

# MASTER THESIS

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## Pre-school mathematics in Norway in theory and practice

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## **Abstract**

In this study, I have had a closer look at how mathematics is organized in pre-schools in Norway, and how beliefs could affect pre-school teachers work with mathematics. The aim of this study is to get insight in the organization of pre-school mathematics and how teachers in school can build further on what the children have experienced in pre-school, as well as how beliefs can affect their work. My master-thesis contains three research questions:

- To what degree is there an active and conscious focus on mathematics by pre-school teachers?
- Does the pre-school teachers' previous experience with mathematics affect their belief and work with mathematics and young children?
- What do teachers in pre-school do to make the transition from pre-school to 1<sup>st</sup> grade easier?

The data collection consists of two methods, both a questionnaire and two semi-structured interviews. The study is based on the empirical data from these two methods, and the participants were mostly pre-school teachers from a specific municipality. The data were analysed using objective hermeneutics and phenomenology, and this is a case-design.

The focus of the study is the mathematical development before school and how experiences and beliefs can affect the work as a teacher either in school or pre-school, with experienced pre-school teachers' reflections regarding working ways, the adults role and the impact experiences and beliefs can have.

The study indicates the same results as previous research regarding pre-school mathematics, with *mathematical awareness* being a central principle to enrich the mathematical development in pre-school. It also shows that not all pre-schools have a structured plan for mathematics, but that most employees are able to highlight the mathematics in daily situations. *Play-based learning* proved to be the most popular method for learning, with games being the second most popular tool. This indicates that mathematics in pre-school differs from the more formal type in school and could explain the fall in motivation throughout the school years. None of the participants in this study had a specialization within mathematics. Regarding beliefs, both respondents in the interview had a *negative image* of mathematics before they started working as a pre-school teacher. During the years of working with pre-school mathematics, the image became *positive*, a change in beliefs.

Key words: Early mathematics; Beliefs; Mathematical awareness; Transition; Pre-school mathematics

## Sammendrag

I dette studiet har jeg hatt et fokus på hvordan matematikk er organisert i barnehager i Norge, og hvordan holdninger kan påvirke barnehagelæreres arbeid med matematikk. Målet for dette studiet er å få innsikt i organiseringen av barnehagematematikken og hvordan lærere i skolen kan bygge videre på hva barna har erfart i barnehagen, i tillegg til hvordan holdninger kan påvirke arbeidet. Problemstillingen min belyses av tre forskningsspørsmål:

- I hvilken grad er det et aktivt og bevisst fokus på matematikk hos barnehagelærere?
- Påvirker barnehagelæreres tidligere erfaringer med matematikk deres holdninger og arbeid med matematikk og små barn?
- Hva gjør barnehagelærere for å lette på overgangen fra barnehage til første klasse?

Datainnsamlingen består av to metoder, både en spørreundersøkelse og to semi-strukturerte intervju. Studiet baserer seg på den empiriske dataen fra disse to metodene, og deltakerne var for det meste barnehagelærere fra en spesifikk kommune. Dataene ble analysert gjennom objektiv hermeneutikk og fenomenologi, og dette er et case-design.

Fokuset i studiet er den matematiske utviklingen før skolen og hvordan erfaringer og holdninger kan påvirke arbeidet som lærer enten i skolen eller barnehage, med erfarne barnehagelæreres refleksjoner rundt arbeidsmåter, voksenrollen og påvirkningen erfaringer og holdninger kan ha.

Studiet indikerer de samme resultatene som tidligere forskning innenfor barnehagematematikk, med *matematisk bevissthet* som et sentralt prinsipp for å berike den matematiske utviklingen i barnehagen. Det viser også at ikke alle barnehager har en strukturert plan for matematikk, men at de fleste ansatte evner å belyse matematikken i dagligdagse situasjoner. *Lekbasert læring* viste seg å være den mest populære metoden for læring, med spill som det nest mest populære verktøyet. Dette indikerer at matematikk i barnehage skiller seg fra den mer formelle typen i skolen, og kan forklare fallet i motivasjonen for matematikk gjennom skoleløpet. Ingen av deltakerne i dette studiet hadde spesialisering innenfor matematikk. Når det kommer til holdninger, hadde begge respondentene i intervjuene et *negativt bilde* på matematikk før de begynte å jobbe som barnehagelærer. Gjennom årene i jobb med barnehagematematikk ble bildet *positivt*, en endring i holdninger.

Nøkkelbegreper: Tidlig matematikk; Holdninger; Matematisk bevissthet; Overgang; Barnehagematematikk

## **Preface**

This study is meant to aid teachers in pre-school and early years of school with teaching mathematics and be aware of their own beliefs. I myself have never had a burning desire for mathematics, but never had a bad image of it either. I have experienced both finding mathematics easy and difficult and believe that everyone can learn mathematics but need different methods to motivate them. I do not believe that everyone should learn complex mathematical equations, but that everyone should have a belief towards mathematics that it is useful for daily life and attainable for all.

This master thesis can be used as a starting point for further research, and I personally think mathematical beliefs for teachers should be more focused on. Mathematics is a debated subject, and I think by being aware of our own beliefs and reflecting upon why they are positive or negative could contribute to making mathematics a less strained subject for the future years.

I would like to thank many people that have inspired me throughout the years:

Teachers who have inspired me in positive and negative ways, competent lecturers in the university, and most of all, my supervisor Klaus-Peter Eichler who have helped me with this research, and shared his insight in the world of mathematics teaching for three years in my teacher-education. A big thanks to everyone who participated in the questionnaire, and those who set aside time for a curious teacher-student to come and ask them personal questions.

Lastly, an enormous thanks to my partner, family and friends who have supported me unconditionally through this process with the master thesis. You have motivated me to keep going, and you are a major part of this work. I am lucky to be inspired from you all.

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August Steffensen

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## **1.0 Introduction**

In this chapter, I will present the background and justification for my master thesis with the themes relevant for the paper, as well as my research-problem and -questions. I will also present the disposition for my paper.

### ***1.1 Background and justification for master thesis***

I was told about a study where the pre-school children were looking forward to learning mathematics, and that there happens a change in motivation during the following years towards this attitude. Mathematics have an undeservedly bad reputation, and most people only associate it being just numbers, equations, and more or less stupid calculations where given rules have to be followed, and therefore they have a strained attitude towards it. Mathematics is not easily defined. The Norwegian curriculum for mathematics in school (Norwegian Directorate of Education and Training, 2010) states that “Mathematics is a part of our global cultural heritage. Mankind has always used and developed mathematics to systematize experiences, in order to describe and understand coherences in nature and in the society and to explore the universe.”. Grevholm, Persson & Persson (2013, p.32-37) says that children define mathematics mainly as calculation and different kinds of calculus. As a cultural phenomenon, mathematics has been central for discovering patterns and other mathematical, logical reasonings in nature and our own work. In nature science, mathematics feels right at home. My own view is that mathematics really is just a systematization of the world around us, for example up, down, big, small, far, near, few and many.

Children’s early mathematical competence is the base for further learning mathematics in school. The more familiar a child is with mathematical ideas, the better are the foundation for facing and understanding the mathematics in school that are more abstract (Salomonsen, 2019). The Norwegian Ministry of Education (2017) published in a press release that one out of four pre-schools don’t have routines that can ensure a good transition for the children, and one of the areas needing improvement is the transfer of information regarding children that the pre-schools will give to the school. This could manifest as necessary extra facilitating that the child has received from the pre-school.

Previous research within this theme in Norwegian pre-schools have indicated that an enhanced focus on mathematics, and awareness from the employees influences the children’s mathematical knowledge and ability to learn in school. My angle differs from these projects in the way of not looking towards the school to enhance the mathematics in the pre-school,

but the other way around. We do not know so much about how the transitional work in pre-school is done regarding mathematics. The beliefs of the employees working in pre-school and their experiences is also a theme that is due for more research.

That is why the goals of my work are to investigate in which way mathematics is organized and conducted in pre-school. The beliefs of the teachers will also be regarded as important, and I want to see if there is a connection between these two. What is the difference from pre-school to school regarding mathematics, both in the specific mathematics and how it is viewed? I will focus on the mathematics in the transition-period from pre-school to school. It is the first big change in the child's life, where there is a change in the type of mathematics the child is confronted with: From informal mathematics of everyday life, to more and more formal school mathematics. This is important, because the children are facing a new environment and expectations from what they are used to. The teachers must be able to familiarize mathematics in a way that the child have been exposed to in pre-school. If the difference is too great, there is a risk of starting on the wrong foot as a consequence, which could affect the future years in school and life regarding the belief towards mathematics as a subject and a tool. Therefore, the start and introduction of mathematics in school should be familiar to former working ways and usage in pre-schools.

The background for my master thesis is based on that teachers in lower grades should be familiar with what the children have experienced in earlier years regarding with what structure, workings ways, strategies, materials and organization we find in pre-school. It is important to be aware of where the children come *from*, where they are *now*, and where they are *going* in order to facilitate for mathematical development. The findings from this study is something I wish to be able to bring with me further in my own methods as a teacher and share with other mathematics teachers. The research problem is as follows:

**«How is mathematics organized in pre-school?» and «What are the pre-school teachers' beliefs towards mathematics?»**



To substantiate the research problems further, I have developed three research questions for this study:

- To what degree is there an active and conscious focus on mathematics by pre-school teachers?
- Does the pre-school teachers' previous experience with mathematics affect their belief and work with mathematics and young children?
- What do teachers in pre-school do to make the transition from pre-school to 1<sup>st</sup> grade easier?

