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Progression of motivation for mathematics education,

from primary to secondary school

Progresjon av motivasjon for matematikkfaget,

fra barneskolen til ungdomsskolen.

Scientific qualitative study

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Abstract

Through focus group interviews this thesis seeks to explore motivation for mathematics education for 7th grade students (final year of Norwegian primary schooling) and 10th grade students (final year of Norwegian secondary schooling). Researching similarities and differences between 7th and 10th grade students. The theoretical framework of Middleton, Jansen and Goldin (2016) was adapted for defining motivation in mathematics education, adding social factors. Focus group interviews with three groups of both sets of students took place, and four individual cases were analysed using Bronfenbrenner's theory of bioecology (Bronfenbrenner, 2005). A multiple-case study analysis was chosen to explore the students of lowest and highest motivational levels, to highlight the outliers of motivational levels. The findings show how most students in the study from both 7th and 10th grade describe lacking motivation for mathematics education. Social factors allowed a large degree of autonomous and independent work for mathematics students but put emphasis on distractions rather than improving mathematical skills for social standing. Self-efficacy beliefs were crucial for any other motivational factor to be influential. Thus, giving few social incentives to improve and engage with the teaching, limiting chances to experience intrinsic motivation (Ryan & Deci, 2000). The biggest difference in motivation between 7th and 10th grade is the influence of testing and grades, which for several 10th graders meant frequent experiences of negative affect. For all 10th graders grades were a measurement of achievement, comparing results and progression to that of their peers. Only students of high motivation regarded testing, grades, and the progression of difficulty in mathematics as positive challenges which had its basis in intrinsic motivation. Social factors were found to be vital when students interpreted their own mathematics competence for both sets, and in turn influenced all other factors of motivation.

Keywords: Motivation, Social factors, Mathematics education, Focus group interviews, Bronfenbrenner, Theory of bioecology

Sammendrag

Gjennom fokusgruppeintervjuer ble 7. klassinger og 10. klassinger undersøkt for sin motivasjon for matematikk. Forskningen ønsker å finne likheter og ulikheter for motivasjon mellom om de to settene. Et teoretisk rammeverk av Middleton, Jansen og Goldin (2016) ble adaptert for å definere motivasjon for matematikk. Inkludert i rammeverket er faktorer som mestringstro, affekt og sosiale faktorer. Fokusgruppeintervjuer ble gjennomført med tre grupper fra hvert sett, hvor fire individuelle kasus ble analysert gjennom Bronfenbrenners bioøkologiske modell (Bronfenbrenner, 2005). En analyse av multi-kasusstudie ble gjennomført med de laveste og høyeste motiverte elevene i studiet, for å undersøke hvorfor noen elever hadde ulike utfall. Funnene i dette studiet viser at elevene fra begge klassetrinn beskriver manglende motivasjon for matematikkfaget. Elevene foretrekker å samarbeide med elever på sitt nivå og med likt engasjementet for faget. Dette resulterer i at sosiale faktorer forsterker elevenes oppfattelse av egen mestring. Mestringstro er en avgjørende faktor for at andre motivasjonsfaktorer skal ha innflytelse. Sosiale faktorer tillater autonom og uavhengig arbeidsinnsats, men fokuserer på distraksjoner heller enn å heve ferdigheter i matematikk. Derav gis få sosiale insentiv for engasjement og forbedring, hvilket begrenser anledningen for indre motivasjon (Ryan & Deci, 2000). Den største forskjellen mellom 7.ende og 10.ende klassingene er innflytelsen til tester og karakterer. For 10.ende klassinger medføre disse stadige opplevelser med negativ affekt. For alle 10.ende klassinger ble karakterer brukt som et sammenligningsgrunnlag av oppnåelse, og resultatene ble sammenlignet med klassekameratene. Kun elever med høy motivasjon anså tester, karakterer, og økende vanskelighetsgrad i faget som positive utfordringer med en basis i indre motivasjon. Sosiale faktorer ble funnet å være essensielle for hvordan elever tolket sin matematiske kompetanse, og derav hadde innflytelse på alle andre motivasjonsfaktorer.

Nøkkelord: Motivasjon, Sosiale faktorer, Matematikkfaget, Fokusgruppeintervju, Bronfenbrenner, Den bioøkologiske teori

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Hanna, Elias, Kg, to which my love and gratefulness is eternal.

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1. Introduction

All students of mathematics deserve a chance to be treated equally. Every child has a voice, and a sense of reason. Through my years of studying the art of mathematics education I have come to see ‘the social turn’ of Lermann (2000), as well as the evolved ‘sociopolitical turn’ of Gutiérrez (Gutiérrez, 2013) as the golden standard of mathematics education. Mathematics education holds a power to put students on or off a path of higher education. Yet throughout my teacher’s education I have observed classrooms void of equality and collaboration. Students who have felt no sense of participation, who doubt their competence in mathematics, who lack motivation for learning mathematics. From my experience two hypothesis have formed. One that the primary mathematics education has fewer external factors influencing the students. Secondly how students in late secondary might be more likely to feel unmotivated for mathematics education then their younger counterparts.

Table 1. Norwegian 10^{th} grade students of mathematics grouped by their achieved level of skill in PISA 2012 (Nortvedt & Pettersen, 2015, p. 118).

Mathematics level	**Low**	**Middle**	**High**
5^{th} grade	18	34	48
9^{th} grade	35	36	29

Table 2. Norwegian students of mathematics grouped by their achieved level of skill in TIMSS 2019 (Kaarstein, Radišić, Lehre, Nilsen, & Bergem, 2020, pp. 11, 13).

Modern international testing, PISA and TIMSS suggests Norwegian students are more successful in their primary years, and the group of students achieving low test-scores increase significantly in size by their secondary school testing (Kaarstein et al., 2020). To seek insight as to how many students have a negative development, I seek to understand how they are motivated for mathematics education. The research question is to compare motivation for mathematics education between 7^{th} and 10^{th} grade students. The intended goal is to identify and address symptoms of why the group of students with lower skill level is significantly larger in secondary school, compared to their primary school counterparts. Are they motivated differently? And if so, how?

2. Theoretical Considerations

"Motivation is, put simply, the reason we engage in any pursuit, mathematical or otherwise." (Middleton et al., 2016). Motivation is human nature and human spirit on display. When motivated an individual can actively seek new experiences, learn new skills, and enjoy exploring simple curiosity. Psychology is the scientific study of mind and behavior, and motivation is therefore an individual construct. Not simply explained through biological background, researchers suggest social contexts are equally important, after all there are no one culture or social hierarchies where all people are motivated (Ryan & Deci, 2000).

"Research on the conditions that foster versus undermine positive human potentials has both theoretical import and practical significance because it can contribute not only to formal knowledge of the causes of human behavior but also to the design of social environments that optimize people's development, performance, and well-being" (Ryan & Deci, 2000, p. 68).

The practical significance for mathematics education is clear, social environments should be designed to maximize a student's potential. Students are different, their behavior are different and modern international testing show they achieve differently (Kaarstein et al., 2020; Nortvedt & Pettersen, 2015). Hannula (2006) suggest that to understand student behavior in their social environments, we first need to better understand what motivation is, and how students regulate their motivation.

2.1 Motivation in Mathematics Education Research

To define and operationalise motivation for this thesis, it is important to understand the historical developments in the scientific field, and what state of the art research use today. Developments in the field of psychology and social science have influenced how learning in mathematics education is understood.

Figure 1. Progression of research on attitude, behaviour, and motivation in mathematics education

Figure 1. is an illustration of my understanding of how research on psychological factors has evolved in mathematics educational research. Around the same time as behaviourist and cognitive learning theories found its footing, social psychology started on another assumption: Cognitive factors were not the only factors influencing learning mathematics (Di Martino, 2016). This led to studies of the construct attitude in mathematics education, and the methodology was dedicated to applying causal relationships between achievement and motivation (Leder, 1985).

To exemplify, when researchers sought to define categories of attitude research, definitions would consistently be focusing on which measurement to observe correlations and significance to achievement. These measurements were typically used by various quantifiable scales, Likert-, Thurstone- and semantic scales (Leder, 1985). This focus caused attitude research to be plagued by the difficulty of quantifying psychology, trying to operationalise measurable aspects, and matching these variables to the respective theoretical definitions of attitude and motivation. How does a researcher prove the impact of individual psychology, based on students' answers? In time neuroscience might help push the boundaries of motivational research (Hannula, 2016), but it was not the case in the middle of the 20th century. In essence this issue of applying the scientific dogma of natural science research caused operationalising issues, "authors either implicitly or explicitly define attitude to mathematics in terms of the instrument(s) used in their research." (Leder, 1985, p. 21). Saying someone was motivated, based on a scale measuring instrument was difficult to validate and researchers struggled for years to prove reliability. Modern researchers imply this has led the field of attitude studies in mathematics to the modern interpretive paradigm and qualitative research, which is like development in other social sciences (Martino & Zan, 2015). Another important development to note is how this in time turned attitude research away from seeking the causal link to achievement (Martino & Zan, 2015). Attitude became a part of the new construct *affect*.

Being aware of this historical development in the field is important, as it shows how attitude, affect, behaviour and motivation are terms with shared historical origins. It also suggests that modern research should build upon previous understanding and move away from quantitative studies seeking causality. Efforts to research cognitive resources has led to study into metacognition and beliefs (Schoenfeld, 1985), and later the importance of emotional influence and affect (Hannula, 2006; McLeod, 1992). Another development of motivation research was the self-determination theory (SDT for short), which described how external regulation could inhibit self-motivation (Ryan & Deci, 2000). This theory from general psychology research would further expand upon the external and internal, defining the basic needs of psychological wellness and how educators can promote motivation. “The term extrinsic motivation refers to the performance of an activity in order to attain some separable outcome, and, thus, contrasts with intrinsic motivation, which refers to doing an activity for the inherent satisfaction of the activity itself” (Ryan & Deci, 2000, p. 71).

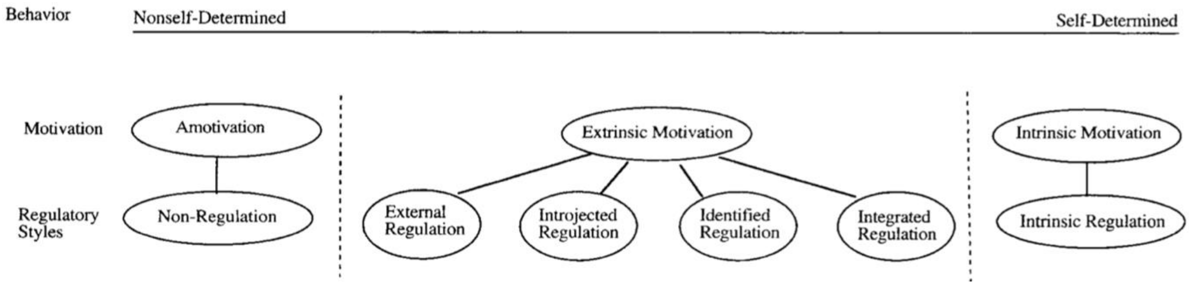

Figure 2. Self-determination theory, with types of motivation and regulation (Deci & Ryan, 2000)

Figure 2. displays the important distinctions of the types of motivation, and their nature. Amotivation being a total lack of motivation, intrinsic as the purest form of joy and curiosity, and extrinsic motivation as divided into several forms of regulating effects based on the level of ‘basic needs’ fulfilled. These basic needs serve as a premise for motivation, every individual has three universal categories of basic needs (Deci & Ryan, 2008). These three are autonomy, competence, and relatedness. Research and developments on “SDT’s analysis of educational settings is primarily focused on the extent to which they meet or frustrate these basic needs.” (Ryan & Deci, 2020, p. 1).

Autonomy	*Ownership of an individual’s action. Strengthened by experiencing interest and perceiving value. Weakened by feeling external control (i.e rewards and punishment)*
Competence	*Feeling success and mastery, self belief that success and growth is possible. Strengthened by positive feedback, meaningful challenges and opportunities for growth. Weakened by self-doubt and feeling less able than the environment and peers.*
Relatedness	*A individual’s sense of connection to their environment, and feeling belonging to it. Strengthened by being given respect and meeting emotional needs positively. Weakened by feeling unwanted.*

Table 3. Basic needs explained (Ryan & Deci, 2020).

These human needs are instrumental as a foundation to understand how social factors influence motivation and well-being. To better understand motivational differences in students, these universal categories of basic needs are important. In turn, they help explain why some forms of motivation are intrinsic, and how different forms of extrinsic motivation influence students' motivational quality.

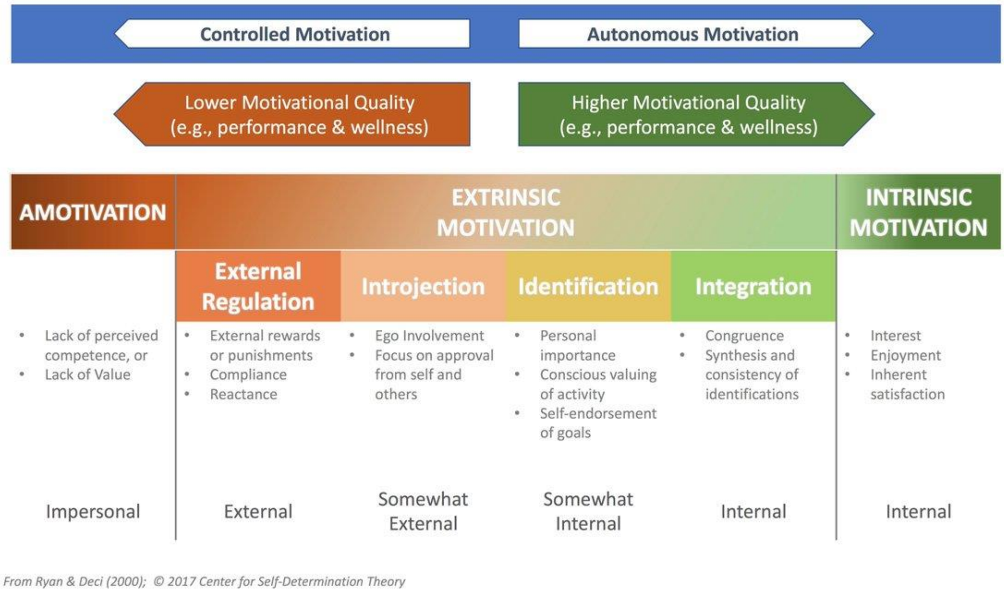

Figure 3. Modern developments of self-determination theory (CenterforSDT, 2017)

Figure 3. displays several developments of self-determining theory that help explain how extrinsic social factors can influence students' motivational quality. How certain types of extrinsic motivation are more like intrinsic motivation than others. All types of extrinsic motivation lack certain elements of the three basic needs (Ryan & Deci 2008). I.e., a presence of competence and relatedness, but a lack of autonomy can lead to controlled motivation. While higher motivation quality comes from internalizing goals, feeling harmony while working and at the very highest levels feeling inherent satisfaction and interest.

The development of self-determining theory brought critique to the reward nature typically used by schools when teaching mathematics. Grades can take the form of feedback and can benefit intrinsic motivation if the feedback is focused on improvement (Ryan & Deci 2020). However, research on grades found the reward nature was to significantly undermine intrinsic motivation (Deci, Koestner, & Ryan, 2001; Krijgsman et al., 2017). The controlling nature of performance-based goals can lead students away from the basic need of autonomy. Mathematics educators have also found grades to be used by students as a mean to compare their performance to other students (Kloosterman, 2002). To explain the modern understanding of motivation in mathematics education, the framework of Middleton, Jansen and Goldin describe 'Key individual motivation factors' (Middleton et al., 2016).

Figure 4. 'Key individual motivation factors' of Middleton, Jansen & Goldin (Middleton et al., 2016)

Figure 4. shows seven factors of individual motivation from Middleton et al., which serve as a wide framework to explain all factors influencing motivation for mathematics education. By the influences of McLeod (1992) and others (Di Martino & Zan, 2011; Hannula, 2006) motivation research has become increasingly aware of the powers of affect in the interplay between cognition and emotions. This highlights understanding motivation as a larger compassing concept; "Motivation is a meta concept that subsumes a number of related concepts such as engagement, persistence, interest, self-efficacy, and self-concept." (Irvine, 2018, p. 2). Skaalvik and Skaalvik (2015) also suggests these areas of factors overlap, and the coinciding influences are important when interpreting motivation.

2.1.1 'The Social Turn' and Cultural Values

'The social turn' for mathematics education (Lerman, 2000) shows how cultural values have changed in the last decades, in views of equity and social factors. Drawing from the revolutionary work of Vygotsky, and impactful figures like Bruner (1986) and Wertsch (1985), the social turn observes how mathematics education have been influenced by the changing theoretical paradigm of how learning mathematics is a result of social interactions combined with the cognitive process. This change of looking at the cognitive individual developing through their social nature also directly changed researchers' perceptions of how motivation is formed (Middleton et al., 2016; Ryan & Deci, 2000).

An understanding of this transition in motivational research is important, as these cultural developments have resulted in a changed perception of mathematics instrumentality (Husman & Hilpert, 2007; Wismath & Worrall, 2015). In mathematics educational research, Gutierrez (2013) argues the values of identity, power, and knowledge to be acknowledge as an emerging phase of social values for mathematics educators. No longer should different mathematical educational outcomes be solely a decider for career outcomes and a higher education in STEM, rather mathematics should be transformed to a practice that benefit all.

