open University Press.

Boaler, J. (2002). The Development of Disciplinary Relationships: Knowledge, Practice and Identity in Mathematics Classrooms. *For the Learning of Mathematics, 22*(1), 42-47.

Boaler, J., & Greeno, J. (2000). Identity, Agency and Knowing in Mathematics Worlds. In J. Boaler (Ed.), *Multiple Perspectives on Mathematics Teaching and Learning*: Ablex Publishing.

Boaler, J., & Wiliam, D. (2001). 'We've still got to learn!' Students' perspectives in ability grouping and mathematics achievement. In P. Gates (Ed.), *Issues in mathematics teaching*. London: Routledge Falmer.

Braathe, H. J. (2011). *Negotiating mathematics teacher identities* Paper presented at the Mathematics Education and Contemporary Theory, Manchester. http://www.esri.mmu.ac.uk/mect/papers-list.php

Braathe, H. J. (2012). Discursive positioning in Norwegian teacher education: Shifting from cross-curricularity to skills-based subject specialization. *International Journal of Educational Research*(55), 26-35.

Braathe, H. J., & Ongstad, S. (2001). Egalitarianism meets ideologies of mathematical education – instances from Norwegian curricula and classrooms. *ZDM 33*(5), 1-11.

Bryman, A. (2001). *Social research methods*. Oxford: Oxford University Press.

Bøe, V. M. (2012). Science Choices in Norwegian Upper Secondary school: What Matters? *Science Education, 96*(1), 1-20. doi: 10.1002/sce.20461

Bøe, V. M., Henriksen, E. K., Lyons, T., & Schreiner, C. (2011). Participation in science and technology: Young people's achievement-related choices in late modern societies. *Studies in Science Education, 47*(1), 37-71.

Damarin, S. (2000). The mathematically able as a marked category. *Gender and Education, 12*(1), 69-85.

Disclosure and Barring Service. (2013). Guide to Criminal Records Bureau (CRB) checks (Disclosure and Barring Service) Retrieved 16.03, 2013, from https://www.gov.uk/disclosure-barring-service-check/overview

Dowling, P. (2001). Reading mathematics texts. In P. Gates (Ed.), *Issues in mathematics teaching*. London: Routledge Falmer.

Education Audiovisual & Culture Executive Agency. (2009/2010). Organisation of the education system in the United Kingdom – England, Wales and Northern Ireland 2009/2010 *Eurybase*.

Fylkenes informasjonstjeneste for søkere til videregående opplæring. (2013). Vilbli.no, from www.vilbli.no

Færden, S. (2012). Her er det vanskeligst å komme inn *Aftenposten*. Retrieved from http://www.aftenposten.no/jobb/Her-er-det-vanskeligst-a-komme-inn-6946195.html

Gates, P. (2001). What is an/at issue in mathematics education? In P. Gates (Ed.), *Issues in Mathematics Teaching*. London: Routledge Falmer.

Gee, J. P. (2012). *Social linguistics and literacies: ideology in discourses*. London: Routledge.

Giddens , A. (1991). *Modernity and self-identity. Self and society in the late modern age*. Cambridge, England: Polity Press.

Holland, D., Lachicotte, W., Skinner, D., & Cain, C. (1998). *Identity and agency in cultural worlds*. Cambridge MA: Harvard University Press.

Institute of Mathematics and its Applications. (2012). A-level results - Mathematics is counting its success Retrieved 01.02, 2013, from http://www.ima.org.uk/viewItem.cfm?cit_id=384272

Israel, J. (1973). *Sociologisk grundbog*. Copenhagen: Gyldendal.

Johannessen, A., Tufte, P. A., & Christoffersen, L. (2010). *Introduksjon til samfunnsvitenskapelig metode*. Oslo: Abstrakt.

Kleve, B. (2007). *Mathematics Teachers' Interpretation of the Curriculum Reform, L97, in Norway*. (Doctoral Thesis), Agder University College, Kristiansand. (5)

Kvale, S., & Brinkmann, S. (2009). *Det kvalitative forskningsintervju* (T. M. Anderssen & J. Rygge, Trans.). Oslo: Gyldendal akademisk.