These questions will contribute to enlighten the research problem from different angles and aid me in the research while collecting data. The research is divided into two parts. The first is to gain an overview for mathematics in pre-school by conducting a questionnaire, and the other part is to focus on the transfer from pre-school to school by conducting interviews.

### ***1.2 Disposition of the paper***

The structure of this paper is divided into seven chapters. In chapter 1, I will explain what the background for my master thesis is along with the research problem plus research questions. In chapter 2, the theoretical background for the master thesis will be presented, followed by chapter 3 which includes relevant, previous research within the scope of the master thesis. In chapter 4, the scientific approach and methods will be accounted for, as well as the choices of data collection. Chapter 5 will be the presentation of data and key findings from my research, and in chapter 6 I will discuss the theory up towards my findings and previous research in order to answer my research problem. The final chapter, chapter 7, will feature the conclusion for the master thesis.

### **2.0 Theoretical background**

In this chapter I will present theories necessary to understand the theoretical background, theory for mathematical didactics and previous research within the same area. They will be visible in the presentation of data, and/or be used in the discussion.

## ***2.1 Adapted education***

*Adapted education* is a principle in the Norwegian education introduced for the first time as a principle valid for everyone in M87, the national curriculum from 1987.

Internationally it is more known in more specific terms, such as individualization or differentiation. It is not central for pre-schools in Norway, but the term “adapted education” is a wide term and the principles are important for most pedagogues. That is why I will say it is not only for school, but for all educational institutions. Adapted education is meant to take the child’s skills, gender, residence, and social and cultural background into consideration for the education. The institution must also consider the child’s linguistical skills, values, physical and mental state (Sjøvoll, 2011, p.175). The best way is to adapt the learning aims to the class or group. It is up to the teacher to evaluate how the organizing of the teaching and choice of methods could benefit the children in the best way.

It is not always possible to find one method or activity for each time that fits everyone, and some may experience loss of motivation as a consequence. In order to motivate the students and expand the teaching of a subject, a project over a given time would correspond to the principles of adapted education. A project gives the teacher the possibility to use a variety of activities and methods and eases the learning for the student by giving it several channels to learn from (Dammsgaard & Eftedal, 2014, p.169-170).

Before the children leave the pre-school, the pre-school are required to pass on information regarding the child if there is necessary for special considerations when starting at school, for example linguistical challenges or others that may contribute to insufficient learning potential in normal education. If the learning outcome is below satisfactory, the need for special education may be required as the paragraph 5-1 in the Education Act (1998). This could in mathematics often present itself as learning difficulties (or wrongly be concluded as for example dyscalculia, when it only could be just requiring varied working ways for the child in order to understand the task).

### ***2.1.1 Adapted education specific for mathematics***

From 1<sup>st</sup> of August 2025, every teacher in mathematics in grade 1-7 in Norway must have at least 30 credits in mathematics. This is to heighten the quality of the teaching in school. Numerous studies have the same conclusions: The higher education for the teacher- the better learning outcome for the pupils. Seven out of ten teachers that have 30 credits or more think that their teaching have improved, an annual study for teachers continuing education showed, called Deltakerundersøkelsen (Ulriksen & Gjerustad, 2017 in Utdanningsnytt, 2017). In my studies, we have for example gained insight in mathematical

processes before school, for children in pre-school. This is useful for teachers working with mathematics in the lower grades. Low general enthusiasm for mathematics enthused me to choose it as my specialization and combining that with adapted education will hopefully be an asset to my future workings. Having the knowledge and skills to adapt the education to the younger pupils in mathematics to stimulate their mathematical growth will hopefully reverse the attitude towards mathematics.

### ***2.1.2 Transition from pre-school to school***

In the transfer between preschool to school, the child faces a new environment. The demands are different, and they are already from the 1<sup>st</sup> grade presented with learning aims. It is important for the school-starters to experience a good transition, and therefore the methods and contents must be familiar from preschool (Nilsen, 2011, p.50-51). Teachers learning about preschool mathematics could be one criterion for a positive facilitation in the transfer-phase.

## ***2.2 What is early mathematics?***

Early mathematics is the term for all mathematical development before 1<sup>st</sup> grade. It revolves around mathematical awareness in daily situations, and understanding shapes, sizes, measurements, time, numbers, location, patterns etc. “It includes becoming aware of similarities and differences as well as patterns concerning time, space and quantities.” as Garvis & Nislev (2017, p.34) puts it. Its aim is to be a way of describing measurable relations between objects in the surrounding world (Schoenfeld, 1994, in Garvis & Nislev, 2017, p.34).

Early mathematics is important and in the center for this master thesis, because it is about the mathematics before the formal type children meet in school. As Clements and Sarama (2009, p.1-2) says: “The early years of a child are important for mathematical development...What they know when they arrive in pre-school and school, predicts their mathematics achievement for years to come- even throughout their school career. Moreover, what they know in math predicts their reading achievement later.”

Mathematics is not only numbers and symbols like many adults seem to think, but it is about comparing, assess and describe how things or situations in time and space relate to each other. These skills develop throughout childhood, going from a concrete to a formal way of mathematics. One way that you can see signs of early mathematics is when the small children in pre-school are playing and experimenting with mathematical concepts and terms. They test

out phrases they have picked up from a daily situation, and is a risk-free environment (Björklund, 2013, p.66-67).

There is a difference between school-mathematics and mathematical thinking. Where school-mathematics are heavily built around symbols, procedures and calculating, mathematical thinking is broader. It is more like a tool for reflecting, systematizing, discovering and solving problems (Nakken & Thiel, 2019, p.25). Mathematical thinking is much like early mathematics, with the same principles.

### ***2.2.1 Differentiation in early mathematics***

Children grow in different tempos, and in pre-school there is a mixed age-group unlike the classes in school. Sometimes in pre-school, the school-starters are grouped together for practising or familiarizing with scholastic demands and activities. This is a way that can be called *differentiation*. Just like their growth, children also learn mathematics in different tempos, both in pre-school and in school. Holm (2012, p.98-102) presents a model for differentiation within mathematics where you can divide it into three resources: the *student*-, the *teacher*- and the *educational resource*. This model complies with Vygotsky's sociocultural theory, more explained in chapter 2.3. It covers all three aspects of teaching: a single student, a group of students with a matching level, and the teacher instructing or guiding.

When talking about *student resource*, Holm (2012, p.98-102) says that you can group a couple of students together. This enables them to discuss and explain with each other. The teacher can pair students with similar development together, allowing them to cooperate while solving mathematical problems and are getting good practice in explaining their mathematical thought process. The *teacher resource* is for example a lesson where the teacher first introduces the subject in front of the entire class, and then spends the rest of the lesson guiding groups that get stuck or face challenges. When the group is unable to solve the task, the teacher can approach them in order to fill in the gaps. This also enables the teacher to remain at a specific group needing more guidance, and then stepping off to another group to help before returning to the group that require more instruction. The third resource, the *educational resource*, is the choice of teaching aids that the teacher makes for the class, group or student.

The Norwegian Ministry of Education and Research (2010) states that the teacher are free to choose suitable teaching aids and materials, and therefore this could be a pedagogically differentiated selection of tasks, different types of aids, challenging in-depth-tasks for the

mathematically strong and more breadth-based tasks for the student that struggles with a concept in mathematics

### ***2.2.2 Rich tasks as a tool to deal with diversity***

When working with a group of mixed age, or young children with different growth at the same age, there should be activities that are suitable for the entire group. Often in Norwegian pre-schools, kids are mixed with age, typically 1-3 years, and 3-5-year old's, dividing it into "big" and "small" children. As previously said, children grow in different tempos, and even if you have gathered every 5-year-old in the pre-school, that does not meet that everyone are at the same level. Rich tasks enables the teaching of pupils with different predispositions. It is a problem-based type task with a low cognitive entry threshold yet have a high potential for solving. Everyone has a change for progression, but it offers a challenge for everyone (Maugesten, 2013 p.55-56). The whole class works with the same task, yet everyone is dealing with it at their own level. Also, pupils struggling with subjects, in this case mathematics, are motivated by such tasks. It challenges the stronger pupils as well, by not giving them more tasks, but forcing them to expand their work (The Norwegian Centre for Mathematics Education, n.d.). A good example of a rich task is the following example brought from The Norwegian Centre for Mathematics Education:

**“Noah saw 12 legs that went onboard. How many animals can he have seen?”**

**“How many different answers can you find?”**

**“Can you explain how you found the different answers?”**



(Figure 3.1 obtained from <https://www.matematikkssenteret.no/satsinger/elever-med-stort-l%C3%A6ringspotensial/n%C3%B8tter-spill-og-aktiviteter/hovedside-1-8-trinn-list-9>)

Thus, Björkqvist (1999, p.35-39) says rich tasks can stimulate and motivate all pupils regardless of their level. They offer a challenge, and are different from normal repetition-based tasks, and I personally mean they are an important aid for the mathematics teacher for making mathematics fun and meaningful. Either in pre-school, or in school.

### **2.2.3 Play-based learning**

For mathematics, there are two types of using play: *Mathematics in play* or *play in mathematics*. Either the focus is on the mathematical aspects in the play that the child itself uses, or that the play is selected from a chosen, defined mathematical learning aim. For pre-schools, mathematics in play dominates, while play in mathematics are more common in schools (Jahr & Øgaard, 2006, p.20). One example could be when playing “grocery store”. In pre-school and mathematics in play, the children could be more interested in just being in the store, working at the register, delivering groceries to the store and having fun, while in school typically the focus is “you have this much money, now go and purchase this and that, and see how much you can get in total”. Inside the play, the children will experience a safe environment where they can try out concepts they have maybe heard from an older sibling or parent, and in their own mind gain a sharper definition of the concepts (Thiel & Nakken, 2019, p.39-40).