The cultural value of mathematics education is one of the highest importance throughout Norwegian society. Engineers, scientists, programmers, and doctors are some of the most prestigious professions, with individual benefits like high income and social status. Yet for motivation in mathematics, it leads to an extrinsic value of maths as beneficial for society, not as a good for personal growth (Heyd-Metzuyanim & Lutovac, 2016). In the mathematics curriculum it is argued how every citizen is to have the best possible understanding of scientific data, critical thinking and how mathematics influence their democratic decisions (UDIR, 2020). For individuals and parents cultural values typically highlight the importance of mathematical professions and science (Reyes, 1984). The societal and democratic arguments show the importance of the professions rooted in mathematics education. Creten, Lens and Simons (2001) argue previous studies have proven most students study for extrinsic reasons, not because they are intrinsically motivated. Further they argue most students lack enough perspective of the future to be aware of how their beliefs of instrumentality will influence their future. These cultural values of mathematics have led researchers to propose that the theoretical understanding of motivation should turn away from the individual process, and focus on including the important social norms, classroom practices and social interactions (Middleton et al., 2016). For my thesis these suggestions are invaluable when comparing motivation. How are social norms and goals reflected by the students for their personal motivation in mathematics education?

2.2 Defining Motivation in Mathematics Education

Summarising the suggestions from research in the field, a trend of qualitative exploration and the social nature of learning are now in focus. Motivational research is no longer seeking causal relationships to achievement through quantitative measurement, instead research is interpretative and cumulative. “Evidence is not on the order of proof, but is cumulative” (Schoenfeld, 2000, p. 649). Motivation is progressively seen and defined by researchers as several coinciding factors. Mathematics educators are changing their perspectives to social causes and equity and changing their beliefs to focus on the skill training process instead of the product of skill measurement. Mathematics has power, and motivation is a product of the social setting and context surrounding the students.

"According to this point of view, the variety of definitions of attitude is not limiting but rather enriching for researchers, since different research problems can require different definitions. Hence, the previous question naturally changes from 'which is the right one?' to 'which is the suitable one for a certain research problem?" (Di Martino & Zan, 2010, p. 29).

In this thesis the research question is comparing motivation for students of mathematics. The purpose of the question to understand, and thus seek insight in a large range of motivational factors to find similarities and differences. For this thesis motivation is therefore defined as the sum of social and personal factors influencing a student's choices when working with mathematics. These social and personal factors are adapted from the work of Middleton, Jansen, and Goldin (2016) who defined 'Key Individual Motivational Factors' as seven coinciding factors. This framework is chosen as a state-of-the-art framework of motivation for mathematics, including factors from the importance of affect, self-efficacy. The framework seeks to explain motivation on an individual level, yet the authors themselves comment the lack of focus on social factors (Middleton et al., 2016). In this thesis the seven factors have been condensed to five factors, and one additional factor has been added. The concept of goals, both personal-, proximal- and - specificity, who in Middleton et al. are separate individual factors, have in this adapted framework been grouped together as the condensed factor *personal goals*. *Social factors* have been added as an independent factor and will be further explained in detail as the major focus of this thesis.

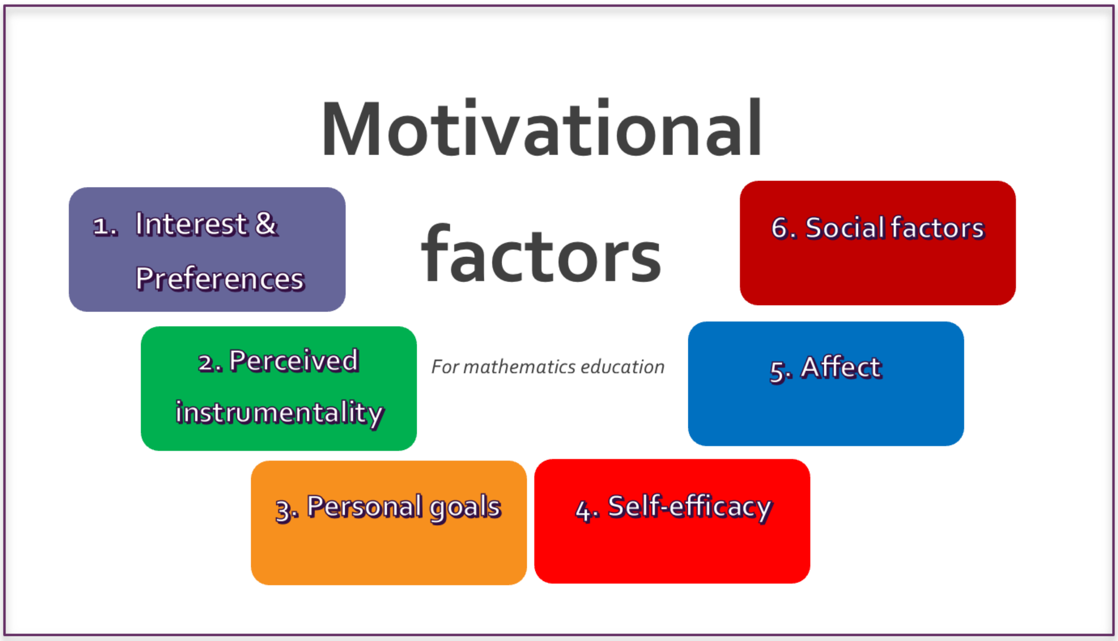

Figure 5. The adapted framework of motivational factors

Figure 5. shows the social and personal factors influencing student's choices while working with mathematics are in this thesis the six factors illustrated and forms the theoretical framework. *Interest and preferences, Perceived instrumentality, Personal goals, Self-efficacy, Affect,* and *social factors*.

2.2.1 Interests and Preferences

Interest is the level of engagement and eagerness a student has when working with or thinking of mathematics. Interest have been found to be a key predictor of mathematical persistence and achievement (Middleton et al., 2016). Going further, Murphy and Alexander (2002) describe interest and self-schema as conceptualisations of motivation, and notes the difference between situational and individual interest. Middleton, Goldin and Jansen (Middleton et al., 2016) observes how mathematical activities that have been evaluated as situationally interesting can develop to long-term individual interest. The two types of interest are not mutually exclusive, but experiences of situational interest are a likely starting point for individual interest in mathematics. *Preferences* is grouped together with interest as it describes what type of mathematical activity the learners prefer. Examples include problem solving tasks, communicative work in groups or algorithmic practice. Berry (2003) describes two main categories of learning preferences: analytical or relational. The analytical learning style regards "logical diagnostic fashion with the ability to discern objects as discrete from their context, analytical learners have a tendency toward impersonal preferences in social encounters."

(Berry III, 2003, p. 246). While relational learning styles favours the use of creativity, divergent thinking, variation, and inductive reasoning, all the while favouring social interactions for learning. *Interest and preferences* are important for motivation as students are less likely to be intrinsically motivated for mathematics while in early schooling (Creten et al., 2001). Interest is one of the defining characteristics of intrinsic motivation, as defined by Deci and Ryan (2000), this variable has significance for determining motivational quality. For students lacking interest, extrinsic rewards such as future goals or believed importance, is an important tool for schools to engage students. In this study intrinsic or extrinsic reasons for *interest and preference* are very relevant to observe if there is a difference in motivation for 7th grade or 10th grade students of mathematics. Does the empirical data of students lacking intrinsic motivation (Creten et al., 2001) transfer to the students in my study? Another thing to note is the social nature of interest and preferences. Skott (2015) notes how beliefs and interest in mathematics go hand in hand with the social practices of the classroom. This social context is an important aspect when interpreting if the students' interest and preferences are signs of situational or individual interest, or whether their motivation is based on intrinsic or extrinsic goals.

2.2.2 Perceived Instrumentality

Perception of instrumentality is defined as the perceived incentive an individual has for their present behaviour (Husman, Derryberry, Crowson, & Lomax, 2004), in other motivational research this is also defined as task value (Bong 2001). If a student believes mathematics to be important, it will affect their motivation and increase the chance of reaching their goals (Creten et al., 2001). At its essence, perceived instrumentality of mathematics is the value an individual believes mathematics has for personal growth or the importance it has for future career prospects. In turn this perception of importance will directly influence students' interest in the field of mathematics (Reyes, 1984). This difference of "short term" skill practice versus the "long term" career goals is the main difference in outcome when describing how the motivation of mathematics students are impacted by their beliefs of instrumentality. As described by Husman et al. (2004) these two categories are either indigenous or exogenous, similarly to Deci and Ryan (2001) describing *interest and preferences* as intrinsic and extrinsic, indigenous describes a perception that a task is important at hand and exogenous being a task can be important for a future goal. Many modern mathematics educators are looking to change students' mindset to a belief that engagement with mathematics education will result in vital knowledge and skills for personal development (Wake, 2014). Thus elevating the importance of individual growth when individuals interact with social contexts or social standing in the classroom (Hannula, 2006). The variable of perceived instrumentality does not deny the importance of these non-mathematical interests: social factors and how social standing in the classroom relates to a high or low skill in mathematics (Husman et al., 2004). I.e.: “He is very smart, he always knows the answer in mathematics class” or the opposite cost in social standing by being a “the girl they call a nerd” (Foyn, Solomon, & Braathe, 2018, p. 80). When seeking to understand an individual’s true perception of mathematics; individual goals and efficacy-beliefs are factors which also helps to explain the intrinsic values of the individual. Goals needs to be both related to the mathematics task at hand by its indigenous value, and long-term exogenous goals of achievement. The variable of perceived instrumentality will seek to explain the possible mindset similarities and difference in perception of mathematics in 7th grade and 10th grade students of mathematics.

2.2.3 Personal Goals

Goals are meant to guide work, both long term goals like academic careers as well as present goals of mastering a concept in the classroom. Goals vary in their nature, yet they all serve a purpose of motivation. To sum up this broad category, there are four different aspects of goals from the framework of Middleton, Jansen and Goldin (Middleton et al., 2016) that are beneficial to understanding the theoretical range of personal goals. Personal goals, goal proximity, goal specificity and goal focus. Personal goals can be described as the sum of the three types of goal proximity, -specificity and -focus (Middleton et al., 2016). Goal proximity refers to the closeness of a target, i.e., the task at hand, or a distant goal like achieving a certain grade. Research suggests students use strategies of self-regulation and planning when goals are proximal, and that goals are a main tool to tap into students’ existing motivation (Hester, 2012). While students’ ability to understand how their mathematical activity creates progress towards a distant goal will decide if the motivational strategies apply (Zhang, Karabenick, Maruno, & Lauermann, 2011). Goal specificity is the need of a clear and specific goal, to plan strategies to get there. For mathematic educators it is vital that students are taught how to create plans and goals which are easily understandable. Interestingly, research suggests specificity goals or other forms of smaller goals is not widely used by students (Hester, 2012). Goal focus is the attention given when working towards a goal. An unclear goal will result in an unfocused learner.

“Primarily, goals are derived from needs: in learning situations, the psychological needs for autonomy, competence, and social belonging are the most significant determinants of goal choices. As a second aspect, this view accepts the influence of students' beliefs about the accessibility of different goals. As a third aspect, the influence of automatic emotional reactions for goal regulation” (Hannula 2006, p.165).

With no thoughts of success as possibility, personal goals both distant and close will be ineffective, and possibly result in the destruction of any notion to perceive mathematics as personal growth. For this study, differences in the use of goals and strategies between 7th and 10th grade students will be key to seek insight in how, or if, they are motivated for learning mathematics. A second important find from empirical research is the suggestion that students are unaware of the value which goal using strategies can have to increase motivation, and they do not use goals strategically (Hester 2012).

2.2.4 Self-Efficacy

Self-efficacy is the student's ability to believe achievement is possible (Bandura, 1977). Past achievements are an important factor for developing self-efficacy (Skaalvik, Federici, & Klassen, 2015). Present success with mathematics tasks and reaching set goals which give a sense of fulfilment can also help develop a learner's self-efficacy. An important aspect to self-efficacy is how success or achievement is attained. There are several ways to achieve success other than completion of tasks and activities. For instance, communication like a teacher's feedback or classmates' responses to social interactions can give a sense of mastery from mathematical peers. Research in the field of mathematics education also found empirical data proposing self-competence beliefs to drop in the transition from primary to secondary education (Ma & Kishor, 1997). This has later been reiterated in research on attitude showing an increase of negative attitudes to mathematics education in students going from primary education to secondary (Köğce, Yıldız, Aydın, & Altındağ, 2009). These findings coincide with research suggesting beliefs of self-efficacy to be of the most accurate predictors for achievement (Nicolaidou & Philippou, 2003). Noting why students believe their self-efficacy levels have developed will be explored in interviews. Skaalvik, Federici and Klassen (2015) also suggests self-efficacy to be the strongest indicator for intrinsic motivation and traits like interest, mathematical identity, effort, and persistence.

2.2.5 Affect

"The research area investigating the interplay between cognitive and emotional aspects in mathematics education is known as affect" (Di Martino & Zan 2011, p.471). Affect is operationalised as the emotional response to experiences with mathematics e.g., achievement, stress, failure, disbelief, or astonishment, which are all natural responses to experience during mathematical activity. These affective situations can create powerful moments of happiness, anger, rejection, and awe. It is quite common for students to struggle with a negative emotional response in mathematics education, for instance anxiety of failure, as recent research has pointed to the importance of affect for motivation (Di Martino & Zan 2011). To further develop goals and self-efficacy, the student needs to be aware of his affect when working with mathematics.

"While a student is engaged in a mathematical activity, there is a continuous unconscious evaluation of the situation with respect to personal goals. This evaluation is represented as an emotion: proceeding towards goals induces positive emotions while obstacles that block the progress may induce anger, fear, sadness or other unpleasant emotions." (Hannula, 2002, p. 29).

A student's affect will therefore be a key factor to interpret levels of motivation, as a tool of insight into the subjective experiences with mathematics education. In this study the variable affect will be investigated from the students' perspectives. How they perceive their affective responses to mathematics, and how emotions are reflected by the students' thoughts on social factors. Is it okay to portray emotion in the mathematics classroom? Do they think about classmates' reactions to their emotions? Do they feel fear of reactions while communicating their mathematic solutions or ideas, and would this be a fear of being wrong or a fear of losing social standing? Differences in magnitude of emotions between 7^{th} to 10^{th} grade students is an interesting angle when researching how students are motivated. Research suggests there is needed further exploration into the classroom context in order to understand how emotional experience flow and influence motivation (Eynde, Corte, & Verschaffel, 2006).

2.2.6 Social Factors

The most recent development in the scientific field of motivation is social factors. Friends, classmates, teachers, and parents will all directly influence a student's mindset, and the influence of others is the major focus of this thesis. Middleton et al.(2016) note how social factors is insufficiently focused in mathematics educational research. They critique the lens of individuality in research on self-regulation, self-determination, and other factors. Instead, interactions and social norms form the purpose of research. Social factors are the major focus in this study. I will be seeking insight to understand why the interplay of social factors and affect is important for motivation in different years of schooling. Research suggests several important influences of social factors on learners of mathematics. Being a part of a supportive environment brings benefits to motivation (Akey, 2006), where experiencing meaningful challenges and perceiving support from friends or the teacher correlates to sensing belonging. A social learning environment also brings distractions and procrastination (Levpušček, Zupančič, & Sočan, 2013). Research suggests extraversive students have been found to negatively correlate with mathematics achievement (Levpušček et al., 2013). Meaning certain students are at risk of having their character traits work against their motivation for mathematics. This could also indicate a lack of a basic need from self-determination theory; students feeling relatedness to the mathematics learning environment (Deci & Ryan 2020). Students might struggle to honestly share their opinions on social factors in a focus group interview setting, yet this might be one of the strengths of the social factors as an explicit focus. Students will be allowed to answer direct questions on their learning environments, in a focus group setting which mimic the environment of the students' everyday mathematics classroom. In this setting, the interviewees will have the chance to answer explicit questions, or non-verbally react to others, with their own social factors present. These reflections are important, as research on this variable is lacking and in need of innovative exploration (Middleton et al., 2016).

2.3 Bronfenbrenner's Theory of Bioecology

Bronfenbrenner's model of bioecology is used to explain and discover connections in a chosen phenomenon (Tudge, Mokrova, Hatfield, & Karnik, 2009). In this thesis the phenomenon is motivation, and the model of bioecology is used as an analytical tool. The analytical strategy is connected to motivation as it searches for connections between motivational factors and the social context of the students. Making a valuable comparability on how students of 7th and 10th grade are motivated differently require an analysis of social context, as suggested by Middleton et al. (2016). The intended goal to interpret how individuals develop their motivation for mathematics between these years of schooling. Uri Bronfenbrenner's theory of bioecology (2005) is frequently used to explain the role of context and process in human development. The change of institutions from primary to secondary, students' work being graded, the choice of high school programs and future education, all give context for the 10th grade students of mathematics. These changes are invaluable context explanations for changes in motivation and serves a purpose for analysing how social factors change with the context. The use of Bronfenbrenner's theory is not uncommon in modern motivational research (Elliott & Tudge, 2012) or research in human development (Berger, Lisboa, Cuadros, & de Tezanos-Pinto, 2016; Rojas-Drummond, 2016). To facilitate the social complexity and present the strategy of analysis more clearly it is important to distinguish how Bronfenbrenner's model is more than a focus on context.