Lerman, S. (2000). The Social Turn in Mathematics Education Research. In J. Boaler (Ed.), *Multiple Perspectives on Mathematics Teaching*. Westport, CT, USA: Greenwood Publishing Group.

Lerman, S. (2006). Learning mathematics as developing identity in the classroom. In P. Liljedhal (Ed.), *Proceedings of the Canadian Mathematics Education Study Group* (pp. 3-13). University of Ottawa: CMESG.

Mason, J. (2002). *Qualitative researching*. London: Sage.

MEI. (2009). The effects of 2-tier GCSE Mathematics on transition to AS and A Level. Retrieved 03.01.2013, from Mathematics in Education and Industry http://www.mei.org.uk/files/pdf/Two_tier_GCSE.pdf

Mendick, H. (2005a). A Beautiful Myth? The Gendering of Being/Doing "Good at Maths". *Gender and Education, 17*(2), 203-219.

Mendick, H. (2005b). Mathematical Stories: Why Do More Boys than Girls Choose to Study Mathematics at AS-Level in England? *British Journal of Sociology of Education, 26*(2), 235-251.

Mendick, H. (2006). *Masculinities in Mathematics. Educating Boys, Learning Gender*: Open University Press.

Mendick, H., Moreau, M.-P., & Epstein, D. (2009). Special cases : neoliberalism, choice and mathematics education. In L. Black, H. Mendick & Y. Solomon (Eds.), *Mathematical Relationships in Education*. New York: Routledge.

Ministry of Education and Research. (2007). *Education - from Kindergarden to Adult Education*. Retrieved from http://www.european-agency.org/country-information/norway/norwegian-files/Gen_Education_in_Norway.pdf.

Norwegian University of Science and Technology. Retrieved 01.02, 2013, from www.ntnu.no

Noyes, A. (2009). Exploring social patterns of participation in university-entrance level mathematics in England. *Research in Mathematics Education, 11*(2), 167-184.

Noyes, A., & Sealey, P. (2009). *Investigating the retention of A level mathematics students*. Paper presented at the British Educational Research Association, Manchester, 2. - 5. September.

Ofqual/09/4144. GCSEs - The official student guide to the system. www.ofqual.gov.uk: tbc.

Ongstad, S. (2006). Mathematics and mathematics education as triadic communication? A semiotic framework exemplified. *Educational Studies in Mathematics, 61*, 247-277.

Paechter, C. (2001). Gender, reason and emotion in secondary mathematics. In P. Gates (Ed.), *Issues in mathematics teaching*. London: Routledge Falmer.

Sandemose, A. (2000). *En flyktning krysser sitt spor: fortelling om en morders barndom*. Oslo: Aschehoug.

Schoenfeld, A. (1992). Learning to think mathematically: Problem-solving, metacognition and sense making in mathematics. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 334-370). New York: Macmillan.

Sells, L. (1980). The mathematics filter and the education of women and minorities. In L. H. Fox, L. Brody & D. Tobin (Eds.), *Women and the mathematical mystique*. Baltimore, MD: John Hopkins University Press.

Sfard, A. (2007). When the Rules of Discourse Change, but Nobody Tells You: Making Sense of Mathematics Learning from a Commognitive Standpoint. *Journal of the Learning Sciences, 16*(4), 565-613.

Sfard, A., & Prusak, A. (2005a). *Identity That Makes a Difference: Substantial Learning as Closing the Gap between Actual and Designated Identities.* Paper presented at the Proceedings of The 29th Conference of the International Group for the Psychology of Mathematics Education, University of Melbourne, Australia.

Sfard, A., & Prusak, A. (2005b). Telling Identities: In Search of an Analytic Tool for Investigating Learning as a Culturally Shaped Activity. *Educational Researcher, 34*(4), 14-22.

Smith, C. (2010). Choosing more mathematics: happiness through work? *Research in Mathematics Education, 12*(2), 99-116.