Playing is one of the most common methods for pre-school. What is unknown, is the effect play have compared to other methods of learning (Vogt, Hauser, Stebler, Rechsteiner & Urech, 2018, p.592). For play-based learning to be considered mathematical, four aspects must be central (Gasteiger, Obersteiner & Reiss, 2015, p.233ff).

1. The mathematics must be part of the mechanics of the game
2. It needs to be “correctly presented”
3. It must be essential for further learning
4. The game needs to be appropriate for the individual needs for the child considering learning

### **2.2.4 Course plan for pre-school mathematics**

In the course plan for pre-school mathematics, “numbers, space and shapes” (Norwegian Directorate of Education, 2013), the learning aims are written differently than those for school. The children are to *discover and wonder, play and experiment, experience, use their body, investigate* and such. It is laid up for enjoying and familiarizing with

mathematical principles, unlike in school where *measure, compare, count* and *estimate* are some of the verbs, indicating that it is more skill-based (Norwegian Directorate of Education, 2010).

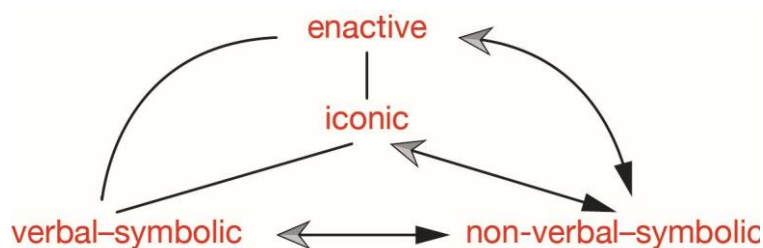
In total, the learning aims for pre-school are seven. It doubles from pre-school to school, and more than triples if we count direct learning aims, not general mathematical concepts and principles, to fourteen for school after second grade. That means pre-school have a different goal for learning than at school (Nakken & Thiel, 2019, p.26).

## 2.3 Learning theories

### 2.3.1 Cognitive development

Cognitive means the inner processes in the mind, and theories regarding *cognitive development* focus on the inner learning. You create your own understanding of different concepts. It really grew in the 50s and 60s with the workings of Jean Piaget, and assimilation/adaption and cognitive forms. Cognitive forms can be understood as the individuals understanding of a concept. If the individual faces an event or situation where the form is challenged, they face a cognitive conflict. This could present itself in the way of thinking that all animals come from an egg, then observing a cow birthing a calf. The individual is presented with two options: Either adapting the new knowledge to its existing form (assimilation), or create a new form based on the new reality (adaptation) (Wittek & Brandmo, 2014, p.119).

When we are talking about learning mathematics, Jerome Bruner (1966, p.10-14) developed a theory regarding the forms of representation mathematics containing three levels: The *enactive*-, the *iconic*- and the *symbolic level*, as shown in the figure below.



(Figure 3.3, Bruner, 1964 in Gleißberg & Eichler, 2019, p.3)

The *enactive* level is something concrete you can physically see or touch. The knowledge is based on what you can do with the concrete object, or how to do it. For example, seeing an apple, and then know how to cut it into pieces to share with a friend. The *iconic* level is more based around the memory of the enactive level, where the individual processes the concept of the apple, and can visualize it through imagination. The third level

from Bruner is the *symbolic* level. Here we are talking about verbal-symbolic and non-verbal-symbolic communication, which means oral language or written text/mathematical symbols. The children can explain what must be done, or write it down, like calculation. The student should be able to go back from non-verbal- and verbal symbolic level to the enactive and iconic level, and this is called intermodal transfer. The *enactive* and the *iconic* levels are implicit because it is something that happens inside the thoughts of the individual. The two symbolic levels are explicit, because the concept takes part outside of the individuals head, it is communicated to others. They are all related, but typically the enactive and iconic level are the starting points.

One misconception is that children only learn mathematics by interacting with concrete objects, but as Sun Lee & Ginsburg (2009, p.34-35) say: “Mathematics is not tangible; it is a set of ideas. Mathematics in the early years does not need to be limited to the concrete or tangible.” Mathematical understanding does not come from the fingertips and up throughout the arm but is created in the mind. Clements (1999a; in Sun Lee & Ginsburg, 2009, p.35) states that “as long as children can think about what four means in their minds, *fourness* is no more in four blocks that it is in a picture of four blocks”.

### ***2.3.2 Sociocultural learning theory***

*Sociocultural learning theory* is based on that the learning takes place through conversations and interactions. Especially in pre-schools the language is important for learning, because children up to 5 years old rarely understand written texts and symbols, not to mention gathering information themselves. This is a theory that has been very popular since the 90s, but its roots stretch all the way back to the father of sociocultural learning theory, Lev Vygotsky in the 1920s. Only through language can a question be asked and answered. Teaching through language is essentially interacting with someone else to show how and why you do something. That is why Vygotsky claim that language is a tool for learning (Lyngsnes & Rismark, 1999, p.67-68).

Within sociocultural learning theory there are two types of helpers, a *mediating* and *sociocultural* helper. A mediating helper is a person who can expand your knowledge and teach you new things. Säljö (2017, p. 169-171) says that when interacting with people with a higher level of knowledge withing a subject, the individual has a chance of developing a higher understanding. A great example of a mediating helper would be a teacher, but it can also be an elder sibling, parent, coach etc. The adult figure is central for a child’s development, where they will be explained the answer to question such as “What is round?” and “Why is the sky blue?”. The main difference between a mediating- and a sociocultural helper is the level of knowledge. Where the mediating helper is at higher level of knowledge,



the sociocultural helper is more like a fellow pupil, for example two 4-year-olds discussing why the snow is cold. Working with a sociocultural helper is called *the closest zone of development*. That is what a person can learn with assistance from others at the same level of knowledge (Lyngsnes & Rismark, 1999, p.67-68).

Vygotsky (1978, in Säljö, 2017, p.170-171) developed a theory of ZPD (zone of proximal development), and it revolves around human competence to learn a concept by themselves or learning with others. The theory is that a person can teach themselves a restricted understanding of a concept, while the collaboration with others either just as qualified or more qualified can reach a higher level of understanding.

## ***2.4 Regarding mathematics, beliefs, motivation and teaching***

Motivation and beliefs are known to affect a person's mindset towards a subject, and mathematics is one of those subjects affecting people. Many people have math anxiety, and it is something that is based on their later years in school, often associated with complex, abstract procedures. The results for OECD 2012 indicate that Norwegian pupils perceive mathematics as demanding, and that they have a stronger anxiety towards mathematics than pupils in other Nordic countries (Kjærnsli & Olsen, 2013). Boys reported higher motivation for mathematics than girls. Girls reported in greater degree about math anxiety.

### ***2.4.1 Mathematics and motivation***

“If you don't feel inadequate, you're probably not doing the job” (Leinwand, 2007 in Van de Walle, Karp & Bay-Williams, 2015, p.35). Whether you have years of experience or is fresh out of teacher education, the words from Leinwand gives depth to the acceptance that there is always more to learn. The best teachers are always trying to improve their methods by gaining new knowledge, staying curious and searching for situations where they can attain new insight (Van de Walle et al., 2015, p.35-36). One element in this master thesis is to study the attitude and beliefs towards mathematics and practicing a dynamic approach to teaching mathematics where you are willing to adapt and change is a belief towards continual growth.

As trends in TIMSS 2015 show, Norwegian 5<sup>th</sup> graders are performing on a very high level within mathematics compared to other countries and being more average in the 9<sup>th</sup> grade (Bergem, 2015, p.22-44). As figure 2.4 from Kaarstein & Nilsen (2016, p.67) tells, the inner motivation for mathematics and nature science drops from 4<sup>th</sup> to 9<sup>th</sup> grade, with mathematics declining most. The trends from both Bergem (2015, p.22-44) and Kaarstein & Nilsen (2016, p.67) correlate, and indicate that the higher grade the child goes to, the lower the motivation

and performance become for mathematics. This relevant for the pre-school teachers, as they are likely to have gone through similar experiences and bring this into their daily work. Previous research has shown that mathematics achievement is a strong predictor of later success in school (Duncan et al. 2007).

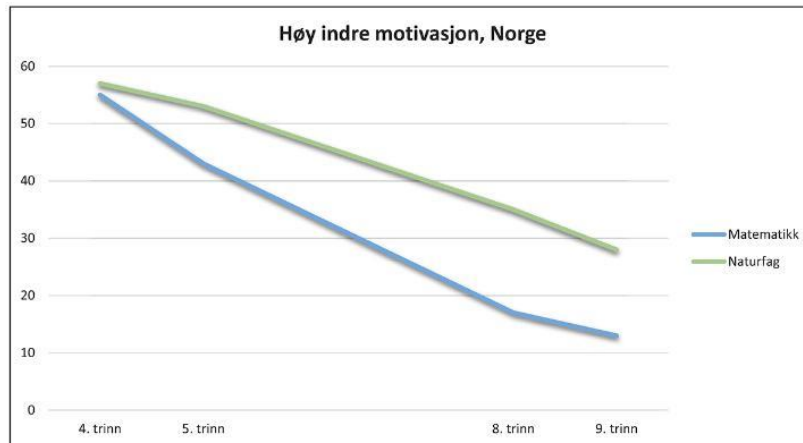


Figure 2.4 Inner motivation development for Norwegian pupils from 4<sup>th</sup> grade to 9<sup>th</sup> grade (Obtained from Kaarstein & Nilsen, 2016, p.67).