Beyond the recognisable circular figure of micro-, meso- and the other systems, there are four separate elements constructing the total framework (Tudge et al., 2009). *Process, Person, Context and Time* (PPCT for short). Clarifying that the bioecology model is more than the contextual systems is crucial, as this is a common misinterpretation among researchers using of the bioecological theory (Elliott & Tudge, 2012). The model does not serve the sole purpose as a context-only descriptive tool of research, it includes a strong focus on social forces and changing environments over time (Edelen, Bush, Simpson, Cook, & Abassian, 2020). This purpose as a tool for analysing social factors and contexts' influence on the proximal process of an individual, is in line with the suggestion of motivational research that individual motivational factors should be explored through social interactions (Middleton et al., 2016).

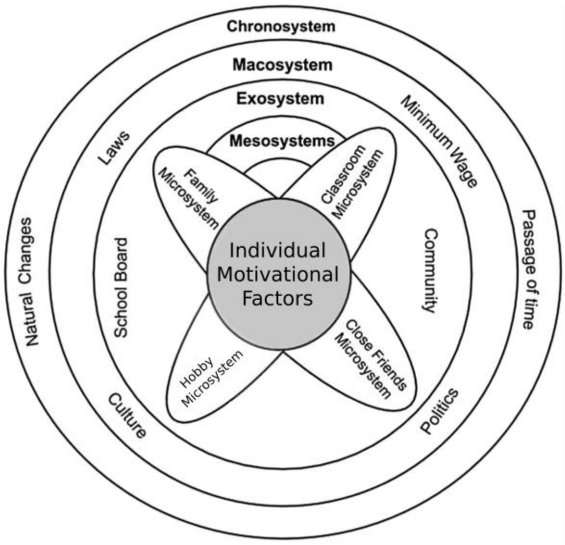

Figure 6. Motivational factors framework of Middleton et.al (2016) integrated to social context of the PPCT model (Eden, Bush et al 2020)

Figure 6. is designed to illustrate the integrated framework of motivation to the social lens of Bronfenbrenner (Edelen et al., 2020). The summarizing thoughts on operationalizing PPCT should be reflected by notes of misuse in human development research (Tudge et al., 2009). The lack of operationalizing by Bronfenbrenner has resulted in researchers doing so individually, where many either weighted the context too heavily or excluded person-process as a significant factor (Xia, Li, & Tudge, 2020). This misuse has resulted in human ecology research on child development to be context driven, where the impact of the meso- and microsystems of a person's family, cultural values, institutional belonging, etc., far outranks the importance of the proximal process in social environments and an individual's agency (Tudge et al., 2009). These experiences and reflections from studies on Bronfenbrenner's theory and its use is important when adopting motivation to this analytical strategy. Social

factors serve to understand how students have developed their individual motivation for mathematics.

3. Methodology

The intended purpose and outcome of interest is central when making decisions on methodology and research design (Petty, Thomson, & Stew, 2012). The research question of this thesis involves exploration of a complex phenomenon: motivation in mathematics education, and the influence of social context. The purpose is therefore to observe social interactions with the theme of motivational factors for mathematics. For my study this purpose designed the data collection to a method well suited to observe social interactions, focus group interviews, and a methodology to explore a complex phenomenon. A methodology well suited to exemplify particularity and complexity is the case-study (Stake, 1995). To benefit a comparison of two sets of students, a multiple-case study design is useful. Multiple-case studies is a methodology argued to allow the researcher to analyse the data within each situation and across different situations (Gustafsson, 2017). Another argument of multiple-case studies as a methodology suited for exploring comparisons is made by Vannoni (2015), advocating the strength of how a researcher is influenced by contrasts and similarities of the multiple cases when they are compared. Well suited to the intended purpose of comparing the phenomenon of motivation and thus answering the research question, a multiple-case study was chosen as a methodology for this thesis.

This is done purposefully as to compare the two sets of groups (7^{th} and 10^{th} grade students of maths) and focus on exploring the main research question of the thesis. The focus of Bronfenbrenner model of bioecology consists of a larger framework on the influence of social context for human development. For short the modern understanding of the bioecological theory can be summarised by the acronym PPCT (process, person, context & time). The PPCT of Bronfenbrenner's theoretical framework adds perspectives to the development students' faces in these years as students of mathematics, in particular individual agency, context, and social factors. One main suggestion of motivational theory have been lacking in research is precisely social factors (Middleton et al., 2016). For this reason, the research design is intended to observe social factors both in method, data analysis and interpretation. Bronfenbrenner's theory of bioecology has seen more use by researchers of mathematics education in recent years (Edelen et al., 2020; Perry & Dockett, 2018), yet is for this thesis implemented differently. In this thesis the model of bioecology is implemented to analyse individual cases in a multiple-case study, which is different from most other researchers using it to describe ecological context in specific groups of people (Atzaba-Poria, Pike, & Deater-Deckard, 2004; Singal, 2006). Siraj and Huang (2020) argues for the use of bioecology theory both in larger scope studies quantitative data analysis as well for individual analysis ".. any qualitative analysis also needs consideration since it can help us further understand complex social phenomena profoundly and contextually." (Siraj & Huang, 2020, p. 24).

The social context is applied as an innovative approach to the research design, and evaluations of the methodology might contribute to the field as possible future tools for research. The philosophy of the research design can be summarised in words by Bronfenbrenner and Morris (Bronfenbrenner & Morris, 2007, p. 801): "we are dealing with science in the discovery mode rather than in the mode of verification". The intended goal of this thesis is to explore motivation. Not to seek casual relationships to achievement in mathematics education.

3.1 Participants

The participants in this study were eighteen students, nine students from 7th grade and nine students from 10th grade, selected on a voluntary basis. The students were interviewed through focus group interviews about the six motivational factors of this thesis. There were three students to each focus group. Of the eighteen students totalling the data collection, four individuals were chosen for individual analysis. These four students were chosen as the highest and lowest motivated students for mathematics education in their respective sets.

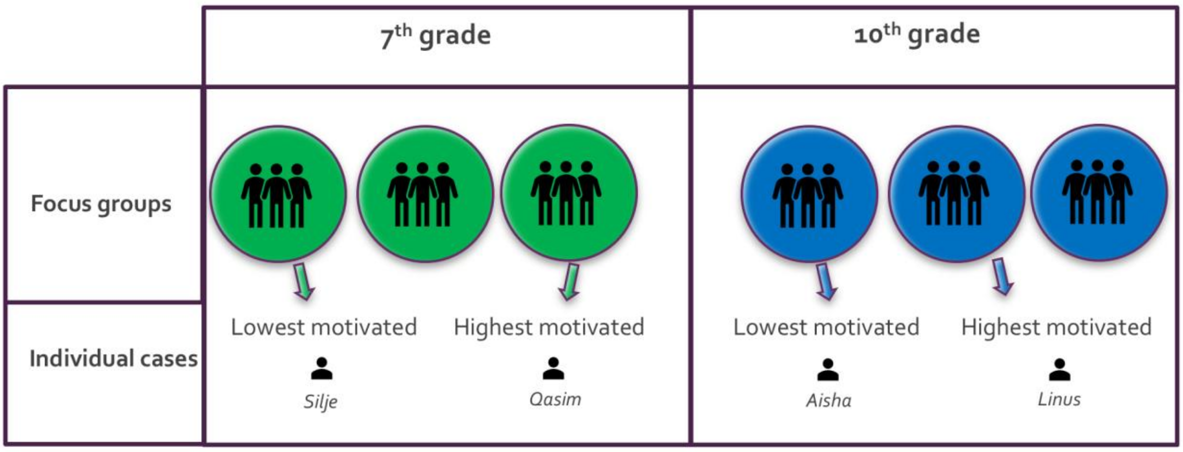

Figure 8. Participants in this study, with four individuals chosen from the focus group interviews.

Figure 8 illustrates the six focus groups, and how four individuals from the focus groups were chosen as individual cases to be analysed. Gender and ethnicity were not added parameters for selection or to describe the chosen participants. The reason for the exclusion of these parameters is in part because research suggests the parameters of gender and ethnicity to statistically be significant when measuring social factors in mathematics (Ma & Kishor, 1997).

Another argument for the exclusion is to keep the research question focused on the theme of motivational factors. Finally, it is not in the scope of the thesis to add demographical parameters. There are elements of randomness in the selection of the schools where data was collected, but not to an extent where the sample can be defined as a strategy of random sampling.

The students' year of schooling being the only criterion of selection has an advantage. It focuses directly on the research question and separate two distinct sets. With no other criteria for selecting participants, sampling bias is largely an avoidable feature. Yet one possible bias is the large demographical differences within the Oslo region. This is not accounted for in the informants chosen, as I have not chosen a sampling technique of probability sampling. This is line with methodology suggestions, as I am not looking to make a statistical inference (Taherdoost, 2016), rather to explore a real life phenomenon in a small sample size. For the purposes of obtaining participants a wide net of school was contacted, both by mail, in person and by telephone. Fifteen schools were contacted before one school of 7th grade students and school of 10th grade students were arranged to be interviewed. Schools were contacted formally, without prior personal knowledge nor through informal contact of personal relationships. With many contacted schools, a natural element of randomness in sampling took place, but demographical and socioeconomic variances of schools do not make the students statistically replicable.

This is important, as socioeconomic status has been found by Lubienski (2000) to influence how students perceive collaborative work. A Swedish study (Hansson, 2012) found a correlation between students' linguistic and social background and the style of mathematics education they received. Hansson argues this indicate a pedagogical-segregation when the proportion of immigrant multilingual students or low socioeconomic-economic students are high. Oslo is one of the fastest growing cities in Europe, much due to immigration (Prescott, 2018). Oslo reports (Oslo kommune, 2022a, 2022b) an unequal geographical spread of immigrant population, with immigrants in some districts making out more than half the total population, while the lowest three districts have 18% of the population being of immigrant background. These demographics should be addressed in a study of social context, as they impact certain students' motivation for mathematics through their environments. Due to the scope of this thesis however, demographics and socioeconomic status is not included in the sample selection, nor in the individual analysis. Even though research suggests these students will be affected by their demographics and socioeconomic background, it is my intention to learn more about the social factors and context influencing the students' motivation in different years of schooling. Further research on demographics or social background variables, and their relationship to the motivational factors is certainly interesting and likely to be significant but is beyond the scope of this thesis.

The chosen individual cases for the multiple-case study were chosen as participants of particular interest due to the outcome of the focus group interviews. These four cases were chosen after the focus group interviews had taken place, as they were the outliers of the 7th and 10th grade sets in motivational levels. The lowest of each set and the highest of each set, four in total, given pseudonyms for the purpose of anonymization. There were several reasons for this choice of highlighting the comparison between lowly and highly motivated students. Di Martino and Zan (2011) discuss how affect can lead students who are negatively dispositioned to mathematics on a path of continuous negative reinforcement. Another interesting reason for highlighting the outliers is how self-efficacy has been found as a strong predictor for interest, intrinsic motivation, and performance (Skaalvik et al., 2015). This divide of success and failure make for an interesting angle to compare the different trajectories. Students who have a feeling of high motivational quality and those with low, how do they contrast or share similarities in motivational factors?

The selection of individual cases has a weakness of not collecting any other data than the group interviews, lasting about half an hour each. These individual cases are as a result not triangulated, i.e., checking with the individuals for clarifications, thus they are less likely to be transferable to other contexts or to other participants. This risks interpretations not matching the intended opinion of the interviewee or failing to notice opinions not voiced honestly. Another probable weakness of not following up the individual cases with triangulation, like individual follow-up interviews, is the level of confirmability, or confirmation-bias, from me as a researcher. This is highlighting the challenge of making the participants feel comfortable enough to honestly voice their experiences in the focus group interview setting, to avoid a more shallow understanding of the individual (Liamputtong, 2011). By less use of triangulation or strategies to check with the source if the researcher has understood the data correctly, the product of the inquiry is more likely to be influenced by interpretations from the author (Petty et al., 2012). My purpose for these cases is to explore and highlight their individual characteristics, proximal processes, and the social context of their statements. The importance of the focus group interview is to allow an understanding of the participants from a multifunctional interview setting (Kamberelis & Dimitriadis, 2013), as opposed to a method of in-depth individual interviews.

An important distinction is the exclusion of specific mathematics tasks in the interview setting, the students will be asked questions and simple discussion exercises, yet not solve any challenging mathematics tasks. This contradicts the base design structure suggested by researchers on motivation in mathematics education to primarily focus on interventional studies and in-the-moment engagement as students work with mathematics, as opposed to reflection on experiences (Middleton et al., 2016). The main reasoning for this choice is the innovative nature of using social context as the main influence of methodology design and research focus. The semi-structured interview guide is added to the appendix in the final section of this thesis.

3.2 Data Collection - Focus Group Interviews

The choice of the qualitative method of focus group interviews when exploring motivation for students of mathematics is influenced by the modern developments in the field of research. The influence of cumulative research suggesting a move away from methodology favoured from the 1950's to early 1990's. The quantifiable methods seeking causal relationships proved difficult to validate and made definitions of motivation for mathematics to be centred on measuring the relationships of cognitive factor and achievement (Leder, 1985). The main reasoning for the focus group interview as the qualitative method for data collection is to obtain insight of the complex social context influencing the factors of motivation. My adapted theoretical framework has six factors, who in their nature are coinciding factors. Focus group interviews is argued as a method uniquely multifunctional in order to explain complex relationships of social and cognitive factors (Kamberelis & Dimitriadis, 2013).

"The pedagogic function basically involves collective engagement designed to promote dialogue and to achieve higher levels of understanding of issues critical to the development of a group's interests" (Kamberelis & Dimitriadis, 2013, p. 2).

To gather data to seek insight in two separate sets of groups (7^{th} and 10^{th} grade students), this design was chosen for its basis of social interactions and dialogue. These focus group interviews were semi-structured, and loosely following an interview guide. My role as a researcher was mainly to focus on guiding the conversation to the topic, and being attentive to the interactions of the participants (Kitzinger, 1995). The group dynamic and interactions feature of the focus group interview has the same element as the variable social factors from my adopted framework, and this 'group effect' of focus groups is a term uniquely found in this type of methodology (Liamputtong, 2011). This social dynamic and interaction played a large part of reflections in the field notes. Field notes are highlighted as particularly important for the researcher to be able to use a tool for interpretation, reflection and to put to words observations of unspoken communication (Kitzinger 1995).

An example of how this has influenced my research design is in the interview guide. An example under questions of perceived instrumentality:

'2.1.3: What does other classmates think of maths, do you think?'

Another example under self-efficacy:

'Q4.4: Do you think your classmates think so? How could you tell?'

These questions have potential for students to show unspoken communication with the classmates in the focus group interview. The questions are sensitive, and honest opinions stand the risk of being influenced by the social dynamics of the group. Field notes will be an important part of interpreting the discussion to follow.

The inquiry method of the focus group is an opportunity for participations to generate their own questions and concepts, in words of their own vocabulary (Kitzinger 1995). One major variance in focus group interviews is the impact of the group size. Groups can consist of three to fifteen people, with the smaller size giving less chance for group interactions and the larger gives less chance for the individual to contribute (Kitzinger 1995). The method has been chosen to explore the students' thoughts, how and why they think the way they do and gaining insight (Liamputtong 2015). The group dynamic will also allow me as a researcher to analyse day-to-day interactions of jokes, anecdotes, disagreements, or teasing (Kitzinger 1995). To preserve the individual, I chose to limit the group size to three, although certain group interactions may be limited by this choice. Like my reasoning for choosing this method in the first place, instead of choosing individual interviews or questionnaires, the issue of method can be summed up to a dilemma of individualization versus group interactions. In the end the limiting factor concerned the composition of the sample group, particularly the age of participants and their institutional context as classmates, made me decide on a design with a smaller focus group size. Thus, allowing more room for the individual, while keeping the focus on the social interactions and dynamics of the focus group interview.

3.3 Data Analysis

An important point of data analysis is to reduce the amount of data, and focus it (Robson, 2002). The same argument for analysis is made by Krueger (2014), who argue that analysis of focus group interviews should focus on the purpose of the research. This focus led to a decision of using a 'framework-analysis' (Rabiee, 2004) in order to categories and manage the raw data. Framework analysis was chosen as the main method to organise and interpret the data for the set of 7th and 10th grade students, while Bronfenbrenner's bioecology theory was used to further analyse the individual cases. Initially developed for policy integration and health studies, framework analysis has in recent years seen growing use in psychology studies (Parkinson, Eatough, Holmes, Stapley, & Midgley, 2016). Being quite similar in purpose as thematic analysis methods, framework analysis was favoured because it emphasized how new issues could emerge during the data collection, and the development of the analytical framework should be guided by the themes found (Parkinson et al., 2016). This is a strength of analysis that suits well to my explorative purpose in research design and data collection. Dialogue and concepts can in focus group interviews be constructed by the participants (Kitzinger 1995), and if this turned out to be the case, framework analysis can adapt to the developments of the collection process. Framework analysis is structured by five stages: familiarisation, identifying a thematic framework, indexing, charting, and mapping and interpreting (Ritchie & Spencer, 2002). I did not use computer programs of framework analysis i.e., 'Delve qualitative analysis tool', due to inexperience and lack of training. As such the five stages were completed manually, with particularly the stage of indexing and charting being a tenuous process of systematic work. The thematic framework is that of the operationalised motivational factors. In the final stage of mapping and interpreting I followed the recommendations of Rabiee (2004).