Solomon, Y. (2009). *Mathematical literacy : developing identities of inclusion*. New York: Routledge.

Solomon, Y. (2012). Finding a voice? Narrating the female self in mathematics. *Educational Studies in Mathematics, 80*(1-2), 171-183. doi: 10.1007/s10649-012-9384-z

Store norske leksikon. middelklasse *Store norske leksikon*. snl.no/middelklasse.

The Norwegian Directorate for Education and Training. (2013). Utdanningsdirektoratet Retrieved 07.01, 2013, from www.udir.no

TIMSS and PIRLS Internations Study Center. (2011). TIMSS 2011 International Results in Mathematics Lynch School of Education: Boston College.

Wacquant, L. J. D. (1989). Towards a reflexive sociology: A workshop with Pierre Bourdieu. *Sociological Theory, 7*(1), 26-63.

Walshaw, M. (2007). *Working with Foucault in Education*. The Netherlands: Sense Publishers.

Wedege, T. (2007). Gender perspective in mathematics education: intentions for research in Denmark and Norway. *ZDM The International Journal on Mathematics Education*(39), 251-260. doi: 10.1007/s11858-007-0026-3

Winther Jørgensen, M., & Phillips, L. (1999). *Diskursanalyse som teori og metode*. Frederiksberg: Roskilde Universitetsforlag.

Appendix 1: Informed consent form used in England

Informed Consent Form

I am a masters student at the University College of Oslo and Akershus in Norway, and I am now doing my final year project. The theme of my thesis is students' choice of mathematics as a subject in Sixth Form (Year 13) in England, and in the equivalent school year in Norway. I am interested in hearing stories from this group of students about their feelings about mathematics, and why they have chosen to study it. Both groups of students will be asked the same type of questions, and the results will be compared for similarities and differences.

I will be interviewing between six and eight students who have chosen to study mathematics in their final year of school (year 13). The students must be at least 18 years old. I will be asking questions about opinions about mathematics and how it can be used, why students chose to study mathematics and how they feel about it. I will audio tape the interviews and take notes after the interview. The interview will take about 1 hour.

Participation in the project is entirely voluntary, and you have the right to withdraw at any time. If you withdraw, your data will be deleted. All the information you supply will be treated with confidentiality, and it will not be possible to recognize individuals in the final report. The information will be anonymised, and will be deleted when the project is finished at the end of 2013. We will not share any information you give us with your teachers.

If you are happy to participate in the project, please sign this consent form.

If you have any questions, I can be reached by email at s149629@stud.hioa.no. My supervisor Yvette Solomon at Manchester Metropolitan University is also available if you have any questions and can be reached on her email y.solomon@mmu.ac.uk.

The research project is regulated by the Norwegian Social Science Data Services (NSD).

Best regards
Katarina With
Helgesensgate 82 e
0563 Oslo

Consent:

I have received written information about this project and I agree to participate in the study. I understand that all data will be confidential and anonymised, and that I am free to withdraw at any time.

Signature ……..

Appendix 2: Guarantee of confidentiality used in England

Guarantee of confidentiality

Supervisor: Yvette Solomon

Student: Katarina With

Title: Choosing mathematics - a comparative study of the reasons of why students choose to study mathematics

Purpose: In this project, I will interview students in 3rd grade upper secondary school in Norway and students in the sixth form in England about how they feel about mathematics and why they have chosen to study mathematics at this level. I hope to gain some insight into students' relationship with the subject from their stories.

This form guarantees that the information gained during the interviews and the project is confidential. Only my supervisor and myself will have access to the data in this project. Any data that is published in the final report will be anonymous, and the data will be deleted from our records when the project is finished.

Place Date Signature

Appendix 3: Informed consent form used in Norway

Forespørsel om å delta i intervju i forbindelse med en masteroppgave

Jeg er masterstudent i grunnskoledidaktikk ved Høgskolen i Oslo og Akershus og holder nå på med den avsluttende masteroppgaven. Temaet for oppgaven er valg av matematikk siste året på videregående. Jeg er interessert i å høre fortellinger som denne elevgruppen har om hvordan de forholder seg til matematikk og hvorfor de har valgt det. De samme spørsmålene vil bli stilt til en elevgruppe i England, og resultatene vil bli sammenlignet for å se etter likheter og forskjeller.