### 2.4.2 Images of mathematics

Mathematics is a discussed subject in society, and each person have their own image of it. Defined by Ernest (2014, p.10-11), an image of mathematics is either a social or personal representation. The social representation is affected by/portrayed by mass-media, presentations and displays in school, and the learning experience of them. The personal images are affected by own experiences and beliefs towards mathematics, mental pictures, and personal philosophies of mathematics. There are who types of images towards mathematics: *Negative* and *positive*.

*Negative images* of mathematics are based on that it is difficult, cold, abstract, theoretical, masculine, and often thought of as something only accessible to highly intelligent, big headed professors. Mathematics is, ironically enough, thought of as academic mathematics, a scholastic view, known as so called “real mathematics”, and where you solve functions, finding “the value of y squared divided by the total mass of the stars, minus the price of 17 watermelons, with an exponential growth” and so on. The prime goal for teaching mathematics is, even more ironically, to make the individual function in society by interpreting data from the weather forecast, bus table, grocery-shopping or other daily actions (Walkerdine, 1995 in Ernest, 2014, p.11). The *positive images* of mathematics are that it is a dynamic, problem-driven and expanding field of human creation and invention. It revolves

around that there are several ways to find an answer to the problems, and that the answer is verifiable.

### **2.4.3 Mathematical awareness**

In the section about “Number, space and shapes” in the curriculum (Directorate for Education and Training, 2017, p.54) mention three times that the pre-school shall facilitate for that the children gets experience with- or experiences mathematics. That requires that the pre-school teachers have a *mathematical awareness*. The best teaching-method for adults is the mathematical conversation. Through conversations with children, we attain access to their thinking, ideas and approach towards mathematics. Through open questions and expanding the conversation, the mathematical content can be processed thoroughly and bring out the child’s thinking. They can be stimulated to work with a problem by expanding it, alter it and possibly find other solutions (Nakken & Thiel, 2019, p.34-35).

Trude Fosse (2016) found five terms that must be fulfilled for that vi can call a conversation mathematical:

1. The conversation must be about mathematical knowledge/elements.
2. It must be structured.
3. The participants must reflect over what they have done, and what they can do in the future.
4. It is important that every contribution is appreciated.
5. The conversation must promote further learning.

By following these five terms, we can see that the role of language is very important for pre-school mathematics, as the children are so young that they (usually) cannot read or write, or even interpret written text.

## **3.0 Previous research**

There have been several projects and research regarding pre-school mathematics, and I will present four projects in this chapter.

### **3.1 The SMIL-project**

There have been a couple of research projects regarding mathematics in preschool in Norway. One of them is called the SMIL-project (Satsing på Matematikk I Lørenskog = Investment in Mathematics in Lørenskog), where the municipality of Lørenskog throughout

the period of 2004-2007 had an enhanced focus on mathematics between preschool and school. Each preschool partaking in the project assigned one employee to be responsible for the mathematics and binding the preschool with the project group (Ridar, K., 2008, p.3). It mainly focused on the role of the adult, and its main findings revolved around the preschool-teachers attitude and motivation regarding mathematics. The project showed that adults should challenge the children to explain using mathematical terms and try to expand the situation to expand to more mathematical action in everyday situations. The teachers in 1<sup>st</sup> grade at the school in Lørenskog reported that the new pupils arriving from preschools involved in this project had a better understanding of mathematical terms and concepts compared to previous years (Ridar, K., 2008, p.37). This project seems more like an initiative, instead of pre-defined indicators or control-group, and therefore hard to prove the actual effects.

### ***3.2 The Agder-project***

Another project conducted within Norwegian preschools are the “Agder project”, which included 71 preschools from the Agder-area in Norway (Rege et al, 2019). They wished to investigate *play-based learning*, and their focus group was 5-year olds, school starters in their last year of preschool. The teachers committed to spend at least eight hours every week for nine months on the developed curriculum, which featured 130 learning activities focused around *play-based learning*, a way of *hidden learning* where the curriculum is hid inside activities or games. All the children involved were assessed before the start of the project (August), after the project (June) and over halfway finished with year 1 in school. Half of the preschools were given the new curriculum; the other half were to proceed as before to function as the control group in order to measure the effect.

The main findings of the project were that those preschools perceived as “good” did not have any big effect, but that those perceived as “not so good” had a remarkable effect in the scoring, especially in mathematics where the children would be up to 5-6 months in advance of their development. They utilized fixed effects at baseline as a proxy for quality, like the centre mean difference between observed and predicted assessment scores. What defined quality indicators, was for example teacher education, child-staff ratios, teacher and management experience, and class size; on child development. What defined process quality was the sensitivity and responsiveness of caregivers, the pedagogical approaches, and curriculum and materials available for learning. At best, the project indicates that it brings all the children up to an even basis and levelling out the predispositions of what preschool the

child attends. The impact was particularly large for math, with 23 percent of a standard deviation.

During the project it received criticism, mostly due to the attempt of measuring skills as early as preschool age (Jelstad, 2019). The current curriculum valued play, learning and caring, not achievement withing subjects such as reading and calculating. This criticism gave my research a nuanced approach and made me aware of how I wish to conduct my study and its focus. The main goal is to focus on the organization of mathematics in pre-schools, not how to best achieve good grades in school.

### ***3.3 Tromsø-undersøkelsen***

A study conducted in three preschools in Tromsø, Norway, was conducted with the focus on systematized mathematics education to increase the children's understanding of numeracy (Salomonsen, 2007, in Sjøvoll, 2011, p.183-184). The mathematics was integrated into the daily situations, and it proved to be effective but at a given criteria. The term for that it would be effective is that the staff had to develop a new learning environment and routines to think creatively to renew the context for learning. This will present the schools with a new challenge, dealing with a more widespread knowledge base for mathematics for school-starters since the preschools will have a varied program for teaching.

### ***3.4 Learning through play – pedagogy and learning outcomes in early childhood mathematics***

Vogt et al (2018) conducted a study regarding using play-based approach to teach early mathematics in pre-school with 35 pre-school educators and 324 six-year old children, randomly assigned to a training programme with a play-based approach or to the control group. The results from this study indicated higher learning gains for the play-based approach, where children with low competencies showed to benefit more from the play-based approach than the formal, instruction-based control group, as well as the children with high competencies also gaining more from the play-based approach. The evaluation from the educators was that play-based approach were better suited to the children's needs, and the more efficient way of teaching early mathematics in pre-school.

#### **4.0 Methodology of my project**

In this chapter, I will present the methods and methodologies and science theory for my master thesis, and the ethical responsibility of me as a researcher related to the research. The research show features relevant for a case-design, and I have chosen triangulation for my research because I will use a questionnaire and conduct interviews. The interpretation of the data will be a combination of hermeneutics and phenomenology, also called hermeneutical phenomenology.

Should I use myself to interpret the data actively, or view the participants as researchers as well? Should the phenomenon's that occur be used for investigation, or is it strictly ethnographic? The researcher must be aware of what he/she wants to investigate, and how he/she wishes to discover it (Brookshier, 2018). In my research, I have planned to include hermeneutics and phenomenology to investigate my research problem. This is because I wish to conduct research and find out the workings in pre-school regarding mathematics.

Firstly, I will look at social science and the scientific approach, followed by methodology and methods used, and ending the chapter with selection, validity, reliability and generalizability.

#### **4.1 Social science**

To find an answer to my research problem, I must dive into the world of social science. Science is what humans depend upon when they wish to find an explanation to phenomenon's in the world, because it is methodical (Tranøy in Dalland, 2017, p.39). In order to find an explanation that can be valid for my work, it must consist of a method and proof so that others can find the same solution, so called "true knowledge" (Dalland, 2017, p.39).

Social science has an empirical tradition and a diversity of methodical approaches. The information gathered is to be analysed, and then interpreted (Johannessen, Tufte & Christoffersen, 2010, p.29). The methods are mainly empirical and aim to bring knowledge and understanding around the "little" and "big" world. Johannessen et al (2010, p. 27-28) says that the "little" world belongs to a single individual, and how he/she is the centre of the world and creates their own experiences, and I will interview pre-school teachers in order to find theirs. The "little" world is part of the "big" world, for example a school where other people have made other experiences. It consists of an amount of people and knowledge that it is not possible to have a complete overview of. But, the information from the "big" world can be gathered via books, tv, news and internet for example.

The aim of social science is to answer the question: “What is the social reality?”. In other words, people’s thoughts, actions and understanding of mathematics in pre-school and general beliefs towards mathematics. Social science is in this thesis useful for researching pre-school teachers work with mathematics and their beliefs towards it, because it gives me information regarding people’s actual perception (Johannessen et.al., 2010, p.35-37). I have a research problem and wish to conduct a study with pre-school teachers in order to see their perception of mathematics.

#### ***4.2 Scientific approach***

My scientific approach for this study is a case-design. Case-design, also known as case studies, is a method used within social science. It is suitable for triangulation, multiple methods to obtain much and detailed data (Yin, 2007 in Johannessen et al, 2010, p.86). The main characteristic for case-design is that the researcher collects data from a few numbers of units over a time, either short or long. My data is collected by two methods, but the common denominator is that it is based on dependency of accessibility and time. My process was started by focusing on a problem based on experiences from real life, and the search for the *how* and *why*. Then I made some assumptions, followed by selecting the informants and data source. After the collection of data, the assumptions and data were compared up to one another. In the end, I will interpret my findings, then relate it to already existing theory and previous research (Yin, 2007 in Johannessen et al, 2010, p.86-87).