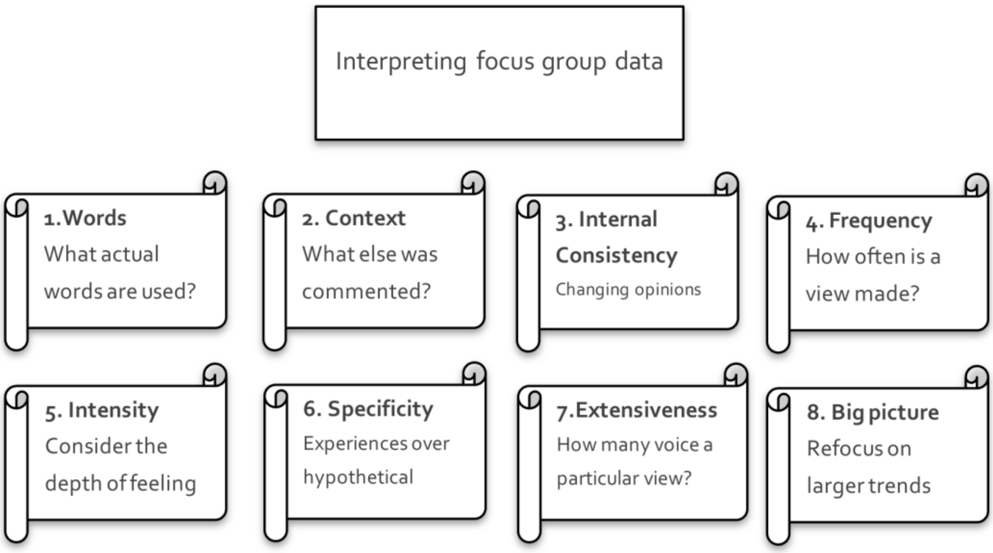

Figure 7. Recommended aspects for interpretation of focus group data (Rabiee 2004)

Figure 7. describe in unprioritized order what the researcher should look for while interpreting the finalized indexed and charted data in a qualitative focus group data set.

An example from how these aspects for interpretation were used in my thesis is from a student's reflection on the importance of mathematics: "I do believe mathematics is important, I just don't understand that much of what we are taught". This statement was indexed as perceived instrumentality and high importance, yet when interpreted in the context of two previous statements with similar views, and a lacking internal consistency (the student later argued most of the mathematics content was of no importance to her life), the interpretation of the data was one of low perceived instrumentality and the influence of social factors.

The individual analysis is done through the lens of social context and the use of Bronfenbrenner's bioecological theory (Bronfenbrenner, 2005; Bronfenbrenner & Morris, 1998). The same framework analysis was used for data management, but one further layer was added to the indexing stage. The four chosen individuals were uniquely coded. This data was used to construct a profile for the case-studies, highlighting their unique experiences and characteristics. From Bronfenbrenner's bioecology theory the individual agency and social context is found through the PPCT framework (Tudge et al., 2016). *Process* is the progressively complex interaction. *Person* focuses on characteristics of people, categorized by demand-, resource- and force characteristics. *Context* involve four inter-related systems that affects the individual. *Time* seeks to express how individual experiences are influenced by history and changes in time. For this thesis it is valuable as major changes of curriculum and technology influences how the students experience mathematics education.

Operationalisation of Bronfenbrenner's theory has no large base of application theory from the author himself (Xia et al., 2020). Research using the theoretical framework of the bioecological model are suggested to include all aspects of PPCT, and assume the variables are synergies as opposed to individual processes in their nature (Tudge et al., 2009; Xia et al., 2020).

For my thesis, these suggestions have led to making sure the purpose and outcome of interest of the analysis both align to the social context of motivational factors for mathematics education. The proximal process is operationalized to the peer setting of their focus groups being the same as their process in their mathematics classroom. Person and context are particularly included to interpret how individual person characteristics interfere or relate to their motivational factors, and how their social learning environment are directly and indirectly influenced by context. Time as a factor has less influence, as the students are quite close in age and the data collected is not a longitudinal study, however cultural developments are addressed as both a factor of context and time.

3.4 Ethical considerations

Ethics serves to make sure the choices made by me, and my intentions are sincere and contribute to scientific research. My choices are reflected in research design, and implicitly show my intentions and possible bias. To contribute to research meaningfully and usefully, reflections on intent and bias are valuable. As proposed in the rather colourful introduction of this thesis, I am fascinated by students who fail. Why a student of mathematics can see a challenge of basic mathematics and proceed to not try at solving said challenge. I am in awe, and this makes me susceptible to take actions or analysis in "bad faith". Jan-Paul Sartre is the original author of the notion of bad faith, "we refuse our basic, human freedoms through recourse to received and static ideas, beliefs and roles" (Kamberelis & Dimitriadis, 2013, p. 4). Put in simpler terms, to be a researcher in 'bad faith' is the notion that the world is the way it is, and there is no way that it can change. The relevance of 'bad faith' for scientific ethics is our common understanding of what counts as evidence. To be persuaded by weak evidence and allow this persuasion to happen is fundamentally 'bad faith'. A logical reason for this to happen is that the evidence that persuaded you can favour your preconceived disposition. In my case this may cause me to favour questions and discussion on reasons to fail and the unsuccessful motivational factors. Focus groups is argued to, by its group interactive nature, to counter preconceptions (Kamberelis & Dimitriades 2013).

".. researchers to dwell in an evidentiary middle space, gathering empirical mate rial while engaging in dialogues that help avoid premature consolidations of their understandings and explanations. This is a starting point for a new approach to evidence that respects the particularities and autonomies of evidence without assuming that evidence can ever speak for itself." (Kamberelis & Dimitriadis, 2013, p. 4).

This idea that the research nature of exploration will help mitigate preconceptions is valuable from an ethics standpoint, but it does influence the strength of transferability and confirmability (Petty et al., 2012). My chosen method of focus group interviews will gain little evidence to support claims or arguments of generalization. Quite simply the sample size is too small for generalizing findings and is not a statistically probable sample. It is a chosen innovative path to gain insight to my participants' stories, explanations, and thoughts, and to gain this insight in their social context. I cannot avoid my preconceptions and be fully objective and cannot avoid my research to be in part influenced by my political and pedagogical intentions. The philosophy of Sartre is only glanced at in this thesis yet has influenced my ethical views on what impact my role as a researcher has, and that true impartiality is inconceivable. One advantage of the research question being explorative, and seeking insight, is the lack of falsification or deductive conclusions. Confirmability of my research would need a larger sample group, with several control groups i.e., the example of demographic differences of school's geographical location or multilingualism.

In qualitative research sampling methods do not to the same extent seek to be statistically randomized, but the research process needs to be systematic and in a methodical manner (Nowell, Norris, White, & Moules, 2017). Where quality of quantitative research data needs high reliability and validity, qualitative research seeks to have high degree of transparency. Trustworthiness criteria were established as a concept for qualitative research to assess acceptability and usefulness (Lincoln & Guba, 1985).

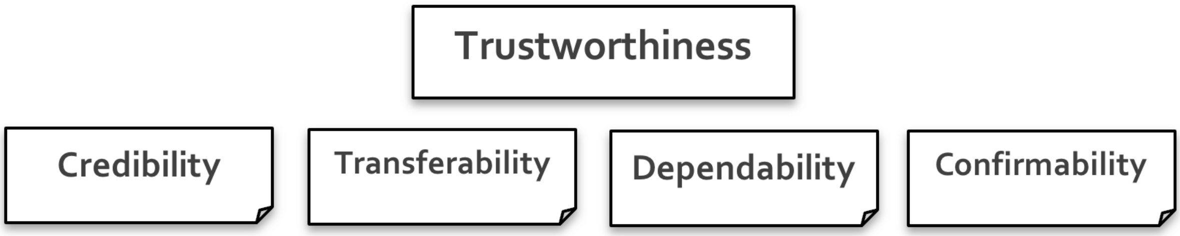

Figure 8. The four criteria of trustworthiness in qualitative research (Lincoln & Guba 1985)

Figure 8. shows the four different criteria a researcher can use to make sure the transparency and quality of research is high. For credibility in my thesis, there is some concerns for the analysis of individual cases, as the amount of data collected is low. There is however plenty of contextual data, from the social interactions of the focus groups. There are several suggestions to increase credibility (Nowell et al. 2017). From these suggestions several debrief session were conducted with peers, to get a continual external view of the research process. From me as a researcher I included what Nowell et al. (2017) calls referential adequacy, going back to check the original raw data to make sure the findings and interpretations hold up to the original wording and intent. The debrief sessions and referential adequacy focused on the interpretations and presentation of the complex social interactions. Transferability is a strength of the study, as selecting students of two sets of grades makes for a large population to sample from. However, transference of the same context of the focus group that took place in my data collection is pointed to by researchers as improbable (Shenton, 2004). Shenton (2004) point to the very geographic and demographic differences I explained in section '3.1 participants', highlighting how the focus for the researcher should be to explicitly describe the setting and process of data collection. This is the only way for other researchers to reflect on whether my

research is transferable to their projects. This is relevant for the school setting, as geographical location is the sole decider for primary and secondary school admissions in Norway. Dependability is for the researcher to make sure the methodological and theoretical decisions made throughout the progression of the project is described in detail (Nowell et al. 2017). To increase dependability a researcher should make the research design and its implementation explicit, address the operational detail of data gathering and evaluate the effectiveness of the inquiry. An important aspect for the operational detail in this thesis is making sure that all factors are included with interview question simplified for the students to understand yet showing no bias in pushing students to specific answers or factors. Confirmability can be understood as the sum of the other criteria of trustworthiness (Shenton 2003). Allowing the reader to determine how and why decisions were made requires these decisions to be transparent (Nowell et al. 2017).

Modern advancements in the field of technology have put one field of scientific ethics at risk: security of personal information. More specifically owning your digital footprint. In my use of focus group interviews, the assistance of digital technology comes into play by audio recording devices. In the same manner that I have anonymized my interview subjects through pseudonyms for their voluntary cooperation in science not to cause issues in their private lives, their digital footprint in my research must be made secure. I have taken steps to use an encrypted recording service hosted by the University of Oslo, called 'Nettskjema-dictaphone,' and have all necessary approvals from NSD (The Norwegian Centre for Research Data) to gather and store my collected data. An important part of this process is that all cooperation in my research is voluntary, and any cooperation or data can be retracted at any time. Through risk analysis forms steps have been taken to ensure that only I, as the sole researcher in my project, know the identities involved and have access to any collected data. While in the past security meant not losing physical data to theft or mismanagement, today it includes data security and online privacy.

4. Findings

4.1 Focus Group Interviews

4.1.1 Summarising the 7th Grade Students

Interest and preferences started the focus groups by first asking if the students liked mathematics. They were split about half and half yes or no. A pattern soon emerged; when the students understood the concept, they would say it was enjoyable. When the opposite was true, they described thinking mathematics was difficult, and not very interesting. The students who were interested would complement several preferences in working methods, like problem solving tasks, puzzles, text-based activities, or collaborative work. All students replied content matter of arithmetic, like plus, minus and multiplication, to be fun and interesting. Working with partners could be enjoyable if the partner put in the effort, while some students argued working alone can be stressful, as they are alone with their effort. “I stress when I work alone, cause I’m alone with zero help, there is no one to talk to.” Another aspect described was how smart students could be bad learning partners, they just gave away all the answers with little to no discussion. A couple of the weaker students complimented learning the rules algorithmically, as it gives a starting point to work out from. “When I use these rules, it is easier, and that’s fun.”

Perceived instrumentality of maths was agreed by all students: mathematics was of high importance. Yet only a single student attributed this importance to be for career possibilities. Most attributed the importance of math to be in daily life situations, like going to the store or exchanging objects. The necessary math skills of arithmetic for daily life situations were highly valued by all the students, but other subject matter was dismissed by some students. “I don’t get why I need the rest; it makes me better for homework and school I guess, but what else?” The students typically knew what their best friends thought of mathematics, and they agreed everyone thought the high importance of math, though it was not uncommon for students to highlight how their friends also disliked mathematics. “I know mathematics is important, I just don’t think that way so much myself.” Several students remarked how they believed they were improving some skills they believed “probably were important”, but they also commented how they couldn’t understand the big picture of when these skills would be important. Parents’ beliefs were for most students positive on the value of mathematics work, but students mostly pointed out how they were being motivated from home to keep working with mathematics, without clear goal setting or specificity. The subject was important, but the content matter was not in focus for parents.

Personal goals of students almost unilaterally were to understand more mathematics. They did not have specific goals they worked towards and could not name any strategies to work on learning a concept of mathematics. Most agreed that they enjoyed comparing themselves to other students, however. “I enjoy finishing the task before my friends are done with it!” In a competitive matter several noted that they enjoyed seeing who would finish first between friends. Some noted how the comparison on what their friends would accomplish reflected on their own progression. The focus groups all emphasised that they worked on the content given to them by their teacher.

Self-efficacy beliefs of the students varied greatly. The students with higher sense of self-efficacy believed they would understand what they were taught in the mathematics classroom. The ones with weaker beliefs of self-efficacy would more often discuss how they could struggle to concentrate in the mathematics classroom. “Even when I want to pay attention my thoughts fly away”. The students struggled to describe when their sense of self-belief started, this was equally true for the stronger and weaker students. Yet most could describe why they felt this way in the moment. Certain of the stronger students pointed out that they knew their level after they started worked with mathematics supposed for 8th and 9th grade mathematics and received comments from classmates that they were good. The weaker ones would explain different situations of comparison to others, and how they were lacking understanding when compared other students’ progression. The students also believed they could point out the level of most other students, and that they believed others probably knew their own level too. “Everybody knows I’m bad, I’m not afraid to fail in maths. I’m good when I understand it, I just don’t care what others think, because they know that I’m bad.”

Affect were described by the students as something they portray very differently at home than they do in school. At home several students described frustration with homework if they couldn’t understand it after trying it several tries. Parents helping would often be a target of frustration in the students’ descriptions. “In school I might be frustrated, but I’ll pretend to be doing the work even when I don’t get anything at all.” Some of the strong students would describe frustration as something that could happen when overworked or if they saw someone progress faster than them. “If they work faster and very well, than I might think I am worse than I really am.” A sense of boringness was common, with several students remarking so. Boredom could happen when their working preferences didn’t fit the activity. Anger was a feeling some students would admit to, though sparingly, while other students did not believe anger to be common with learning mathematics. Sadness was the opposite, explained similarly to frustration, as it could commonly be experienced when the students’ believed, they did not understand and felt less smart. Happiness was an emotion all students described quite similarly as well. For instance, when working with something new and grasping the concept quickly, mastering several follow up tasks. Students would connect happiness to pride and achievement. One student reported how certain type of tasks made him happy. “Economics are my favourite part of math, then I can be happy and so. Every time we get an economics task, then I’m happy.”

Social factors reflected by many students on a happy, yet quite unfocused classroom. They tended to spend quite a bit of time small-talking and chatting, both in between tasks and before starting work. “I think our class is quite good at maths, but we are easily distracted and find other things more fun.” Several students would complement how it was easy to ask learning partners for help, but none would comment on an atmosphere suited to group work. Some did comment how raising their hand in class could be difficult, and they did believe more students knew the answers to the teacher’s questions than those who raised their hands. When asked to clarify they believed this might be because the students were bored, or because they didn’t have the courage to be wrong. “I know there are many in class that are good in maths and know the stuff we are working on, but when I do my homework, I am frustrated and just don’t understand it. So why can’t I when the rest get it?”

4.1.2 Summarising the 10th Grade Students

Interest and preferences questions were initiated by asking the students whether they like mathematics. Students’ replies were mixed, but a common theme was that it depended on their sense of self-efficacy. Students’ who believed their level of mathematics to be low found less interest in the subject, and the opposite was true for students confident in their own skill. For learning preferences most students replied of satisfaction to being allowed freedom of choice, whether in terms of working on tasks independently or in groups. They enjoyed discovering and learning in mathematics and were frustrated with difficulty. “Learning rules can be practical and gives me some starting point when the task seems a little impossible.” Yet most discussed how understanding, or the lack of understanding the mathematics, were the main facilitator of interest. For those who replied they frequently lacked understanding in mathematics they also didn’t enjoy much group work. “Group work can be alright, I appreciate hearing other students describe how they understand it, but if I don’t get it then I don’t get much space, as others will dominate the process.” Personal economics was singled out by many as a highly interesting subject matter, due to its perceived high relevance to their lives.

Perceived instrumentality of mathematics was by students portrayed for its high importance for future careers. In large part the subject matter of personal economics was used as an example of mathematics they found useful, and with relevance as a skill to explore. Many believed this feeling of relevance with personal economics made mathematics “more fun” as opposed to a feeling of mathematics being “mostly theoretical.” Several students gave credit to mathematics importance for higher education, but only the same students who previously replied they liked and were interested in mathematics would go on the elaborate how mathematics education could shape their futures. When asked no student gave long statements to how their friends viewed mathematics. Questioned on the views of their parents this changed. Variances were large when students described parents’ views and behaviors. Some parents were described to take great interest and help with mathematics work, other parents struggled to be able to help due to personal skills in mathematics, and some were described to not be pedagogical enough when trying to help with mathematics work. “They try to help, but they do the mathematics they remember from high school or university level, and I just don’t understand any of that stuff.”