For å finne ut av dette, ønsker jeg å intervjue 6-8 elever som har valgt matematikk siste året på videregående skole. Elevene må være 18 år eller eldre. Spørsmålene vil dreie seg om meninger om hva matematikk er, hva man kan bruke matematikk til, hvorfor man velger å ta det som et fag og hva slags forhold man har/har hatt til matematikken. Jeg vil bruke båndopptaker og ta notater mens vi snakker sammen. Intervjuet vil ta omtrent en time, og vi blir sammen enige om tid og sted.

Det er frivillig å være med og du har mulighet til å trekke deg når som helst underveis, uten å måtte begrunne dette nærmere. Dersom du trekker deg vil alle innsamlede data om deg bli anonymisert. Opplysningene vil bli behandlet konfidensielt, og ingen enkeltpersoner vil kunne gjenkjennes i den ferdige oppgaven. Opplysningene anonymiseres og opptakene slettes når oppgaven er ferdig, innen utgangen av 2013.

Dersom du har lyst å være med på intervjuet, er det fint om du skriver under på den vedlagte samtykkeerklæringen.

Hvis det er noe du lurer på kan du ringe meg på 93 43 07 33, eller sende en e-post til s149629@stud.hioa.no. Du kan også kontakte min veileder Yvette Solomon ved Manchester Metropolitan University på e-post y.solomon@mmu.ac.uk.

Studien er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste (NSD).

Med vennlig hilsen
Katarina With
Helgesensgate 82 e
0563 Oslo

Samtykkeerklæring:

Jeg har mottatt skriftlig informasjon og er villig til å delta i studien.

Signatur ……..

Appendix 4: Guarantee of confidentiality used in Norway

Taushetserklæring

Prosjektansvarlig: Yvette Solomon

Student: Katarina With

Prosjekttittel: Master i skolerettet utdanningsvitenskap

Formål: I dette prosjektet, vil jeg bruke intervjuer med elever i tredjeklasse videregående skole (og elever i sixth form i England) til å se på forholdet de intervjuede elevene har til matematikkfaget, og hvorfor de har valgt å studere faget det siste året på videregående skole. Jeg ønsker å få innsikt i deres historier og fortellinger om deres forhold til matematikkfaget.

Undertegnede, student Katarina With, og prosjektansvarlig, Yvette Solomon, vil være de eneste som vil ha tilgang til de opplysninger som samles inn i forbindelse med prosjektet, og som kan tilbakeføres til enkeltpersoner.

Jeg erklærer med dette at ingen opplysninger som kommer meg i hende i forbindelse med prosjektarbeidet vil være tilgjengelig for andre. I forbindelse med masteroppgaven vil kun anonymiserte opplysninger bli gitt, og dataene vil slettes når prosjektet er ferdigstilt.

Sted Dato Underskrift av student

Appendix 5: NSD approval

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Yvette Solomon
Institutt for grunnskole- og faglærerutdanning
Høgskolen i Oslo og Akershus
Postboks 4, St. Olavs plass
0130 OSLO

Vår dato: 14.09.2012 Vår ref:31433 / 3 / MSI Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 11.09.2012. Meldingen gjelder prosjektet:

31433	*To choose mathematics. A comparative study on the reasons of why students choose to study mathematics*
Behandlingsansvarlig	*Høgskolen i Oslo og Akershus, ved institusjonens øverste leder*
Daglig ansvarlig	*Yvette Solomon*
Student	*Katarina With*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/forsk_stud/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 31.12.2013, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Vigdis Namtvedt Kvalheim

Marte Sivertsen
Marte Sivertsen

Marte Sivertsen tlf: 55 58 33 48
Vedlegg: Prosjektvurdering
Kopi: Katarina With, Helgesensgate 82e, 0563 OSLO

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 31433

Formålet er å undersøke og sammenligne valg av matematikk siste året på videregående skole i Norge og siste året ved Sixth form i England. Utvalget omfatter 12-16 elever.