There are similarities between case design and both ethnographic research and grounded theory, but ethnographic research are solely based on the culture, and the focus of grounded theory is too wide for where I am going. I have already defined the focus and research-questions, and therefore case design is the most suitable research design for my master thesis.

#### ***4.3 Objective hermeneutics***

When interpreting, I will use a method called hermeneutics. Hermeneutics can be explained as phenomenon’s that are meaningful. The same can be said about paintings, human actions, texts and expressions, beliefs and architecture (Gilje & Grimen, 1993, p.142-144). Furthermore, Gilje & Grimen (1993, p. 142-144) says that the term *meaning* or *meaningful* is used in relation to human activities and about the result of the human activities. I will interpret the meaning my interview objects give their statements.

In the context of this master-thesis, I will interview pre-school teachers about mathematical situations in a pre-school and their own experiences and beliefs towards mathematics. Later I will interpret their statements and give them meaning. As I collect data, I will try to reflect around the mathematical content and degree of use of mathematics in what the respondents describe as every day-activities (Dalland, 2017, p.44-46). This is all a part of what Johannessen et al (2010, p.364-365) refer to as the *hermeneutical circle*, where the part I want to interpret, and the context of it is to be interpreted in, it must be explained as a whole and accounted for. By having follow-up questions and trying to get their daily work accounted for, the context surrounding would be included to.

It is important to see the specific statements in the whole, like if for example a comedian uses a form of satire when talking about a subject and someone only hears a part of the act. It can be taken out of context, and later it can be believed to be the persons actual thoughts and meaning. How the part is interpreted, depends on the wholeness, and vice versa. It is my responsibility to not put words in the objects mouth or twist their statements into a context which would benefit me and thereby undermining the respondent. That is why the interpretation must be based on the interview, and what is said throughout the whole conversation, not only snippets.

There are typically two traditions within hermeneutics. The first is based on that the scientist should not take the actors description of themselves and their own actions into consideration. This is linked with Émile Durkheim, who meant that opinions could complicate the actual situations and how it really is. The other tradition can be represented by Max Weber and is heavily based around the actor's own thoughts and meaning. Actions made by humans in a social setting are given a subjective meaning both by the actor and the recipient and is important in order to really understand the actors understanding of own actions (Gilje & Grimen, 1993, p.145-146). I will follow the tradition represented by Weber, where I will use the interview-objects subjective meaning as the base for the analysis, as I am interested in their opinion.

There may be a case of *double hermeneutics*, as I am interested in the pre-school teacher's awareness and active use of mathematics. In that case, I will have to interpret somebody else's meaning of a situation or action, and thereby relate to the actors in the study (Gilje & Grimen, 1993, p.146). The sociologist Anthony Giddens came up with the idea that social sciences is based on double hermeneutics. It is a combination of the two traditions mentioned earlier from Durkheim and Weber where you interpret both the objective and subjective to gain an understanding of the whole. You can also say that double hermeneutics



is an interaction between two opinions within the same frame. It could be, in relation to my master-thesis, that one of the actors during observation have no formal education or experience with mathematics, and possibly “try and fail”, and then present an educated guess.

#### ***4.4 Phenomenology***

Phenomenological analysis consists of a focus on the content in the data. It is still the interpretation that the method is based on, more specific the deeper meaning with people’s thoughts and actions. (Johannessen et al, 2010, p.173-174). As a researcher, I will analyse the results from the questionnaire, and use both the whole impression and specific answers for the analysis, as they are related to each other. The phenomena are portrayed as something that is visible or shows itself and are perceived by the senses. The researcher focuses on the way actions and phenomena are experienced by the research object (Dalland, 2017, p.45). That is the main difference from hermeneutics, where the researcher focuses on its own reflections and interpretations. They are closely related but differ in the choice of focus.

According to Malterud (2003, in Johannessen et al, 2010, p.173-178), phenomenological analysis consists of 4 main phases:

1. Main impression and the meaning of content
2. Codes, categories and terms
3. Condensation
4. Summarizing

In the first phase, my focus is to attain an overview of the data materials and note the main categories. The interview- or document-material are skim-read, and there are not yet attention to detail. This will portray my first impressions and understanding of the data material and may indicate a possible finding.

Secondly, it is time to classify and sort the material, to analyse. It is time to find the meaning and details of the data collected. I may have already made codes, or will create them during the analysis. Coding is what we call it when a certain theme is to be highlighted, for example if the researcher has an interview, and every data regarding early mathematics are highlighted in a certain colour. The codes may alternate the further the analysis goes, in order to be more precise and differentiate between themes. Coding, categories and terms are mainly the same, a categorization of the material. All the answers and data within the same concept are grouped together. My codes will be apparent in the chapters presenting the data.

Thirdly, the condensation is based on the coding, but now the parts not included in the codes from phase 2 are removed, so that the material are solely the findings deemed relevant for the research and researcher. The codes can be rebranded and combined to form a more precise category, and easier to present. It is the process of finding the main core and remove the irrelevant data.

At last we have the summarizing. Here I will summarize the materials after the coding and condensation and must assess if the material in some way matches the original content. If not, I must retrace my steps back and find the anomalies of the analysis and interpretation. This process makes the method traceable and present the steps in an orderly fashion.

#### ***4.5 Qualitative or quantitative- or triangulation?***

There are two main methods in science, *qualitative* or *quantitative* method. The selection done by the researcher of what method is based on the research problem, and I selected the strategy most suitable, a complimentary combination of qualitative and quantitative method called *triangulation*. I thought that it was not possible to interview or observe several respondents in my study but needed to in some way see if the interview-objects did or did not differ from the general opinion pre-school teachers. I decided to conduct a questionnaire before the interviews to gather mass data from others, while limiting the total time usage and data mass. It would be the most effective way to find indicators of congruence for my master thesis, adding more generalizability to the statements in the interviews, as well as the interpretation of these. Further research on this theme could very well conduct interviews in a larger scale, as well as questionnaires and observations.

There was a debate in the 70's for that quantitative method was not suitable for social science. The philosophers and sociologists argued for that qualitative method was more adapted to social science's focus, human actions. The use of a quantitative method before or after an interview/observation could be complementary in the form of verifying from several sources what your in depth-analysis indicated (Ringdal, 2018 p.109-110). This was my idea as well.

##### ***4.5.1 Difference between qualitative and quantitative method***

The main difference between qualitative and quantitative method are mainly found in the names. Qualitative in this case means few objects, analysed over time and is not possible to gain from numbers, due to the aim for insight in the meaning and experience (Dalland, 2017, p.52). Methods frequently used within qualitative method are interviews, observation and text analysis. In this study, the qualitative part is interviews with pre-school teachers. It is

an inductive method, where the I first gain an overview of the objects reality by using an in-depth interview, and thereby try to find concepts and theory that can be used to gain understanding for the objects situation and actions (Ringdal, 2018, p.110).

Quantitative method is based on collecting multiple data, and the aim for my use of it is to get data that could be representative for a larger population or selection, in this case the organization and planning of mathematics in pre-school, and the employees view and usage of mathematics (Dalland, 2017, p.52). Methods frequently used within quantitative method are surveys/questionnaires, repeated experiments or by use of secondary data, and I decided to conduct a questionnaire. The questionnaire was sent to each pre-school within the same municipality, and I wished to have as many responses as possible. I allowed a timeframe of 2 months for the response, with several reminders sent to each pre-school to make sure that I got as many responses as I could. It is a deductive method, and I asked questions based on a theoretical perspective (Ringdal, 2018, p.110).

#### ***4.5.2 Triangulation***

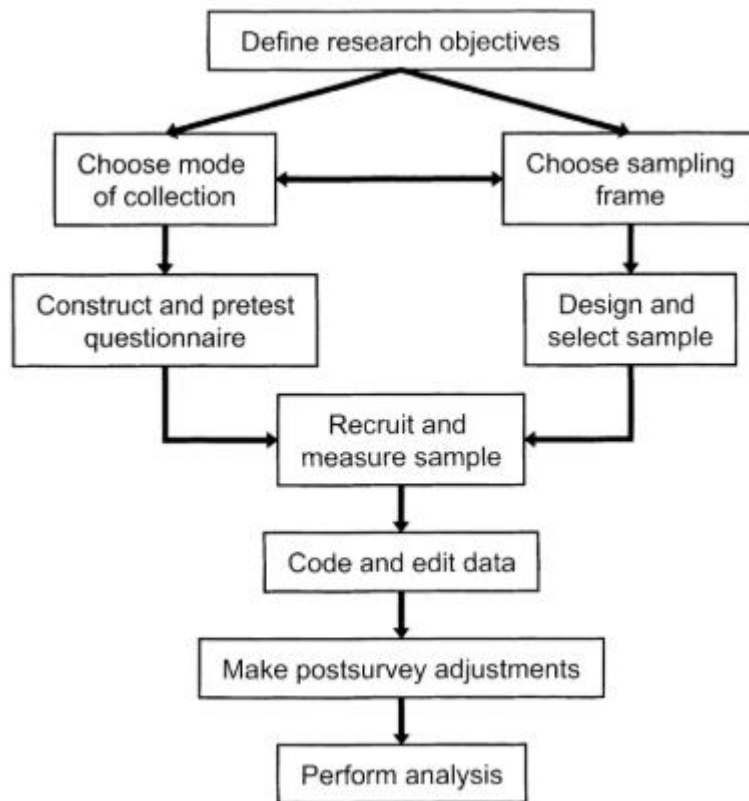
As mentioned earlier, triangulation is a complimentary combination of both qualitative and quantitative method (Ringdal, 2018, p.109-110). If the intention is to use triangulation, then the researcher must be open both approaches and its different methods. It makes it possible to use multiple lenses to look at a problem, and therefore be sure to not exclude any data. Every data contains some sort of error and true data, triangulation enabled me to investigate potential errors by looking at the context or compare true data with more data (Heath, L., 2001, p.15901-15906).