Personal goals were by all students described by grades and exams. “I don’t know my future goals, but I do think of my grade a lot.” “I know I should focus on learning, but I only think of what I need to learn to get that grade, which is a shame really.” Some students described their goals as a specific grade they worked towards. Other students discussed how high grades meant they could go on to take specific mathematics courses in a high school, and in one student’s case how a lack of skills in mathematics meant he should take the lowest level of mathematics courses in high school. When asked of strategy choices and use of goals in terms of proximity or goal focus, no student would reply that they actively used these strategies. They worked with the content matter decided by the teacher, resulting in a test. In most focus groups tests were interpreted by the students as the most proximal goal, with a specific grade achievement being the main target goal they explicitly described. A goal many students agreed to use frequently was competing with classmates for progression and grades.

Self-efficacy beliefs among the students were completely individual, with high variance among the focus groups. Students who believed in their own competence in mathematics discussed high grades and comparisons to classmates as reasons for why they felt skillful. Students who had low beliefs of their own competence discussed how difficulty levels, and how once they started struggling it would only be so long before they lost focus and struggled to regain concentration. Interestingly, some students described how a lack of understanding in turn affected their willingness to ask for help. “The teacher is the one giving our grades, so I’d rather hide from him when I don’t understand anything. It’s easier to ask a friend.” Students also believed that they knew the level of all other students and found that they believed that you had to be smart if you were smart in mathematics, but you could still struggle in other subjects. Other students' competence levels had less impact on their social standing in the group, no student would admit that some students were cool because of their skill in mathematics.

Affect were described by students through experiences of testing and grades, with some responses of hiding their true affect in the classroom setting. Negative emotions like frustration and sadness would be common, with several students describing these emotions as stressful. "It is particularly bad if someone else in class is just flying through the work, yet I don't understand anything. Then I can feel particularly frustrated." Anger was not an emotion many would recognize when working with mathematics. Being bored was however a state many would recognize. Some attributed it to the subject itself, some to when their working preferences did not match the type of activity they were doing, others did not often feel much bored with mathematics. Sadness was another very recognized affective state. Particularly when close to a test. One student explained how she would stay up all night before tests trying to practice, and how she had experimented with going to bed with an early alarm instead. "I need to know it all. If I don't, then I'll keep on practicing. I'm sad if I feel like I won't get it right." Several students believed they could recognize affect in their classmates, but usually in the form of cues. "For instance, if he says 'bro' repeatedly while working, then that says a lot about how he feels," another student added "Or if they don't start the work, they just instantly start talking about something else."

Social factors were described by the students as a social atmosphere, where initially they work quite productively, but that they struggle as a group to keep the focused environment over time. All it was okay to be confused and not grasp the mathematical concept at hand, the same was true for students asking for help. One aspect brought up by many students is the major differences in skill level in mathematics. If the stronger students struggled to keep a positive mindset when they were bored by a slow pace, they might upset the class atmosphere by asking questions out-loud as to why they are doing this activity. On the other hand, if the stronger students struggled to grasp the concept or to complete the activity, some students remarked they would lose all confidence. "If she can't, then it has to be impossible for me," as one student put it.

4.2 Case-Study Analysis

The section of analysis uses the PPCT framework of Bronfenbrenner's model of bioecology. In this section I will present four students of mathematics, Silje and Qasim from 7th grade, Aisha and Linus from 10th grade. The interpretations and analysis of their individual cases of motivation in mathematics, as they are the outliers of the highest and lowest motivational quality in the collected data.

4.2.1 Silje

Silje is a 7th grade student of mathematics, and she says she does not like mathematics. The case of Silje is interesting to analysis with the use of Bronfenbrenner's model of bioecology as she is the student with the lowest motivational quality responses in her set. She does not portray all negative responses about motivation for mathematics, however, she confidently responds in a focus group setting that she is the weakest of her class.

Silje: "You are lucky you are interviewing this group specifically, here you have the strongest and the weakest student of mathematics"

Eskil: "You know that you are the weakest?"

Silje: "Yep."

Eskil: "And you know that he is strongest?"

Silje: "Yeah, I think so "

Although feeling the inferior mathematics student in the focus group setting, and in her classroom, Silje honestly display her proximal processes with mathematics. The other students in the focus group does not argue her points or feelings, instead nodding and listening. In Silje's closest group of friends they all dislike mathematics, she explains. While at home she reflects on a supportive environment, yet one that shares her frustration with the difficulty of mathematics. When questioned, Silje responds that she is more affective at home than at school and with her friends, even if her feelings of mathematics are the same in both settings. These regular experiences of frustration will influence Silje's motivation for mathematics. Her proximal processes are filled with emotional support and mathematical challenges at home, where she seeks help to understand, and the affective frustration are shared with her closest circle of friends. She enjoys mathematics when she understands the concepts and explains her fondness for basic arithmetic and personal economics.

Silje's person characteristics are one of strong resource characteristics. She has a light social touch, an intelligent and reflected manner of speech, and makes students around her smile and laugh with her comments. Her parents give her their time to help, and she has several material resources to facilitate her learning mathematics, among them her own working space in a private room. Force characteristics will challenge her on a personal level. While reflecting she admits to frequent and impactful affective experiences. At home mathematics can bring out frustration in the form of anger at her parents or of feeling sadness. At school she is more restrictive in allowing her affect to come to show, but she admits to lacking persistence when she does not understand the mathematics. Silje's lack of self-efficacy heavily impacts her self-regulation, and social factors is not enough to adjust her focus.

Silje: "Even when I want to focus, I just find my thoughts wander."

Eskil: "Why do you think that is?"

Silje: "I just. If everyone else gets it, then I don't understand why I can't understand it. It frustrates me."

In a contextual view Silje's microsystem allows her to experience challenging mathematics but are individually marked by negative affect and unsuccessful attempts. On a mesosystem level, where her microsystems meet, she experiences empathy for her views of mathematics. In the third level of context, the revolving exosystem, she is impacted by the teachers lack time for the individual, and the school's available resources to adjust to her unique learning needs in mathematics education. Her strategy of hiding her negative affect while in the mathematics classroom might further limit the opportunities the teacher or others to understand the extent of her shortcomings. In turn the possible benefits like governmental agencies and helpful specialist advisors made available by the exosystem might be unused by her teacher and school. Silje's focus group classmates' comments on how they used to enjoy their former mathematics textbook to a large degree. Full of colors, illustrations and they could write in the actual book. The textbooks would progress in difficulty with a unique color to code its difficulty level, and the group agreed this progression was fun. While now they have received old textbooks and writing in this book is forbidden. They resolve the tasks on a separate sheet of paper. This lack of resources results in a less interesting mathematics education for Silje, with fewer options for individual adapted goals and achievement. This is a result of political decision-making on a local authority and national authority level.

Time has affected Silje's view of self-efficacy. When questioned on her beliefs she suggested the experiences to have begun long ago. As such meso-time, or the activities that occur consistently, might suggest Silje to have had similar experiences of not understanding mathematics for several years. On a macro-time level, Norwegian primary education recently reformed its curriculum, and shifted the paradigm of mathematics teaching. The implementation of the new curriculum is still ongoing, formally introduced August 2020. It is also reasonable to assume the last curriculum of 06, the introduction of nationwide testing (national tests) as well as the influence of international tests and comparisons (Pisa, TIMSS) to have affected the development of Silje's mathematical classroom.

4.2.2 Qasim

Qasim is a 7th grade student of mathematics and has been challenged by his teacher to work with 8th and 9th grade mathematics textbooks. Qasim enjoys mathematics, and explains he particularly likes problem solving and text rich activities. For subject matter he enjoys a wide range of mathematics from the 7th grade curriculum, and some from secondary school like algebra, equations, and graphs. He perceives mathematics as important for his future career goals, believes group work is fine, yet prefers working on his own. He describes how some of his close friends share his interest in maths, and that he enjoys competing with them in mathematics. Qasim reflects that his self-efficacy improved greatly when he received textbooks for another grade of mathematics than the rest, and that his classmates typically comments that he is good in mathematics.

Qasim: "I think it's fairly easy to focus on mathematics, more so than other subjects"

Eskil: "No matter the working style or the content matter?"

Qasim: "Yeah, but I particularly enjoy economics, I am always happy when it's an economy task."

Interestingly, Qasim reports low levels of affect with mathematics. Frustration is rare, mostly when he is overworked. Neither negative nor positive affective experiences can he recall to a large extent, without seemingly looking to be holding back the truth from his focus group peers. He just seems quietly content, although perhaps withholding some positive affective experiences due to the more frequent responses of frustration, anger, and sadness by his classmates.

On a process level Qasim enjoys working with mathematics in his classroom environment but prefers working on his own accord. His proximal processes intrigue his sense of competitiveness, and he enjoys a challenging discussion, yet he announces that discussions require the partner to be engaged and work hard. By his teacher he is challenged to go above the expectations set for the rest of his classroom, and the other students in his focus group proclaim this earns him a role as the smart one.

On a person level he can be categorized by potent force characteristics. His self-efficacy gives him a calm temperament, and a confident belief that he can understand most concepts of mathematics for his level. Uncertainty, trial, puzzles, and making errors are his favorite activities in mathematics, and his perceived instrumentality of mathematics is that these skills will help him whatever future he chooses. Resource characteristics are a bit different. He is intelligent, yet does not embrace his role socially, preferring a more isolated role. These attributes might be contributed to several personal uncertainties, but it does not originate from a lack of motivation in mathematics education. In his focus group he is admired as smart and given space to reflect upon challenges and positive sides of mathematics the other students do not share.

The context level on a micro- and mesosystem both give Qasim a lot of freedom to be an individual learner of mathematics. He is encouraged at home and at school to challenge his mathematical skills, and it has given him a powerful sense of self-efficacy. On an exosystem level this could influence his options in future schooling, his teachers might look to him as a guide and benchmark for other students, and his parents might push him in a direction of mathematical studies and fields of career. The macrosystem might be another influence for a STEM education. Cultural values and social standing of mathematics related fields of study being among the top of Norwegian society. The new curriculum of 2020 will challenge Qasim's mathematics skills in a sociocultural direction and challenge his view of mathematics as mostly preferring individual work. Whether this will increase his motivation or push mathematics from his comfort zone and into more affective experiences is up to his personal development. If his current views persist, he might struggle to adapt to a new perception of mathematics as having an important social foundation.

4.2.3 Aisha

Aisha is a 10th year student of mathematics, and she proclaims she does not like mathematics.

Aisha: "I just don't understand it, I think it's a little uninteresting maybe. I like languages."

Other student: "I like it if I like the content, like economics was fun, but not geometry or formulas"

Aisha: "I think economy is quite okay, really. But formulas don't enter my brain, and I'm not good with numbers, being systematic and such."

Quite confident in her own lower level of mathematics competence she proclaims her perceived instrumentality of mathematics is that a lot of it is not necessary. In her focus group the other students mostly agree, yet she is the only student to discuss how her family are "more a language family."

In terms of process Aisha appears to be frequently frustrated with mathematics, both at home and at school. She struggles to concentrate with mathematics and find it stressful. She fears being openly wrong yet admits that in the classroom most students know when she does not understand. “I begin breathing loudly, like pushing in air and pushing it out again. That happens when I don’t understand anything.” In her proximal process she is one who has no belief of self-efficacy, and it shows in her outlook and reactions when discussing motivation for mathematics. Yet this only rings true for her in mathematics. In other subjects, like English, she admits a strong belief of self-efficacy, and says the teacher frequently turns to her for answers. The social factors around her support her to work on mathematics, but this support does not change her outcome or her beliefs of self-efficacy.

In Bronfenbrenner’s description of personal attributes (2005), Aisha appears as one rich of resource characteristics. Portraying strong mental and emotional attributes, willingly sharing her insecurities, and reflecting openly on why mathematics does not motivate her. Force characteristics in mathematics is different, she displays none. She frequently describes low motivation, lacking persistence, and negative affective experiences with mathematics. These characteristics hinder her developing the necessary self-efficacy and perception beliefs of mathematics as useful.

Context has important clues for Aisha’s development of mathematics motivation. In her microsystems she is continuously reminded of the importance mathematics has. She proclaims that she frequently reminds herself how much worse she is then her peers, and this in large part is reflected by her mathematics grades. In the macro system, the value of grades can be attributed to the importance of mathematics. Grades decide in large part which high school and later field of study you can realistically be admitted to. A low set of mathematics grades will directly influence which opportunities in education are open to you.

Time is not gentle to Aisha’s motivation in mathematics. In occurring interactions, she rarely feels that she masters mathematics. She admits that mathematics rarely fills her with interest or a sense of exploration, over time grades have continuously affirmed her lacking competence compared to her friends.

4.2.4 Linus

Linus is a 10^{th} grade student of mathematics. He enjoys mathematics education and sums up his interest in the subject as the fulfillment of discovering the truths of mathematics. This perceived instrumentality is not lost upon the rest of the focus group, yet they openly retort that they cannot make much sense of mathematics. Linus does not retract or amend his statement but seems comfortable with the position of a lone statement. He does not receive criticism, but neither does he receive support for his personal views. This social factor is interesting, as it does make Linus isolated in parts of his interest in mathematics. With certain classmates he compliments competitiveness in working and grades, highlighting the friendly manner the competition takes place. His goal for mathematics is top marks, and to go on to take advanced mathematics courses in high school. When questioned upon his use of more focused or proximal goals, he says he is uncertain, but does suggest tests makes for natural goals.

Linus proximal process in his mathematics classroom cannot quite match his level of interest and does not share his enjoyment of mystery for understanding mathematics. But the proximal process around him does not hinder him either. Socially the group compliments the highly autonomous freedom to individually choose working preferences as they see fit, which suits Linus well. The students note how group projects can be a bit unfocused, but discussions and presentations are noted by Linus to be among his favorite working styles. An interesting discussion to interpret is how the students in all 10th grade focus group would agree that the students mastering mathematics education were smart. Yet they would hesitate to note that this mastery would affect their social standing. Linus is personally complimented for his social status in his focus group, but his motivation for mathematics and his mathematical skills is not among the reasons for his status. Considering the general hesitance for all focus groups to agree that mathematics skills impacted social standing, this is a familiar feeling for Linus. Highlighting how the social factors are inclined to focus personal qualities other than mathematics skills.

Personal resources of Linus notes top marks in all categories. Well dressed and groomed, resource characteristics of high emotional and social skills and force characteristics concluding high motivation for learning mathematics. Linus works against the current in the sense that he is among the few enjoying mathematics education. To find a social course where he still enjoys the inclusion to the social group and a balance between social focus and mathematics work. Grades are discussed by the focus groups as a large area of affective challenges.

> Student: “I can stay up all night ahead of a test, I’m sad and frustrated when I don’t feel like I know it all.”
>
> Linus: “Yeah, at times I’ll even hide questions from the teacher, pretending that I understand more than I do. After all he is the one marking our grades. It’s not right really, but I do it.”

Microsystems and mesosystem of Linus are areas where he might feel the need to hide some of his ambitions, interests, and uncertainties. As a popular classmate he might prioritize other skills and attributes to match the social factors around him. His statement of hiding questions from the teacher receives nods and other students saying they agree. This creates an interesting angle of interpretation that Linus might be aware of what is correct to highlight in the social setting, as his self-efficacy and top marks might suggest that he has few mathematical misunderstandings. At home he explains he mostly likes to work with mathematics on his own, preferring to work in his own tempo with the target goal of understanding the mathematical concepts.

In terms of time, changes in meso-time have not been noted negatively by Linus. The introduction of grades and testing in secondary school has mostly affected the social factors in his surroundings. Where other students note negative affect with test and grades, Linus views grades with competitiveness and as a benchmark for how the quality of his work. His self-efficacy has not changed since primary school, and his perception of mathematics as important for life skills remains the same. Linus still explores mathematics with a sense of adventure and intellectual intrigue. For his classmates this is atypical, and it is rare to rare to find similar experiences in other students' stories.

5. Discussion

5.1 Comparing the Two Sets

It is interesting to discuss similarities and differences separately when comparing the two sets of student groups, before discussing how the case-studies highlight the variance of the lowest and highest motivated. The general findings of this thesis and focus of the research question, how the students of 7th grade and 10th grade are motivated differently in mathematics education. The individual differences have been found to be large. Therefore, a logical structure is to first compare the two sets before the multiple case-study, to discuss how certain students face different trajectories than most of their respective set.