Ifølge prosjektmeldingen skal det innhentes skriftlig samtykke basert på muntlig og skriftlig informasjon om prosjektet og behandling av personopplysninger. Personvernombudet finner informasjonsskrivet tilfredsstillende utformet i henhold til personopplysningslovens vilkår.

Data innsamles ved hjelp av personlig intervju, og registreres ved hjelp av lydopptak som behandles elektronisk. På bakgrunn av intervjuguiden finner personvernombudet det lite sannsynlig at det vil fremkomme sensitive personopplysninger om rasemessig eller etnisk bakgrunn, eller politisk, filosofisk eller religiøs oppfatning jf. personopplysningsloven § 2 nr. 8 a).

Innsamlede opplysninger registreres på privat pc. Personvernombudet legger til grunn at veileder og student setter seg inn i og etterfølger Høgskolen i Oslo og Akershus sine interne rutiner for datasikkerhet, spesielt med tanke på bruk av privat pc til oppbevaring av personidentifiserende data.

Prosjektet skal avsluttes 31.12.2013 og innsamlede opplysninger skal da anonymiseres og lydopptak slettes. Anonymisering innebærer at direkte personidentifiserende opplysninger som navn/koblingsnøkkel slettes, og at indirekte personidentifiserende opplysninger (sammenstilling av bakgrunnsopplysninger som f.eks. yrke, alder, kjønn) fjernes eller grovkategoriseres slik at ingen enkeltpersoner kan gjenkjennes i materialet.

Appendix 6: Interview guide with research questions

Research Questions!

How do students in Norway and England describe choosing mathematics?

- What stories do they tell about significant people?
  - role of parents?
  - role of teachers?
  - role of siblings?
  - role of friends?
- What stories do they tell about the school system?
  - grading?
  - testing?
  - ability?
  - pressure?
- What stories do they tell about gender differences and similarities?
  - girls and boys?
  - teachers?
  - ability?
  - reasons to study?

Appendix 7: Interview guide with key questions

Interview guide

Information	• Talk a little about the subject or theme for the interview, and what I am going to use it for • Give information about the guarantee of confidentiality and about anonymity of the interviewee in the final report, which I have to sign • Inform about that my supervisor also will have access to the interviews • Make sure the interviewee knows that I will record the conversation • The interviewee will have to sign the consent form • Ask if anything is unclear • Explain that the interviewee can withdraw from the interview at any time • Inform the interviewee that I might ask him/her to talk louder because of the recording
Warming up questions	First, if you could tell me a little about your family situation - Parents work and/or their education, brothers or sisters etc.
Key questions and themes Extra: mathematician, describe maths, ability!!! Remember: Tell me about… Could you… Listen closely… Girls and boys…	**Choosing maths:** - Could you tell me about what made you choose maths? - What other subjects do you study? Any favorites? - Why do you think people choose or do not choose to study maths? - What does it mean to be good at maths? What makes some good at maths? - Are you good at maths? Why/why not? When did you realize this? (ability) - What about your friends, have any of them chosen maths too? - How does your friends and family see your choice of maths? Are they girls or boys? **Mathematical history** - I am very interested in your mathematical story: do you have some memories of special episodes or teachers? - Is there somebody in your family who likes maths? Or anyone else close to you who enjoys maths or studies maths? - Do you get support from friends, family, or teachers etc.? In what way? Do they help you with your maths? Do they agree with your choice of maths? - What does this support mean to you? **Lessons in school** - Can you describe a typical maths lesson? - Are there any differences between the boys and girls in your class? - Can you tell me about sets, and what sets you have been in? - Can you tell me about grades and testing? How often? Do your grades show how much you have worked and how much you know? **The future etc.** - Can you tell me about your plans for the future? - Do you think there are any differences between girls and boys who chose to study maths, or between what they choose to study?
Finishing up	- Sum up what we have talked about - Ask if I have understood things correctly - Ask if the interviewee would like to add something, or if he/she has any questions