#### ***4.6 Data collection***

In this subchapter I will present theory regarding the methods I used to gather data for my master thesis, questionnaire, and interviews. This is the theory I based my construction of both methods on, and will be visible in the chapter 4.7, where I will go more in detail about how I did in my research and why.

##### ***4.6.1 Questionnaire***

Questionnaires can be used by several actors, and they differ in their scope and target group. They can be used by companies looking to increase their knowledge about their market or by official bureaus looking to collect data to represent an entire country (Ringdal, 2018, p.191). In my case, I used it to attain an overview from pre-schools and their employees within a specific topic. There are several steps that should be followed in order to create a successful questionnaire, and I will present a model proposed by Groves et al (2004, p.47-48) to show how mine was planned and created.



At first, the purpose should be made clear. The purpose for my questionnaire is to attain an overview from several pre-school teachers regarding the organization of mathematics in their pre-school, and how they themselves work with mathematics and the children. The next step is to decide the technique for data collection, which came down to the questionnaire (followed by interviews later). The best quality comes from personal interview, while factors such as breadth, time and limiting data mass favourites to the questionnaire. After the method have been decided, the selection is chosen. The respondents of the questionnaire were selected by their geographical area. Once the target group had been identified and the questionnaire created and tested, it was time to conduct the fieldwork. In my case, I created an online survey and sent it out to the respondents and waited for the data being sent back to me. Then it was time to code the data, followed by a mild edit in order to remove the errors, for example non-response. Lastly, the results of the data were analysed and arranged in a way that could indicate the conclusion of the questionnaire. This will take place in chapter 5.1. regarding the results from the questionnaire.

There are seven categories you can classify the methods in: *Communication, technology, privacy, time scope, cost, strengths* and *weaknesses* (Ringdal (2018, p.197). The communication form is mostly visual, and the respondent both read the question/assertion and the different answers and are in complete control. The technology used is nowadays mostly

digital in the shape of an internet survey, and increases the reach and reduces the time for processing, since the researcher can feed the answers directly from the survey into a digital analysis program, instead of having to manually type in the answers. The time scope for the questionnaire are medium because the respondent must read, interpret the question, then pick the most suitable answer. If the researcher were available, the respondent could simply ask for a definition or explanation.

The cost of a self-report questionnaire is low, especially for a digital form, and it was the most suitable way for me to get the breadth of data I needed. There are several programs for online questionnaires that are free, and the researcher are not dependant on travelling to the respondents. The strength of this type of questionnaire is that you can reach a far greater population and selection that via interviews in person and that it is anonymous, and no one will hear the answers in case it is an uncomfortable question. If you would answer by phone, you still would have someone hear your opinion. The weakness of this method is that it can be challenging to get a valid amount of response, and it is easy to ignore an email asking to partake in a survey. Also, it is difficult to control or follow up on the answers from a self-report questionnaire, given that it is completely anonymous, and you receive an un-nuanced response (Ringdal, 2018, p.195-198). It was distributed to the pedagogical leaders of each pre-school so that they could forward it to their employees, so that I would limit the treatment of personal information. I also thought it would be more likely to get responses if the pre-school teachers received the link from their leader.

#### **4.6.2 Interviews**

The interview-guide is like a manuscript the researcher follows in order to make sure the interview will cover the themes and questions discussed, as well as keeping a clear path throughout the interview. When designing the interview-guide, I identified the main themes that is included in the research-problem- the core of the master thesis. There will often be sub-themes that the researcher intends to ask about, to enlighten the main themes and master thesis from different angles and bring more nuance into the data. There are seven categories/parts that I planned for when designing the interview-guide, and I followed the steps in Johannessen et al (2010, p.141-142) when planning and creating an interview: *introduction and presentation, factual questions, introduction-questions, transitional questions, key-questions, complicated/sensitive questions* and finally *closing*. The interview-guide used in my research is attached as attachment 1.

For the *introduction and presentation*, the researcher must present him/herself, the intentions of the project, the recording of the interview and how this will be processed later,

and that the informant have the right to end the interview at any point. This is to give the respondent a better overview of the project and the interview, as well as reminding them about the rights they have regarding the participation of a research-project.

Secondly, the *factual questions* should be simple questions to start of the interview. It can be thought upon as a warm-up and consists of simple questions about the respondent and for example its interests. These questions are not only useful for establishing an amount of trust between the interviewer and respondent, but important for the following questions later in the interview, because it can be traced back to this phase. It is important to not have any complicated or provoking questions in this part.

After the introduction-phases, there must be a *transition* towards the main theme of the interview. It is meant to have the respondent start to focus in on the main subjects, such as explaining their general attitude towards the theme. Personal experiences are the keyword here.

The *key-questions* are self-explanatory and are the main part of the interview. Here, the interviewer will ask questions that often require elaboration from the respondent. This part often takes up half the time of the total interview and consists of specific questions in a given setting. The respondent can resonate around the question and give a longer answer.

Regarding *complicated* and *sensitive questions*, each of them should be very much reflected upon by the researcher before including in the interview-guide. Leave them out unless they are important for the project. In this master-thesis, the most sensitive questions asked are the ones revolving around the respondent's own experiences with mathematics, both in general live and experiences from school. Some people could have a very strained relationship towards mathematics and would therefore not be willing to answer the question in other ways than "good" or "not so good", with no further explanation. The reaction from the respondent must be accessed by the interviewer, and possibly a need to change the subject would be indicated.

For the *closing* part, the researcher must try to round it off in a natural way. This could be done by for example letting the respondent know how many questions are left to give them an overview of how long it will be until the interview is over. When all the questions have been asked, there must be set aside time to hear if the respondent have any more questions or information regarding the subject, have some concluding remarks or let them know what will happen with the data one more time before the interview is ended.

## ***4.7 My research***

In this subchapter I will present my research and choice of methods, how I designed both the questionnaire and the interviews, defined questions and categories, and present my expectations for the answers. Both the questionnaire and the interview-guide are based on the theory provided in the previous subchapter.

The original plan of this study was firstly a questionnaire to attain an overview of the pre-school teachers' use and organizing of mathematics, followed by observation to see how it really was, and finally an interview to talk about the pre-school teachers thoughts and experiences regarding pre-school mathematics. It was structured like this to overlap each other, and thereby enable cross-checking of what they say, do and think. The observation was not possible to conduct, as it was scheduled for March 2020, the same time as the outbreak of the pandemic and forcing the pre-schools to shut down.

I think that people sometimes give the expected response from the interviewer. By seeing what they say anonymously, personally, and through actions and then comparing these three, I hoped to find either anomalies or continuity. Are things really as they say, or is the reality different? The only observation I was able to do, was for one whole day. Therefore, the observation part of the study is excluded from this master thesis, making the questionnaire and interviews the main base of this study.

The main selection is to find pre-school teachers with experience or training in teaching mathematics, preferably within a certain area to make it possible to observe their work. Therefore, the population in this study equals the pre-school teachers with those two characteristics, a stratified selection, where the participants are selected based on those stratification variables (Johannessen et al, 2010, p.241-243).

### ***4.7.1 Questionnaire***

Questionnaire is clearly the most popular method within quantitative method. It is also called a survey and is a systematic way of collecting data from a selection in order to attain an overview of opinions from a population. My questionnaire is designed to gain an overview about how mathematics is planned in pre-schools, how it is thought upon by pre-school teachers and how they use it. The questionnaire was divided into six categories from A to F, where the last one, part F, only was a question about further participation in an interview. Please see attachment 2 for the questionnaire in full form. The questions will be written in bold, and the answers in parenthesis, for example:

**“Question 1? (Answer 1, answer 2)”**

Part A is about the respondent's background and experience from working in pre-school. The three questions were:

**A1: What is your gender?**

(Woman, man, other)

**A2: How many years have you worked in pre-school?**

(Less than a year, 1-3 years, 3-8 years, 8-15 years, 15 years or more)

**A3: What type of education do you have?**

(Pre-school teacher, pre-school teacher- student, children- and youth worker, others, do not want to say)

This was meant as an introductory category, but also important for my research, especially their experience and education. I expected there to be an overwhelmingly percentage of female respondents, educated as a pre-school teacher with a bachelor's degree. Their experience was not something I could guess. These three answers were something I would check for every other given answer, to see if there was an indicating connection between the answers in the other parts related to gender, experience or education.

Part B is about mathematics in pre-school, both in their own studies and everyday work. The three questions were:

**B1: Have you experienced classes regarding mathematics in pre-school?**

(Yes - normal part in my education, yes – as a specialization, no)

**B2: How often do you have an active and conscious focus on numbers, room and shapes (the curriculum for mathematics in pre-school) throughout your day?**

(Daily, 2-3 times a week, 1 time every week, 2-3 times every month, 1 time every month, rarer)

**B3: Is there a structured year plan for mathematics in your pre-school that you follow?**

(Yes, no, do not know)

My idea was that every pre-school teacher has touched within mathematics as a normal part of their education, but I wished to see if there was anyone who had a deeper specialization. For their focus and consciousness, I imagined that most would say that they do



have a daily focus, but this is impossible for me to control after the questionnaire. I was hoping that every pre-school had a structured plan for mathematics, but by asking directly, I would get an indicating answer. Again, this is a category like part A where I could retrace the answers to find an indicating connection.