5.1.1 Comparing Similarities

For the factor of *interest and preferences,* 7th grade students and 10th grade students have responded similarly to their interest in the subject of mathematics, and to which working preferences they favour. As a key predictor of persistence and achievement (Middleton et al., 2016), interest in mathematics is vital for motivation. My data showing similar levels of interest between the two sets reflects how few of the students reports long-term interest in the subject (Murphy & Alexander, 2002). Situational interest seems for most students to depend on their ability to relate to the mathematics content, and students from both sets specifically reported content relating to personal economy did so (Murphy & Alexander 2002). 7th grade sets were intrigued by the role of economy in daily lives, and 10th grade students reported a meta understanding of how knowledge and skills in personal economics would benefit them personally. In term of long-term interest in the field of mathematics, the case of Qasim and Linus shows intrinsic motivation (Deci & Ryan 2000), yet they were a minority. The collected data show situational interest in both groups, but individual interest to be rare for most students. This coincides with empirical research suggesting intrinsic motivation to be less likely in early schooling (Creten et al., 2001). Interest and self-schema being conceptualisation of motivation, as argued by Murphy and Alexander (2002), would logically infer those students who are not interested in mathematics are lacking basic concepts of motivation for the subject. *Preferences* also sees similar tendencies for the two sets of students. Both classrooms can be unfocused and spend time on distracting small talk when given the chance. Students of both sets add to this by describing a preference of working with other people only if the partner they work with are focused and trying (7th grade discussing learning partners), and if they are given the space to contribute to the work (10th grade discussing individuals with a high mathematics skill impact on a group setting). Skott (2015) argues this social nature of interest and preferences is influenced by the social practices of the classroom. With classroom environments being less focused on shared mathematics engagement, rather allowing individuals greater autonomy to work independently, this might negatively contribute to the students' interests and preferences.

The *perceived instrumentality* among the two sets is similar in several regards. Almost all students agree that mathematics is important, and most highlighted how their parents' views were the same. Creten, Lens and Simons (2001) argues the students' beliefs of importance will affect their motivation and increase the likelihood of achieving their goals. Beliefs of importance were among both sets not correlating with their motivation for the subject. An example of this is the case of the 7th grader Silje, who argues she wants to do good; she just does not believe she is able to. "I just. If everyone else gets it, then I don't understand why I can't understand it. It frustrates me." The value of social factors impacting her self-efficacy and overriding the effect of perceived importance is an interesting find in this case. Another shared value of perceived instrumentality is how most students did not perceive mathematics as skills for personal growth, with an inherent value of the tasks themselves. If the task has the inherent indigenous value it will be important to practice on its own (Husman et al., 2004), yet most students of both sets did not reflect on this value of learning mathematics, rather they questioned the purpose of most content matter. The case of the 7th grader Qasim portrays how a strong perceived instrumentality of mathematics could lead to an intrinsic interest in any mathematics task. This is like the 10th grader Linus enjoying exploring mathematical questions and enjoying not knowing the answer. The sets of students have large individual differences. Most students responded that they wanted to understand mathematics yet did not really enjoy the sense of exploring unknown mathematical concepts.

Personal goals are the variable of motivation that the students of both sets have very few responses of explicit use. Goal proximity, goal specificity or goal focus are three main aspects of goal types (Middleton et al., 2016). When questioned the students responded that they do not use these types of goal strategies. Considering how research suggest students' ability to use strategies of self-regulation go hand in hand with the proximity of goals (Hester 2012), this find might give clues to why the social factors of the classroom struggle to focus their mathematics activity. Student activities should create progress toward a focused goal (Zhang et al., 2011), yet these strategies are not reflected in the student responses from both sets of groups.

Self-efficacy has the same core principle in all responses. The students' want to understand the mathematics they are made to work with. Considering how present success can help develop learners' self-efficacy (Middleton et al., 2016), the similarities of both sets responding mostly negatively to their own self-efficacy suggests that these experiences of success are rare. Teacher's feedback or classmates' responses can contribute to self-efficacy. For the two sets of students, feedback or responses were uncertain to have lasting influence. Qasim mentioned classmates telling him he was good probably meant that he was good, but rather emphasized working on more difficult material as the reason why he believed in his self-efficacy. This is interesting, as it suggests the students give low value to compliments for their self-efficacy beliefs. Self-efficacy is by some researchers argued to be the strongest indicator for intrinsic motivation (Skaalvik et al., 2015), and is vital for developing core motivational characteristics like interest, effort and persistence. The common reflections of both sets to have low to medium beliefs of self-efficacy indicates intrinsic motivation is hard to develop once a student struggles to believe in their own competence. This could suggest that the main body of students in both groups are motivated for mathematics due to extrinsic goals, and the perceived importance of mathematics all students agreed to.

Students have similar strategies when it comes to portraying and regulating *affect*. Affect being the emotional response in the interplay of cognitive and emotional aspects (Di Martino & Zan 2011). The students mostly seem to agree that affect is to be hidden in the classroom setting. Most of the students believe that they can tell how other students are feeling in the mathematics classroom, through subtle hints or characteristics. Students like the 10^{th} grader Aisha also believe that they are quite transparent when experiencing affect, noting how she believed most students could tell when she could not understand the mathematics. Empirical research suggests negative emotional responses are more common than positives in the mathematics classroom (Eynde et al., 2006). The negative affect has its basis in the social nature of comparing progress and results, or lack of results, with classmates. Situations of negative affect have been found to be highly specific person-in-context (Op't Eynde, De Corte, & Verschaffel, 2006). The same is true for my data. Most students reflected on negative affective experiences and how they would try to hide these emotions from classmates and their mathematics teacher. A particular similarity between the two sets of students is how they acknowledge these affective experiences, and in particular negative emotions, to be more frequent when working at home. Change the social context of their proximal process to one at home and in private, and the affective reflections and regulations of the students are markedly different. Where they agree that you can tell affect in the classroom by a student's tells, they also comment that frustration, anger and sadness is more common at home. Parental help to learn mathematics were described by several students of both sets to be a frequent setting for negative affect. Many describing explicit frustration, anger or sadness while working on mathematics with their parents. This finding might suggest the social learning environment of the classroom to be viewed as an improper arena to be honest about their affect and motivational factors.

Social factors are promoted by education researchers as important yet has been a less focused area of research (Middleton et al., 2016). Students are more likely to be motivated and engaged when they perceive support from their teachers and friends, with benefits from sensing belonging and meaningful challenges in their working environments (Akey, 2006). In my data both sets of students report supportive environments, but not particularly meaningfully challenging environments. The students discussed easily distracting each other from their mathematics works, and although they did report benefits from discussing and explaining their reasoning with classmates, most students did not want more frequent use of collaboration when working with mathematics. The cases of 7th grader Aisha, and 10th grader Linus also show how individuals tend to perceive the same attitudes as their close friends. Students who were less motivated for mathematics would describe that their friends felt mostly the same way, and the same was true for motivated students. This could construct a repetitive circle where the stronger students, like Linus, creates a beneficial learning environment with his friends of equal skill, while students like Aisha create a proximal process of less mathematics interest, favouring social distractions and comfort.

5.1.2 Comparing Differences

The sets of students are motivated differently in several regards, in multiple of the factors from the adapted framework of motivation. In terms of *perceived instrumentality,* the students of 10th grade more frequently reported that they did not understand the reasoning for why they need to learn the content matter. Struggling to see the benefits for life skills or how to implement the knowledge in other settings, even though educators are working to teach these perceptions (Wake, 2014). This implicates the 10th grade students to a larger degree need to find extrinsic reasons for motivation (Husman et al., 2004), searching for meaning outside their own interests and intrinsic reasons of motivation. This is in line with research suggesting that a decrease of valued importance from 7th grade students to 10th grade will lead to less motivation for mathematics education (Creten et al., 2001). A possible consequence of this decrease is the social value of mathematics skills to be lessened in the classroom environment of 10th grade, mathematics skill does not mean as much to the students which in turn creates less incentive for collaboration and focusing on improving mathematics skills for social reasons. Students in the 10th grade set also discussed future mathematics courses in high school and educational careers as an important concept of perceived instrumentality, while 7th grade students focused their answers on believed importance of mathematics skills. Highlighting a dissonance by 10th graders reflecting on exogenous reasons for instrumentality of mathematics, while 7th graders reflected on indigenous reasons (Husman et al., 2004).

Self-efficacy beliefs shared the common core of wanting to understand what they were taught and experiencing negative affective responses when they did not. 10th grade students however also in large part based their self-efficacy beliefs on the grades they received and comparing these results to their classmates' grades. Past achievements are an important aspect of growing thoughts of self-efficacy (Skaalvik et al., 2015). However, the achieved grades resulted for most of the students as a parameter to measure how they had failed to achieve, or to what degree they had failed. The individual case of a high achiever in mathematics, the 10th grader Linus, is particularly interesting, as one of the few students to report success with grades for intrinsic motivation. Linus described using it as a competitive benchmark and enjoying a measure of the quality in his working progress. With force characteristics of persistence and high motivation for mathematics, the impact strength of self-efficacy that his achieved grade has is one of intrinsic motivation while other 10th graders compare their grades as a product instead of a process.

Personal goals are important for motivation, as an unfocused goal will lead to an unfocused learner (Hannula, 2006). Most students of both sets were unfocused, with few goals of either proximity or focus. This is in line with research suggesting that students commonly are not aware of the importance by making proximal and targeted goals to reach a future goal (Hester, 2016). Where the two sets differ is the pragmatic goal setting of grades for the 10th grade set. Most students of 10th grade had a goal target of achieving a specific grade. It was not explored in this research project whether these goal targets were realistic for the students to achieve, and thus the motivational strength of this finding is unclear. Realistic goals set at an appropriate level is found by research to be critical for goals to be engaging and for development of self-efficacy and achievement (Akey, 2006). In this data collection personal goals are found to be an underused strategy of motivation and self-regulation.

For *affect,* grades had another substantial impact for the 10th grade students. Namely that many experiences of strong negative affect were concerned with an achieved grade, or a future grading situation. Tests were described as particularly stressful, with students spending the final hours and days cramming practice before tests. As an unconscious evaluation of progress toward a goal (Hannula 2002), the resulting negative affective responses display how most students negatively value their individual progression. This interplay between beliefs of self-efficacy and affect is proposed by Di Martino and Zan (2011) to be particularly strong when a negative disposition to mathematics is linked to low levels of perceived competence. In my research this link proves true for all students describing a dislike of mathematics. The day of testing, and while the students worked to prepare for the test, were situations of frequent negative affect. Students who believed their self-efficacy to be low would elaborate on several negative affective experiences. The research question of this thesis has not been to evaluate the strength of factors impacting motivation, but it is a distinct link to affect being discussed by 10^{th} grade students in combination with testing and grading which is not found in the set of 7^{th} grade students. Research does not suggest negative affect to lead to positive mindsets of process and meaningful thinking in mathematics education (Di Martino & Zan 2011). Grades mostly are beneficial for intrinsic motivation in the strongest students of mathematics, who can add the achievement positively to their sense of self-efficacy.

5.2 Case Comparisons

The individual cases are interesting to compare to their older counterparts. In this part of the discussion the two lower motivated mathematics students from 7^{th} and 10^{th} grade will be compared to each other, following the two higher motivated mathematics students of 7^{th} and 10^{th} grade will be compared. This is interesting to highlight differences in trajectories and development for students of similar levels of motivation for mathematics. These students are the lowest and highest motivational outliers of their respective sets.

5.2.1 Low Motivated 7^{th} Grader Compared to Low Motivated 10^{th} Grader

Silje the 7^{th} grader and Aisha the 10^{th} grader shares their dislike for mathematics education. They are interesting to compare as the lowest motivated mathematics students in the two sets. They share characteristics, they are both socially and emotionally adept, sharing signs of empathy, humor, and critical self-reflection. They also equally share force characteristics of lacking motivation, issues of persistence and have a temperament.

They both describe themselves as preferring relational learning styles, longing to understand the concepts of mathematics. Research suggests relational learners favor creativity, inductive reasoning and divergent thinking through social interactions and discussions (Berry III, 2003). Yet their reflections of interests and preferences does not match their behaviour in their proximal process. They favour working with students of a similar skill level and are easily distracted by these students. Past achievements are highlighted by researchers as vital to develop self-efficacy (Skaalvik et al., 2015). For Silje and Aisha self-efficacy beliefs hinder their progression. A key similarity between them is how they rank their own self-efficacy based on the level of their classmates. Silje believes her progress is slow compared to other 7^{th} graders and describe frequent experiences of negative affect when she is reminded of how other students master mathematics, she does not believe in her abilities. Silje remarked how she felt this way since she first started observing other students progress in early schooling. Aisha the 10th grader remarks how the grades display achievement for all to see and make her self-efficacy beliefs an objective truth. Her friends and classmates are graded higher than her, and for this reason she must be worse in mathematics, further influencing her lacking self-efficacy growth.

The self-efficacy beliefs of ranking themselves lowly suggests they both perceive the instrumentality of mathematics to be that of the product, not the process of learning. The students' interest in mathematics are not drawn to a perception of life skills, and research suggest this view of mathematics as a product is troublesome, especially if the perceived importance of mathematics is to lead to interest in the subject (Reyes 1984). Considering how researchers indicate interest to be a key predictor of mathematics achievement (Middleton et al., 2016), the trajectory of perceived instrumentality does not change from 7th to 10th grade for students who consider themselves low in competence and motivation. As a matter of fact, Aisha the 10th grader to a larger extent than Silje argue that most mathematics content in school is without purpose for her life.

The trajectory of self-efficacy and interest does not seem to improve by the contextual change of institution from primary to secondary school in my findings. This is consistent with empirical research who found competence beliefs to drop from primary education to secondary (Ma & Kishor, 1997), and attitudes to grow increasingly negative through primary education (Köğce et al., 2009). The importance of this trajectory for the lower motivated students cannot be understated, as empirical research also deduces self-efficacy beliefs to be strongest predictors to achievement (Nicolaidou & Philippou, 2003). A possible explanation for why this trajectory is in a decline could be the increasing difficulty of the mathematics content. If the case of Aisha had a similar starting point to Silje, when she was in 7th grade herself, it is reasonable to suggest she entered secondary school with an already low belief of self-efficacy. By increasing the difficulty of mathematics education, without experiences of success to back it up (Skaalvik & Skaalvik, 2013), Aisha increasingly might have observed her shortcomings as a mathematics student. This hinders an increase of interest in the field of mathematics. Summarised by the continued negative affective responses explained by Aisha, as she remarks how testing has been experienced throughout her years in secondary school.

5.2.2 High Motivated 7th Grader Compared to High Motivated 10th Grader

Qasim the 7th grader and Linus the 10th grader shares a high motivation for mathematics education. They are both interested in mathematics, and in addition share a view of perceived instrumentality. When describing what content they like, they address a wide range of mathematical concepts. They describe recent experiences and reflect on why they believe mathematics fascinate them. In similar fashion to how research suggests mathematical activities that are evaluated as situationally interesting could develop to long-term individual interest (Middleton et al., 2016). Both Qasim and Linus proclaim a long term interesting in mathematics. In terms of general preferences, they enjoy complex mathematics, problem solving and exploring new dimensions of mathematical concepts. Interestingly they both enjoy an analytical and a relational learning style (Berry 2010), noting how social learning styles of discussions are dependent on who they are partnered up with. Seemingly more universal in learning styles, rather than selective of one style, they both seem to thrive if the mathematics is challenging.

Linus discusses how mathematics will be important for his future career, and how he foresees working with mathematics through high school. He believes mathematics to be important to his future, even if his choice of profession remain undecided. The impact importance has for perceived instrumentality of mathematics is through motivation and use of goals (Creten et al., 2001). Interestingly, Linus does not reflect long on the extrinsic motivational reasons of future career choices, although his belief of valued importance is explicitly stated. Perceived instrumentality is described in literature as the incentive an individual has for their present behaviour (Husman et al., 2004), and for Linus the intrinsic enjoyment and fulfilment of exploring mathematics is the emphasis of his reflections. His lack of using personal goals might suggest the same. The motivational impact of the extrinsic goals of future career goals does not influence his use of strategies or goals in his situational mathematical interest. Qasim, the 7th grader, share to a large degree these reflections, with some distinct differences. Qasim to a lesser degree extends the importance of mathematics to a career, and rather emphasises the importance of mathematics in all of life's aspects. In comparison with Linus, he too finds intrinsic motivation to learn mathematics, as described by Husman et al. (2004) as indigenous perception of the value a mathematical task has. Like Qasim, he agrees to the exogenous importance of mathematics, but in his reflections the indigenous value of life skills and process thinking outshines future goals. Qasim and Linus both focus on in-the-moment engagement, and although Qasim is more reflected upon the contextual changes he has been through, and will be going through, they share the situational interest to all mathematical content.

Self-efficacy beliefs are similar for both students, both achieving proficiency and understanding. This is in line with research suggesting self-efficacy to have the strongest value of indication for intrinsic motivation (Skaalvik et al., 2015). They are both persistent, motivated and believe they will master the subject matter. A key difference is why they believe this sense of self-efficacy to be present. Qasim believes the reason might be because he works with higher level textbooks, unlike his other classmates. He notes the value of other friends explicitly stating he is good in mathematics, yet points matter of factly to the increased difficulty he faces as a reason for his self-efficacy beliefs. Linus believes his overall understanding and testing gives reason for his self-efficacy, he masters mathematics as proven by his abilities and it is further proven by his achievements in grades.

A relatively new critique of research on motivation is how a lens of individuality is commonly used in research on motivational factors, arguing that a lens of social norms and interactions should be used instead (Middleton et al., 2016). The findings of this thesis interestingly find that both the strongest students, and the weakest, mostly use social norms and interactions to compare their level of skill. This belief of self-efficacy in turn is the strongest indicator of their motivation for mathematics education. Another issue is extraversion, or an openness to social interactions in mathematical activities. The personality trait of extraversion has been found in empirical research to be of negative correlation to mathematics achievement (Levpušček et al., 2013). In my findings, the highly motivated students of Qasim and Linus do not seem to rate social factors as very important for their motivation to learn mathematics, more so as a mean of measuring self-efficacy and as one of many possible styles of working preferences. This is important when comparing the two sets of students as individuals further from the mean skill of the group have opposite outcomes. High level students have been found in this data to have an important impact on social factors for the whole class when showing affective responses to the teaching. If the high-level students, who commonly are very motivated for mathematics, showed boredom, the group believed their progress was too slow compared to other students. On the other hand, if the high-level students were frustrated by difficulty the group were influenced to give up, as their self-efficacy beliefs had a basis of comparison to the stronger students. If the strongest students of mathematics failed, the rest believed they had no chance of success.

Linus and Qasim are both given the freedom to independently challenge themselves, and continuously face success and achievement with mathematics education. The social factors surrounding their proximal process are positive to their autonomous work with mathematics, yet less as collaborative partners for learning. In terms of development, this suggests there are areas of their learning environments that could improve to further develop their motivation for mathematics. Skott (2015) discusses how beliefs and interest in mathematics are dynamically linked with the social practices of the classroom. The remarks of Skott are essential when interpreting the reasons for the beliefs and motivation of students like Linus and Qasim, who are so far from the norm and social practices of their classrooms. Where mathematics education research suggests social and relational learning to be the most valuable for learning mathematics, the students of the highest motivational levels struggle to find social interactions for learning useful.

6. Conclusions

The purpose of this thesis was to explore differences and similarities in motivation for mathematics education, comparing 7th grade students to 10th grade students. A simple answer to the research question is that motivation is mostly similar when comparing 7th and 10th grade mathematics student in Norway. Beliefs of self-efficacy is found to be the core foundation for motivation, and many students find their self-efficacy lacking. Self-efficacy was found to have tendency where low sense of self-efficacy was linked with a low interest in mathematics. This is in line with research in the field of mathematics educational research suggesting self-efficacy beliefs to be low for most students (Ma & Kishor, 1997), and the role of competence beliefs as vital predictor for motivation in mathematics (Nicolaidou & Philippou, 2003). Interestingly, when interpreting the social factors both lower motivated students, and higher, equally struggled to see the value of collaborative working preferences of mathematics. Lower motivated students noted how they were easily distracted by socialising and consequently procrastinated. Higher motivated students noted how group work were dependent on the skill level and focus of their partners. They all enjoyed hearing others' ideas if they understood the concept. In a group setting students that struggled admitted they were frequently dominated by stronger students taking too much space or too quickly rushing through answers.

The finding of distracting social factors is important. Analysing multiple case-studies was done to explore the range of influence social factors had for individuals. For the sets of groups, a similarity of social norms and learning environments were found. A highly autonomous culture of being allowed to perform at your own level, with little emphasis on mathematics skills influencing social standing in the classroom. Students described preferring their learning partners to be of equal skill level to themselves. This might infer social factors for both 7th grade, and 10th grade students have a tendency of reinforcing students' perceptions of self-efficacy and perceived instrumentality of mathematics, instead of challenging these beliefs. Social factors had another impact in decisions of choosing strategies to hide affect, and to evaluate self-efficacy. Both sets of students would hide their affect in the classroom, rather allowing their true feelings to be shown at home. 10th grade students were more likely to hide their affect from their teacher, as it might reveal failed understanding and result in the teacher lowering their grades.

When comparing individual cases, trajectories of high motivated students suggest they enjoy the change of institutions. The biggest change to their proximal process being their work continuously being tested and graded, yet this did not influence the intrinsic motivation for these students negatively. For lower motivated students testing appears to be a focal point of negative affective experiences. Both higher and lower motivated students shared a lack of using personal goals as a strategy for monitoring progress and benefitting motivation. This might suggest that the intrinsically motivated students, who enjoyed most of the mathematics content and perceived instrumentality of mathematics as skill improving, had an easier time staying focused on the task at hand. For extrinsically motivated students, particularly in the 10th grade, continuous experiences of failure to understand was a more frequent experience. The stronger student's trajectory is one of independent and autonomous progress, while facing more advanced and challenging mathematical concepts. And they thrive learning this way. For the weaker students experiences of success and achievement are lacking, and in turn their negative outcome does not change from 7th grade to 10th. What they share is a lack of useful motivation from their social factors. The stronger students struggle to find collaborative work they feel challenge them, mostly preferring to work independently. The weaker students tend to use social factors to seek comfort and distractions.

6.1 Suggestions for Future Research

A suggested area for motivational research in mathematics education is social factors (Middleton et al., 2016). From my research design and findings, I would suggest noting how different individual variance is between students. Specific studies for differentiated levels of motivation could be key to reliably, and viably, research the influence of social factors on motivation. Another critical aspect is how my data suggest students hide their true affective responses from their classmates, and in 10th grade even from their mathematics teacher. Getting students to honestly reflect on their affective experiences might be easier in a private setting and is an element that could be lost if intervention-based research on social factors do not include post-evaluation or private and anonymous reflections.

Social factors have in this study been an integral part as both a factor of motivation and in designing a research method. Analysing individual case studies through Bronfenbrenner's model of bioecology gave strength to interpreting how individuals were influenced differently by social factors for their motivation in mathematics education. As a model of analysis this could be further improved by following individuals in longitudinal studies, with repeated and continuous observation of individuals. This could improve upon the main strength of the model: human development. An important note is to not use a lens of individuality, as described by Middleton et al. (2016), but to gather data and interpret the results based on the social interactions and engagement students have in their educational setting. The limited scope of this research should not neglect the value the findings have for possible longitudinal studies or intervention-based methods.

For the social factors found in this thesis the overall lack of mathematical focus, the low influence of mathematics skills for social standing, and an autonomous learning culture have been important finds. For mathematics educators, the impact of social factors for motivation should be studied as to how teachers to a larger degree can influence students of different motivational levels to benefit, if their social factors were to be focused on the mathematics. Social interactions particularly distracted lower motivated students, but neither were truly beneficial for higher motivated students. Self-efficacy was particularly influenced by social factors, as most students would monitor and compare their progress to other classmates. If social factors can be adjusted to help students prioritize personal goals, and help lower motivated students struggling with negative affect, the findings of this thesis suggest it would impact their self-efficacy positively. With an improvement in self-efficacy, more students could develop long-term interest in mathematics, which should lead to a more focused learning environment. For this interest to develop, students need to experience success and progression, and see the instrumentality value of their mathematics education. Further research is particularly needed to address how social factors can be addressed and adjusted for improving the effect of social factors for motivation. For students of all levels of motivation.

7. References

Akey, T. M. (2006). School Context, Student Attitudes and Behavior, and Academic Achievement: An Exploratory Analysis. *MDRC*.

Atzaba-Poria, N., Pike, A., & Deater-Deckard, K. (2004). Do risk factors for problem behaviour act in a cumulative manner? An examination of ethnic minority and majority children through an ecological perspective. *Journal of child psychology and psychiatry, 45*(4), 707-718.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological review, 84*(2), 191.

Berger, C., Lisboa, C., Cuadros, O., & de Tezanos-Pinto, P. (2016). Adolescent peer relations and socioemotional development in Latin America: translating international theory into local research. *New directions for child and adolescent development, 2016*(152), 45-58.

Berry III, R. Q. (2003). Mathematics standards, cultural styles, and learning preferences: The plight and the promise of African American students. *The Clearing House, 76*(5), 244-249.

Bronfenbrenner, U. (2005). The bioecological theory of human development (2001).

Bronfenbrenner, U., & Morris, P. A. (1998). The ecology of developmental processes.

Bronfenbrenner, U., & Morris, P. A. (2007). The bioecological model of human development. *Handbook of child psychology, 1*.

Bruner, J. S. (1986). *Actual minds, possible worlds*.

CenterforSDT, C. f. S.-D. T.-. (2017). Representation of the Motivation Continuum. Retrieved from https://twitter.com/centerforsdt/status/989140986730373121

Creten, H., Lens, W., & Simons, J. (2001). The Role of Perceived Instrumentality in Student Motivation. In *Trends and Prospects in Motivation Research* (pp. 37-45). Dordrecht: Springer Netherlands.

Deci, E. L., Koestner, R., & Ryan, R. M. (2001). Extrinsic rewards and intrinsic motivation in education: Reconsidered once again. *Review of Educational Research, 71*(1), 1-27.

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian psychology/Psychologie canadienne, 49*(3), 182.

Di Martino, P. (2016). Survet of the State of the Art - Attitude. In *Attitudes, beliefs, motivation and identity in mathematics education: An overview of the field and future directions*: Springer Nature.

Di Martino, P., & Zan, R. (2010). 'Me and maths': Towards a definition of attitude grounded on students' narratives. *Journal of mathematics teacher education, 13*(1), 27-48.

Di Martino, P., & Zan, R. (2011). Attitude towards mathematics: A bridge between beliefs and emotions. *ZDM, 43*(4), 471-482.

Edelen, D., Bush, S. B., Simpson, H., Cook, K. L., & Abassian, A. (2020). Moving toward shared realities through empathy in mathematical modeling: An ecological systems theory approach. *School Science and Mathematics, 120*(3), 144-152.

Elliott, J. G., & Tudge, J. (2012). Multiple contexts, motivation and student engagement in the USA and Russia. *European Journal of Psychology of Education, 27*(2), 161-175.

Eynde, P. O. t., Corte, E. D., & Verschaffel, L. (2006). "Accepting emotional complexity": A socio-constructivist perspective on the role of emotions in the mathematics classroom. *Educational Studies in Mathematics, 63*(2), 193-207.

Foyn, T., Solomon, Y., & Braathe, H. J. (2018). Clever girls' stories: The girl they call a nerd. *Educational Studies in Mathematics, 98*(1), 77-93.

Gustafsson, J. (2017). Single case studies vs. multiple case studies: A comparative study. In.

Gutiérrez, R. (2013). The sociopolitical turn in mathematics education. *Journal for research in mathematics education, 44*(1), 37-68.

Hannula, M. S. (2002). Attitude towards mathematics: Emotions, expectations and values. *Educational Studies in Mathematics, 49*(1), 25-46.

Hannula, M. S. (2006). Motivation in mathematics: Goals reflected in emotions. *Educational Studies in Mathematics, 63*(2), 165-178.

Hannula, M. S. (2016). Attitudes, beliefs, motivation and identity in mathematics education: An overview of the field and future directions. In *Attitudes, beliefs, motivation and identity in mathematics education: An overview of the field and future directions*: Publisher: Springer Nature.

Hansson, Å. (2012). The meaning of mathematics instruction in multilingual classrooms: analyzing the importance of responsibility for learning. *Educational Studies in Mathematics, 81*(1), 103-125. doi:10.1007/s10649-012-9385-y

Hester, A. (2012). The effect of personal goals on student motivation and achievement. *Studi 012 R*, 55.

Heyd-Metzuyanim, E., & Lutovac, S. K., Raimo. (2016). Identity. In *Attitudes, beliefs, motivation and identity in mathematics education: An overview of the field and future directions*: Springer Nature.

Husman, J., Derryberry, W. P., Crowson, H. M., & Lomax, R. (2004). Instrumentality, task value, and intrinsic motivation: Making sense of their independent interdependence. *Contemporary Educational Psychology, 29*(1), 63-76.

Husman, J., & Hilpert, J. (2007). The intersection of students' perceptions of instrumentality, self-efficacy, and goal orientations in an online mathematics course. *Zeitschrift für Pädagogische Psychologie, 21*(3/4), 229-239.

Irvine, J. (2018). A Framework for Comparing Theories Related to Motivation in Education. *Research in Higher Education Journal, 35*.

Kaarstein, H., Radišić, J., Lehre, A.-C. W. G., Nilsen, T., & Bergem, O. K. (2020). *TIMSS 2919 - Kortrapport*. Retrieved from

Kamberelis, G., & Dimitriadis, G. (2013). *Focus groups*: Routledge London.

Kitzinger, J. (1995). Qualitative research: introducing focus groups. *Bmj, 311*(7000), 299-302.

Kloosterman, P. (2002). Beliefs about mathematics and mathematics learning in the secondary school: Measurement and implications for motivation. In *Beliefs: A hidden variable in mathematics education?* (pp. 247-269): Springer.

Köğce, D., Yıldız, C., Aydın, M., & Altındağ, R. (2009). Examining elementary school students' attitudes towards mathematics in terms of some variables. *Procedia-Social and Behavioral Sciences, 1*(1), 291-295.

Krijgsman, C., Vansteenkiste, M., van Tartwijk, J., Maes, J., Borghouts, L., Cardon, G., . . . Haerens, L. (2017). Performance grading and motivational functioning and fear in physical education: A self-determination theory perspective. *Learning and Individual Differences, 55*, 202-211.

Krueger, R. A. (2014). *Focus groups: A practical guide for applied research*: Sage publications.

Leder, G. C. (1985). Measurement of attitude to mathematics. *For the learning of mathematics, 5*(3), 18-34.

Lerman, S. (2000). The social turn in mathematics education research. *Multiple perspectives on mathematics teaching and learning, 1*, 19-44.

Levpušček, M. P., Zupančič, M., & Sočan, G. (2013). Predicting achievement in mathematics in adolescent students: The role of individual and social factors. *The Journal of Early Adolescence, 33*(4), 523-551.

Liamputtong, P. (2011). Focus group methodology: Introduction and history. *Focus group methodology: Principle and practice, 224*, 1-14.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*: sage.

Lubienski, S. T. (2000). A clash of social class cultures? Students' experiences in a discussion-intensive seventh-grade mathematics classroom. *The Elementary School Journal, 100*(4), 377-403.

Ma, X., & Kishor, N. (1997). Attitude toward self, social factors, and achievement in mathematics: A meta-analytic review. *Educational Psychology Review, 9*(2), 89-120.

Martino, P. D., & Zan, R. (2015). The construct of attitude in mathematics education. In *From beliefs to dynamic affect systems in mathematics education* (pp. 51-72): Springer.

McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. *Handbook of research on mathematics teaching and learning, 1*, 575-596.

Middleton, J. A., Jansen, A., & Goldin, G. A. (2016). Motivation. In *Attitudes, beliefs, motivation and identity in mathematics education: An overview of the field and future directions*: Springer Nature.

Murphy, P. K., & Alexander, P. A. (2002). What counts? The predictive powers of subject-matter knowledge, strategic processing, and interest in domain-specific performance. *The Journal of Experimental Education, 70*(3), 197-214.

Nicolaidou, M., & Philippou, G. (2003). Attitudes towards mathematics, self-efficacy and achievement in problem solving. *European Research in Mathematics Education III. Pisa: University of Pisa, 1*(11).

Nortvedt, G. A., & Pettersen, A. (2015). 6 Matematikk. In *Stø kurs* (pp. 107-135).

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International journal of qualitative methods, 16*(1), 1609406917733847.

Op't Eynde, P., De Corte, E., & Verschaffel, L. (2006). Epistemic dimensions of students' mathematics-related belief systems. *International Journal of Educational Research, 45*(1-2), 57-70.

Oslo kommune, C. o. O. (2022a). Population of administratative district, country of origin. Retrieved from https://statistikkbanken.oslo.kommune.no/webview/index.jsp?catalog=http%3A%2F%2Fstatistikkbanken.oslo.kommune.no%3A80%2Fobj%2FfCatalog%2FCatalog51&submode=catalog&mode=documentation&top=yes

Oslo kommune, C. o. O. (2022b). Population of imigrants in Oslo. Retrieved from https://www.oslo.kommune.no/statistikk/befolkning/landbakgrunn/#gref

Parkinson, S., Eatough, V., Holmes, J., Stapley, E., & Midgley, N. (2016). Framework analysis: a worked example of a study exploring young people's experiences of depression. *Qualitative research in psychology, 13*(2), 109-129.

Perry, B., & Dockett, S. (2018). Using a bioecological framework to investigate an early childhood mathematics education intervention. *European Early Childhood Education Research Journal, 26*(4), 604-617.

Petty, N. J., Thomson, O. P., & Stew, G. (2012). Ready for a paradigm shift? Part 2: Introducing qualitative research methodologies and methods. *Manual therapy, 17*(5), 378-384.

Prescott, C. (2018). Changing demographics in Northern Europe: transforming narratives and identifying obstacles. A case study from Oslo, Norway.

Rabiee, F. (2004). Focus-group interview and data analysis. *Proceedings of the nutrition society, 63*(4), 655-660.

Reyes, L. H. (1984). Affective variables and mathematics education. *The Elementary School Journal, 84*(5), 558-581.

Ritchie, J., & Spencer, L. (2002). Qualitative data analysis for applied policy research. *The qualitative researcher's companion, 573*(2002), 305-329.

Robson, C. (2002). *Real world research: A resource for social scientists and practitioner-researchers*: Wiley-Blackwell.

Rojas-Drummond, S. M. (2016). Explaining literacy development from a bioecological systems framework: Affordances and challenges. *Human development, 59*(4), 188-194.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist, 55*(1), 68.

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology, 61*, 101860.