For part C, I asked five multi-selection questions regarding where and when mathematics is facilitated for in pre-school, both in planning and execution. The five questions were:

**C1: In which situations are there facilitated for mathematics in your pre-school?** eating, playing, adult-guided play, outdoors, conversations with the children, sharing-time (reading, singing), while dressing, others

**C2: In which situations do the staff have a focus on planning for mathematics in the pre-school?**

Year plan, parent-meeting, planning-meetings, courses, others

**C3: What access do you have to counselling within mathematics?**

Internal in the pre-school, PPT, Statped, Others, no counselling accessible

**C4: Where do you find inspiration for working with mathematics at work?** Course plan, literature, PPT, Statped, Utdanningsdirektoratet, Internet, others

**C5: Do you think there is enough focus on mathematics in pre-school?**

Yes, No, Okay (so so)

For the situations where mathematics was facilitated for, I thought the beliefs of the respondent would decide where they saw an opportunity. For the planning of mathematics, I generally thought they would plan it for the year plan. For the access to counselling, I thought they would counsel each other internally. For the inspiration for mathematics, I imagined the course plan would be the answer. For the last question about if there was enough focus on mathematics, I could not make a guess based on my limited experience.

For part D, I gave the respondents four claims about themselves which they would answer on a Likert scale from “do not agree at all” to “agree a lot”. The four claims were:

**D1: I use mathematical terms actively and reflected at work.**

**D2: I expand the daily situations for children where mathematical concepts and context is visible and present.**

**D3: I ask follow-up questions to the children after they have used mathematics to see how aware they are of their use.**

**D4: I think it is challenging to take mathematics down to the children's level.**

The first three I thought would be leading claims, and that they would select agree, even though it is anonymous. I of course hope they answered honest, but it is impossible for me to check. For the last, I thought they would disagree, and I formulated it in a vulnerable way to see if they took their time to think about claims, effectively “flipping the scale upside down”. If they did not pay attention, they could have selected agree, even though it was fine to answer that. I just did not think they would answer that.

Part E was the final main category of the questionnaire, where they would again select multiple answers. They were asked about four specific aids they could use during a day within mathematical thinking, and the aids was brought from the course plan “Numbers, space and shape” (Directorate for Education and Training, 2017). The four claims were:

**E1: I use games to inspire the children to mathematical thinking.**

**E2: I use books to inspire the children to mathematical thinking.**

**E3: I use playing to inspire the children to mathematical thinking.**

**E4: I use digital tools to inspire the children to mathematical thinking.**

I thought games and playing would be the most popular aids, leaving books and digital tools the least popular.

The final part, F, was a question about if the respondent were willing to participate in an interview for this project.

**F1. Are you willing to participate in an interview in relation to the work around mathematics? The interview will be conducted at your premises in regards of time, place and duration. (Yes, no).**

**If yes, type in your contact information here (e-mail, phone number etc.)**

The expected result of the questionnaire was that mathematics was a very visible subject in pre-schools, and that it is planned and structured in a scholastic fashion. I also expected that when asked about what they do, the respondents would access themselves from

what they would like themselves to be doing, not what they actually are doing. When conducting a questionnaire (or even interviews for that matter), you cannot do anything but use the answers given and interpret it as the truth, unless other factors indicate otherwise.

#### ***4.7.2 Interviews***

Based on the response from the questionnaire, where I added a question regarding participating in an interview, I conducted interviews with those who opted for “yes”. I chose to limit the interviews to not more than five interviews, depending on the information gained. This is due to the other methods’ data-mass and time restraints. Those who opted for “yes” in the questionnaire was contacted and interviewed, due to that they work in a preschool and are based around the same geographical area, a so-called stratum-selection. As the study came to an end, four people opted for participating in an interview, three interviews were conducted, but for one interview, the audio-recording device had an error, so that the audio-file were erased and thereby not ending up as a part of the study. In the end I had two interviews, lasting for about an hour each.

The method selected for the interviews was semi-structured, meaning that there are specific themes that would be brought up, in addition to following up on some of the things the respondent brought up (Postholm & Jacobsen, 2011, p.75-76). It also enabled the conversation to be a bit more natural and less rigid. In the base of the interview, there are main themes that is to be answered. There is a chance that they will be answered by the respondent without the interviewer asking about it, and therefore the flexibility that the semi-structured interview offers is great for the natural flow, making it feel more like a conversation, and less like that one subject have to be answered at a certain time. These themes are the starting-point for the interview-guide. The interview-guide is the attachment 1.

The preliminary part of the interview included a checklist to make sure that all the information regarding the project, its purpose and the interview were made clear. They included the following six points:

- 1. Inform about the project and purpose.**
- 2. Inform about the structure and themes in the interview.**
- 3. Inform about voluntarily participation.**
- 4. Free to withdraw at any time without having to give a reason and ask that the data collected are deleted/not used.**
- 5. Inform that the material will be anonymized.**
- 6. Ask for permission to record sound. Inform regarding storage and processing of data.**

Each of the six points is to make clear to the respondent about the interview, the treatment of data and the respondents rights related to it. Not only is it informative, but it also shows professionalism from the researcher.

The first category is much like the first part in the questionnaire, and they are relevant for the rest of the answers given.

### **Part A- Background and information**

**A1. How long have you worked in preschool?**

**A2. What type of education do you have?**

**A3. Have you had any lessons/education regarding mathematics in preschool?**

**If yes, to what extent? General/specialization?**

There was not possible to expect the responses of these questions. It is of course possible to trace this information from the questionnaire given that in total four people opted for participating in an interview, but it could be similar responses from all four, making this important to ask about. The answers given in the questionnaire would not be relevant for this interview anyhow. Also, this is an easy introduction to the interview, hopefully “warming up” the respondents.

### **Part B- The pre-school**

**B1. How many children is there in the preschool you work at?**

**B2. How many of them are in their last year of preschool?**

**B3. Do you have any type of a “six-year club”?**

**B4. Is there any change in the working ways/activities for the children that have their last year in preschool?**

Again, like part A, this comes down to each pre-school and their structure and organization. The total number of children can differ greatly from each pre-school, but it is relevant to know about. Regarding the “six-year club”, there is often a grouping of those with their last year in pre-school, so that they could work on preparing to be a school-starters with different activities and demands than the rest of the children. The last question, B4, is in some way dependant of B3 but can also cover aspects that the “six-year club” does not affect.

**Part C- Preschool and mathematics.**

**C1. Is there a structured plan for the year in mathematics that you follow?**

**C2. Can you describe a typical week in preschool for the oldest children with focus on mathematical activities?**

**C3. Do you have an employee that have the main responsible/initiative for mathematics?**

**C4. Do you feel that mathematical focus is done on your own initiative, or is it something that are encouraged and backed up by the leader and other employees?**

The question C1 is similar to question B3 in the questionnaire. It would hopefully indicate the rest of the answers of part C. For question C2, I wanted to hear specifically about which activities that takes place in a normal week. This could have been done by observation, but having them explain it, I would get their purpose behind these as well. I imagined there would be a focus on counting and learning daily terms like giving directions, equal share and others. Question C3 and C4 are related, and they were intended to see how the culture in the pre-school was, and how the collegiate viewed mathematics. I hoped that there was not just one person responsible for mathematics, and that it was encouraged by the other employees as well.

**Part D: Own belief towards mathematics/mathematical subject**

**D1. What is the first thing you think about when you hear the term “mathematics”?**

**D2. What do you associate with the term “mathematical lenses”?**

**D3. How have your experiences with mathematics been throughout your education and growing up?**

**D4. Do you see a coherence between your belief towards mathematics and your work with children where mathematics is present?**

For part D, I switched the focus from the pre-school to the object, making it more personal. I started with question D1 and D2 asking about what they associate with mathematics to gain insight in their experience and belief, but in a more discrete way than later in question D3. This was intended to make the respondents “open up” to seemingly easy questions, instead of asking direct, hard questions right away. I do not think people would give a good answer if they are confronted right away with something they can be insecure about. The questions D3 and D4 is important because they would offer insight to the

respondents' belief and experience with mathematics, which for some can be a touchy subject. It is known that some people have a strained attitude towards mathematics, possibly portrayed as math anxiety, and I expected the pre-school teachers to be within that category.

**Part E: Transition from preschool to school**

**E1. What do you think is important to consider for teachers that meet school-starters in 1<sup>st</sup> grade?**

**E2. What working ways and organization are the most beneficial with 5-6-year olds based on your experience?**

**E3. Are there some areas within mathematics that teachers should have extra focus on in the beginner-learning?**

**E4. What type of mathematics do the children learn the most of in preschool?**

**E5. Is there something you personally think the children should wait until school to be introduced to regarding mathematics?**

**E6. Do you have any dialogue with teachers in school about the children after they have started at school?**

The last part, part E, was about the transition from pre-school to school. This was placed after part D in order to end the interview with talking about something that is not too personal and make the ending of the interview well-rounded. These questions are solely based on the respondent's opinion, and therefore I chose not to make pre-assumptions for all the questions in this category except E4 and E5. For E4 I imagined there was a focus on counting and learning precise terms relevant for daily life, like my assumptions for question C2 in the interview. For E5, I thought learning skills would be something they would recommend waiting for until school. That is because my reflection around the difference between pre-school and school mathematics are skill-based. You learn familiarity and knowledge with mathematical concepts in pre-school, and how to use them in school. Part C was intended to offer the respondent a chance to share their experience and opinion regarding the transfer to school, as well as give me insight in how they work with the subject.