Schoenfeld, A. H. (1985). *Mathematical problem solving*. Orlando, Fla: Academic Press.

Schoenfeld, A. H. (2000). Purposes and methods of research in mathematics education. *Notices of the AMS, 47*(6), 641-649.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for information, 22*(2), 63-75.

Singal, N. (2006). An ecosystemic approach for understanding inclusive education: An Indian case study. *European Journal of Psychology of Education, 21*(3), 239-252.

Siraj, I., & Huang, R. (2020). Operationalizing Bronfenbrenner's PPCT model in researching human development: Commentary on Xia, Li and Tudge. *Human development, 64*(1).

Skaalvik, E. M., Federici, R. A., & Klassen, R. M. (2015). Mathematics achievement and self-efficacy: Relations with motivation for mathematics. *International Journal of Educational Research, 72*, 129-136.

Skaalvik, E. M., & Skaalvik, S. (2013). School goal structure: Associations with students' perceptions of their teachers as emotionally supportive, academic self-concept, intrinsic motivation, effort, and help seeking behavior. *International Journal of Educational Research, 61*, 5-14.

Skaalvik, E. M., & Skaalvik, S. (2015). *Motivasjon for læring : teori og praksis*. Oslo: Universitetsforl.

Skott, J. (2015). Towards a participatory approach to 'beliefs' in mathematics education. In *From beliefs to dynamic affect systems in mathematics education* (pp. 3-23): Springer.

Stake, R. E. (1995). *The art of case study research*: sage.

Taherdoost, H. (2016). Sampling methods in research methodology; how to choose a sampling technique for research. *How to Choose a Sampling Technique for Research (April 10, 2016)*.

Tudge, J. R., Mokrova, I., Hatfield, B. E., & Karnik, R. B. (2009). Uses and misuses of Bronfenbrenner's bioecological theory of human development. *Journal of Family Theory & Review, 1*(4), 198-210.

Tudge, J. R., Payir, A., Merçon-Vargas, E., Cao, H., Liang, Y., Li, J., & O'Brien, L. (2016). Still misused after all these years? A reevaluation of the uses of Bronfenbrenner's bioecological theory of human development. *Journal of Family Theory & Review, 8*(4), 427-445.

UDIR, T. N. D. f. E. a. T.-. (2020). Central values of mathematics education. Retrieved from https://www.udir.no/lk20/mat01-05/om-faget/fagets-relevans-og-verdier?lang=eng

Vannoni, M. (2015). What are case studies good for? Nesting comparative case study research into the lakatosian research program. *Cross-Cultural Research, 49*(4), 331-357.

Wake, G. (2014). Making sense of and with mathematics: The interface between academic mathematics and mathematics in practice. *Educational Studies in Mathematics, 86*(2), 271-290.

Wertsch, J. V. (1985). *Vygotsky and the social formation of mind*: Harvard university press.

Wismath, S. L., & Worrall, A. (2015). Improving University Students' Perception of Mathematics and Mathematics Ability. *Numeracy: Advancing Education in Quantitative Literacy, 8*(1).

Xia, M., Li, X., & Tudge, J. R. (2020). Operationalizing Urie Bronfenbrenner's process-person-Context-time model. *Human development, 64*(1), 10-20.

Zhang, L., Karabenick, S. A., Maruno, S. i., & Lauermann, F. (2011). Academic delay of gratification and children's study time allocation as a function of proximity to consequential academic goals. *Learning and Instruction, 21*(1), 77-94.

8. Appendix

8.1 NSD Assessment

Meldeskjema / Elevers motivasjon i matematikk / Vurdering

Vurdering

Referansenummer
601377

Prosjekttittel
Elevers motivasjon i matematikk

Behandlingsansvarlig institusjon
OsloMet – storbyuniversitetet / Fakultet for lærerutdanning og internasjonale studier / Institutt for grunnskole- og faglærerutdanning

Prosjektperiode
01.01.2022 - 14.05.2022

Meldeskjema

Dato	Type
17.12.2021	Standard

Kommentar
Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet 17.12.2021 med vedlegg, samt i meldingsdialogen mellom innmelder og NSD. Behandlingen kan starte.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle alminnelige personopplysninger frem til 14.05.2022.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra registrerte, og fra de foresatte til behandlingen av personopplysninger om barna. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte/foresatte kan trekke tilbake.

Lovlig grunnlag for behandlingen vil dermed være de foresattes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

• lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at foresatte får tilfredsstillende informasjon om og samtykker til behandlingen
• formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke viderebehandles til nye uforenlige formål
• dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
• lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
NSD vurderer at informasjonen om behandlingen som de registrerte og deres foresatte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18) og dataportabilitet (art. 20).

Vi minner om at hvis en registrert/foresatt tar kontakt om sine/barnets rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

Ved bruk av databehandler (spørreskjemaleverandør, skylagring eller videosamtale) må behandlingen oppfylle kravene til bruk av databehandler, jf. art 28 og 29. Bruk leverandører som din institusjon har avtale med.

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

MELD VESENTLIGE ENDRINGER
Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:
https://www.nsd.no/personverntjenester/fylle-ut-meldeskjema-for-personopplysninger/melde-endringer-i-meldeskjema. Du må vente på svar fra NSD før endringen gjennomføres.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Kontaktperson hos NSD: Sturla Herfindal

Lykke til med prosjektet!

8.2 Risk Assessment

Risikovurdering av personopplysninger i masterprosjekt	
Virksomhet: OsloMet	**Fakultet:** GFU
Student(er): Eskil Uggen	**Veileder(e):** Constantinos Xenofontos
Hva slags personopplysninger skal behandles? Subjektive personopplysninger i meninger og uttalelser. Lydopptak av enkeltpersoner.	**Hvordan oppbevares personopplysninger?** I kryptert iPad tilknyttet OsloMet, bak to faktor-autorisering. I diktafon-nettskjema appen til nettskjema, som krypterer opptak.

Se veiledning til utfylling på slutten av dette dokumentet.

Dette dokumentet er en bearbeidet versjon av en mal fra https://www.sikresiden.no/forebyggende/risikovurdering

Forhold (uønsket hendelse) som er vurdert Legg til de forhold som er vurdert. Hendelse 1 til 6 er eksempler som kan endres.		**Betydning for** Sett kryss	**Risikonivå (L,M,H)** Sannsynlighet (horisontalt) Konsekvens (vertikalt) Sett ett kryss.	**Nødvendig med tiltak (Ja/Nei)**
1	Utstyr- eller brukerfeil gjør at data ikke blir lagret eller blir lagret i for dårlig kvalitet	__Konfidensialitet _X_Integritet _X_Tilgjengelighet	X	Ja, test av utstyr før datainnsamling
2	Utstyr- eller brukerfeil gjør at data ikke blir lagret eller medfører bruk av andre alternative utstyr.	__Konfidensialitet _X_Integritet _X_Tilgjengelighet	X	Ja, test av backup før datainnsamling
3	Håndskrevne notater blir mistet og kan bli tilgjengelige for uvedkommende	_X_Konfidensialitet _X_Integritet _X_Tilgjengelighet	X	Ja, minimere bruk av håndskriv
4	Data er utilgjengelig for studenten over en lengre periode	__Konfidensialitet _X_Integritet _X_Tilgjengelighet	X	Ja, varsomhet for tidspress
5	Dataene blir oppbevart på et så vanskelig sted at man tar snarveier og lagrer andre steder i stedet	__Konfidensialitet _X_Integritet __Tilgjengelighet	X	

1

Risikovurdering av personopplysninger – Enkel mal v1.0

6	Mister oversikten over hvilke data som tilhører hvilken informant, som gjør analysen dårligere og gjør at hele datamaterialet må slettes hvis en person trekker seg (t)	__Konfidensialitet __Integritet _X_Tilgjengelighet	X	Ja, systematisk koding av materialet
7	Det gis for mye bakgrunnsinformasjon om informantene, slik at de (i personlige sitat) kan gjenkjennes av lesere. (k)	_X_Konfidensialitet __Integritet __Tilgjengelighet	X	Ja, minimer bruk av bakgrunnsinfo
8	Det rekrutteres informanter som det er vanskelig å anonymisere uten å fortie relevant informasjon (eksempelvis ved et for lite / spesifisert utvalg av informanter)	_X_Konfidensialitet __Integritet __Tilgjengelighet	X	Ja, klarheter overfor skoleleder/lærere
9	Vedlegg er ikke tilstrekkelig anonymisert (k)	_X_Konfidensialitet __Integritet __Tilgjengelighet	X	Ja, ikke spesifiserte/ gjenkjennbar informasjon
10	Sletting gjøres feil eller glemmes, så filer fortsatt eksisterer etter at de skulle ha vært slettet. (k)	_X_Konfidensialitet _X_Integritet __Tilgjengelighet	X	Ja, sette som nøkkelpunkt i gjøreplan
11	Masteroppgaven/dataene blir lagret et sted som ikke har backup om pcen går i stykker (t)	__Konfidensialitet __Integritet _X_Tilgjengelighet	X	Nei
12	Tap eller tyveri av fil lagret på bærbart utstyr (k, t)	__Konfidensialitet _X_Integritet _X_Tilgjengelighet	X	Ja, tidlig kodet data for anonymisering og data lagret i sky med to-faktorautorisert beskyttelse

Tiltak:

- Test av utstyr før datainnsamling
- Test av backup før datainnsamling
- Minimere bruk av håndskrevne notater
- Varsomhet for tidspress
- Systematisk koding av materialet for anonymitet
- Minimer bruk av bakgrunnsinfo
- Klarheter overfor skoleleder/lærere
- Ikke spesifiserte/ gjenkjennbar informasjon
- Sette sletting som nøkkelpunkt i gjøreplan

8.3 Consent Form

Vil du delta i masteroppgavenforskningsprosjektet
"Hva motiverer elever for matematikk i 7. og 10 klasse?"

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å undersøke hvordan motivasjon utvikler seg for skoleelever i overgangen fra barneskole ut ungdomsskolen . I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål
Formålet er å undersøke hva som skaper motivasjon hos elevene i denne aldersgruppen.
Blir elever motivert av andre faktorer på barneskolen, når de på ungdomsskolen skal begynne å vurdere hvilke livsvalg matematikkfaget påvirker? Eksempelvis i valg av videregående skole og utdanningsløp.
Dette er en masteroppgave, utført av Eskil Uggen som studerer grunnskolelærerutdanningen 5-10 på OsloMet.

Hvem er ansvarlig for forskningsprosjektet?
OsloMet er ansvarlig for prosjektet.

Hvorfor får du spørsmål om å delta?
Utvalget er gjennomført selektivt, og er et ikke randomisert utvalg. Merk at du blir spurt da jeg kom i kontakt med barnets lærer og skole, og er ikke valgt ut etter å blitt søkt opp.

Hva innebærer det for deg å delta?
For deg har det ingen praktiske behov ved å delta. Jeg ønsker å kunne intervjue ditt barn i et fokusgruppeintervu (30 minutter). Dette er et intervju i en gruppe på tre-fire elever, og vil gjennomføres i skoletiden. All informasjon vil bli anonymisert, og det vil ikke være mulig å gjenkjenne elevene i masteroppgaven.

Om ønskelig kan du gjerne ta kontakt for å få se intervjuguiden ved å ta kontakt med meg (Eskilugg@oslomet.no).

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykkettilbake uten å oppgi noen grunn. Alle personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Tiden det tar å intervjue vil være avklart med læreren til elevene, og tilpasses undervisningen slik at eleven ikke går glipp av relevant undervisning.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandleropplysningene konfidensielt og i samsvar med personvernregelverket.

Kun jeg som masterstudent vil ha tilgang til dataene jeg samler inn, min veileder (Førsteamanuensis Constantinos Xenofontos)

Under intervjuet vil jeg ta lydopptak. Dette opptaket vil slettes umiddelbart etter transkribering, og navn vil være anonymisert i all databehandling.

Deltakere vil ikke gjenkjennes i publikasjon. Opplysninger som kommer opp i intervju vil kun publiseres om de omhandler motivasjon for matematikk.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:
- innsyn i hvilke personopplysninger som er registrert om deg, og å få utlevert en kopi av opplysningene,
- å få rettet personopplysninger om deg,
- å få slettet personopplysninger om deg, og
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg eller ditt barn?

Vi behandler opplysninger om deg og barnet ditt basert på ditt samtykke.

Opplysninger om deg gjelder kun dette samtykket.

På oppdrag fra OsloMet har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

Eskil Uggen – Masterstudent som skriver oppgaven (Eskilugg@OsloMet.no)

- Constantinos Xenofontos – Veilededer for masterstudenten (Constantinos.Xenofontos@oslomet.no)

Vårt personvernombud: Jorunn Wiig Strømberg (Jorunn.Stromberg@oslomet.no)

Hvis du har spørsmål knyttet til NSD sin vurdering av prosjektet, kan du ta kontakt med:

NSD – Norsk senter for forskningsdata AS på epost (personverntjenester@nsd.no) eller på telefon: 55 58 21 17.

Med vennlig hilsen

Eskil Uggen

(Forsker/veileder)

Constantinos Xenofontos

Samtykkeerklæring

Navnet til ditt barn

Jeg har mottatt og forstått informasjon om prosjektet *"Hva motiverer elever for matematikk i 7. og 10 klasse?"*, og har fått anledning til å stille spørsmål. Jeg samtykker til:

☐ ·At mitt barn deltar i fokusgruppeintervju
☐ ·At dette samtykket oppbevares etter prosjektslutt

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet

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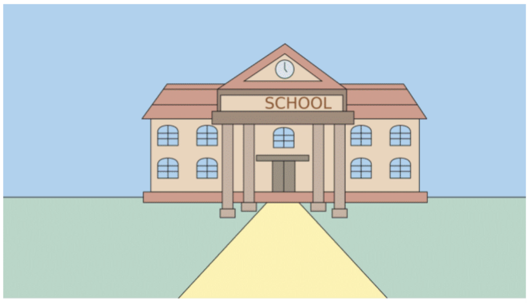
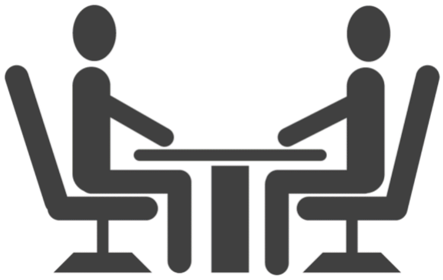
(Signert av prosjektdeltaker, dato)

8.4 Interview Guide

Interview Guide





Interview guide for master's thesis on motivation in mathematics – E. Uggen 2022

Focus group interviews – Interview guide

Research questions:

How are students' motivated differently between 7^{th} to 10^{th} grade?

1. Interest & Preferences

Question 1.1: Does math interest you?
1.1.1 Anything in particular about math you like?
1.1.2 Do you have a favourite theme or chapter

Q 1.2:Do you like math?
1.2.1 If not, why not?

Q1.3: How do you like working with mathematics?
1.3.1: Problem solving?
1.3.2: Completing tasks?
1.3.2: Working in groups / with a partner?
1.3.3: Do you like solving puzzles? (Could use examples)

Q 1.4: Do you like learning rules in maths?
Q1.5: Do you like trying to understand why things are connected?

Q1.6 Do you know if your friends like mathematics?
1.6.1 Do you care what they think?

2. Perceived instrumentality

Q 2.1: Do you feel like maths is useful?
2.1.1: Do you feel like you're learning useful skills in maths?
2.1.2: Anything you have learned which you think you'll never find use for?
2.1.3: What does other classmates think of maths, do you think?
2.1.4 What does your teacher say about learning maths?

3. Personal goals

Q3.1: What are your goals in maths?
3.1.1: When you are in class, do you make goals for yourself?
3.1.2: What type of goals do you make?
3.1.3: Is it important for you what your teacher say is your goals in maths?
3.1.4: Is it important for you what your classmates achieves?
3.1.4.1: Do you compare your goals to your friends?
3.1.5: Do you know what your classmates goals are? / who matters when you make goals

Q3.2: Do you make goals in every maths class?
3.2.1: Do you have a goal for the chapter you are working on right now?
3.2.2 Do you have more long term goals for mathematics?

Q3.3: Are you competitive with maths?
3.3.1: Is the class competitive?
3.3.2: What are your goals in life? (External – internal)

4. Self-efficacy

Q4.1: Are you good in maths?
4.1.1 Why you think so?
4.1.2 When did you develop this feeling?
Q4.2: Do you think it is easy to concentrate with maths?
Q4.3: Do you feel good compared to your classmates?
Q4.4: Do you think your classmates think so? How could you tell?
Q4.5: Do you often feel mastery in mathematics?
Q 4.6 Do you want to be good in maths?

5. Affect

Q5.1: When you work with maths, do you often feel frustrated?
Q5.2: Do you feel success?
Q5.3: Boredom?
Q5.4: Carelessness?
Q5.5: Did math ever make you rage?
Q5.6: Do you hate it?
Q5.7: Does math ever make you sad?
Q5.8: What about happy?

6. Social factors

Q6: How is the atmosphere in class when you work with maths?
Q6.1: How is it when you work individually?
Q6.2: How is it when you work in groups?
Q6.3: How much do you participate in class/groups?
Q6.4 Is it cool to be good in maths?
Q6.5 Do you know who is bad at maths?
6.5.1 Do you think they are less-smart because they are bad at math