## **Part F: Summary/final questions**

**F1. Do you have any additional comments or thoughts regarding the theme of the interview?**

**F2. Is there anything you would like to know more about regarding the research?**

These two questions are like a parachute for my interview, offering a chance for the respondent to elaborate about previous statements, or make sure that they have said what they wanted. Also, to round off the introduction, I again offered them to ask about the project for transparency.

### ***4.8 Validity, reliability and generalizability***

When it comes to validity, Dalland (2012, p.52) define it as following: "...what is measured, must have relevance and be valid for the research problem." In other words, the data collected from the study must be relevant for the research problem, and in some ways give answer to it.

There may be a chance that the mentioned actions from the pre-school teachers may differ from normal when I will be interviewing, given that they are aware of the interview and can try to say what they think I wish to hear. The questionnaire can also contain other data than reality since the questions draw focus on a subject the respondent may not reflect upon often. Even if the questionnaire will be completely anonymous and interviews referred to in the master thesis will not contain any characteristics of any object, they may still try to "decorate" the results.

I may have a preconceived idea and focus while interpreting, which could affect the way the data is used, and thereby potentially miss out in other relevant data and discoveries. Regarding the reliability of my research, I must firstly say that as I will be conducting a questionnaire and interviews where the respondents and the actors will be anonymous, there is no way that I can have a solid and representative result for every pre-school and their teachers in Norway. The aim for reliability in research is that another researcher can discover the same findings that I did by using the same methods and selections. The only thing I can say, is that my data and findings could indicate an answer to my research question compared to relevant theory and other studies.

#### ***4.9 Ethical responsibilities***

All research must submit itself to ethical principles and legal guidelines. For science, it means to make the research ethically sound. If the research would have any consequences for the participants, it must be considered from ethical standards, no matter the importance of the research (Johannessen et al, 2010, p.89-90). As NESH (National research Ethical committee for Social science and Humaniora) say, the researcher is to portray a good custom for reference, and avoid plagiarism, as well as to portray the data collected, and not fabricate or angle data in a way that would make them false or abusive. The participants should be treated with dignity, and not portrayed in a way that could harm their integrity or life. The participants in my study will be free to withdraw from the research at any time, without having to justify why (Kleven, 2011, p.22-23). As a measure to anonymize the participants, the questionnaire was conducted anonymously, and the invitation was sent to the leaders of each pre-school for them to pass on to their employees in order to limit personal information. The interviews have been anonymized, and there is no personal information apparent. They were all informed that they could ask at any time to have their statements revised or revoked, as you can see in attachment 3.

#### ***4.10 Limitations***

Due to the situation as of March 2020, the observation part of the data collection for the master thesis was not possible due to the pandemic. Therefore, there had to be made a change to the field work, and it was replaced with more focus on the interviews. The interviews had to be conducted by phone and could influence the interview regarding bodily communication. Due to increased demand at the time, the schools and pre-schools was not able to give time for more interviews, making the total amount of interviews in this study to two. I analysed the data alone, which also is a limiting factor. It could be helpful to have an unbiased analysis of the data by inviting someone unrelated to the project and ask what they think of the data.

#### **5.0 Presentation of data**

In this chapter, I will present the empirical data material that I have gathered through the questionnaire and interviews regarding pre-school mathematics. Results from the questionnaire will be presented separately from the interviews. I will present the results from



the questionnaire with pictures showing the distribution of answers. A similar questionnaire was conducted with 13 respondents from another region as a way of cross-check but will not be included or mentioned unless there are clear differences. The presentation of results from the questionnaire is divided into three parts: overview of mathematics in pre-school, focus on mathematics and lastly, the employees use of mathematics with given criteria.

For the interviews, I have divided the findings into three parts: Mathematical processes in pre-school, personal beliefs and experience with mathematics and lastly, the transfer from pre-school to school. Please see chapter 4.7 for all questions and detailed explanation for each category.

## 5.1 Questionnaire

### Part A: 3 questions.

#### Question A1:

##### Del A- 3 spørsmål

Her blir du spurt om din bakgrunn, og erfaring fra å være ansatt i barnehage.





##### A1. Hva er ditt kjønn? \*

Svar	Antall	Prosent
Dame	25	86,2 % 
Mann	4	13,8 % 
Annet	0	0 %

For my questionnaire, I had in total 29 respondents within the local area, where 25 respondents (86,2%) were women and 4 respondents were male (13,8%).

### Question A2:




#### A2. Hvor mange år har du jobbet i barnehage? \*

Svar	Antall	Prosent
Mindre enn 1 år	0	0 %
1-3 år	2	6,9 % 
3-8 år	4	13,8 % 
8-15 år	7	24,1 % 
15 år eller mer	16	55,2 % 

: The majority of the respondents, 23 in total, (79,3%) had 8 years or more work experience in pre-schools. 16 of them had more than 15 years of experience, so the questionnaire had a majority of very experienced pre-school teachers.

### Question A3:

#### A3. Hvilken utdanning har du? \*

Svar	Antall	Prosent
Barnehagelærer/førskolelærer	25	86,2 % 
Barnehagelærer under utdanning	0	0 %
Barne- og ungdomsarbeider	2	6,9 % 
Annet	2	6,9 % 
Vil ikke si	0	0 %

25 of the respondents (86,2%) had a bachelors-degree for pre-school teachers. 2 of the respondents was child- and youth workers, while 2 had a different education, possibly a pre-school employee without formal education.

#### 5.1.1 Organization of mathematics in pre-school



**Part B: 3 questions.**

### Question B1:

#### Del B- 3 spørsmål

Her blir du spurt om matematikk i barnehage, både i studie og på jobb.




#### B1. Har du vært innom undervisning om matematikk i barnehage? \*

Svar	Antall	Prosent
Ja, innbakt i vanlig studieløp	23	79,3 % 
Ja, som spesialisering	0	0 %
Nei	6	20,7 % 

When asked about education regarding mathematics in pre-school, 23 respondents (79,3%) of the respondents said that they have had it in their normal education. None had it as a specialization.

### Question B2:




#### B2. Hvor ofte har du et aktivt og bevisst fokus på antall, rom og form gjennom din arbeidsdag? \*

Svar	Antall	Prosent
Hver dag	23	79,3 % 
2-3 ganger per uke	5	17,2 % 
1 gang per uke	0	0 %
2-3 ganger per måned	0	0 %
1 gang per måned	0	0 %
Sjeldnere	1	3,4 % 

The same percentage (23 respondents, 79,3%) also said that they had an active and conscious focus on pre-school mathematics daily at work.

### Question B3:

#### B3. Er det lagt opp en strukturert årsplan for matematikk som du følger? \*

Svar	Antall	Prosent
Ja	16	55,2 % 
Nei	12	41,4 % 
Vet ikke	1	3,4 % 

For question B3, they were asked if there is a structured year-plan for mathematics in the pre-school they worked at, and 55,2% of the respondents said yes. I cannot say that more than half of the pre-schools have a year-plan for mathematics, because there could be several respondents from the same pre-school.

What is interesting though, is that in question C3 27 out of the 29 respondents (93.1%) ticked off that there was a focus on mathematics when discussing the year-plan. That could indicate that there is a general focus, but not specifically written down competences.

### 5.1.2 Focus on mathematics









#### Part C- 5 questions

##### Question C1:

###### Del C- 5 spørsmål

Her kommer det noen flervalgs-spørsmål om hvor og når matematikk tilrettelegges for i barnehagen, både i planlegging og utøvelse. Her skal du krysse av alle alternativene du mener stemmer for deg, og du kan velge flere alternativer.






###### C1. I hvilke sammenhenger tilrettelegges det for matematikk på avdelingen? (Sett flere kryss) \*

Svar	Antall	Prosent
Spisesituasjoner	29	100 % 
Frilek	20	69 % 
Voksenstyrt lek	24	82,8 % 
På tur	27	93,1 % 
Samtaler med barna	26	89,7 % 
Samlingsstunder (lesing, sanger ...)	28	96,6 % 
Påkledning	27	93,1 % 
Annet	6	20,7 % 

When asked about situations where there is adapted for mathematics, there was a broad agreement within the respondents that there is mathematics in every situations involving children, with an average percentage of 89,2% for all the situations I listed that could occur in an average day, including eating, playing, being outdoors, dressing and others.

##### Question C2:






###### C2. I hvilke situasjoner har barnehagen fokus på matematikk? (Sett flere kryss) \*

Svar	Antall	Prosent
I årsplanen	27	93,1 % 
Foreldremøter	9	31 % 
Planleggingsmøter	20	69 % 
Kurs	11	37,9 % 
Annet	6	20,7 % 

In question C2, they were asked in which situations the staff had a focus on mathematics. 93,1% said it occurred in the yearly plan, which indicate that there is a general focus, but maybe not defined specifically, as I asked about in question B1. 69% of the responses was also in planning-days for the pre-schools. The rest of the options show that there is a greater focus on other things than mathematics.

### Question C3:

#### C3. Hvilken tilgang har du til veiledning innenfor matematikk? (Sett flere kryss) \*

Svar	Antall	Prosent
Internt i barnehagen	24	82,8 % 
PPT	3	10,3 % 
Statped	3	10,3 % 
Andre	6	20,7 % 
Nei, ingen veiledning	6	20,7 % 

For question C3, they were asked about access to guidance within mathematics. The most selected option was “internally in the pre-school” with 24 respondents (82,8%) selecting it. One error must have been made for this question, given that 6 respondents chose “no, no guidance”, when 24 already selected yes for the first option. That means that one respondent chose both “internally in the pre-school” and “no, no guidance”, which I checked, and it was true. Regardless, a huge majority of the respondents said “internally”.

### Question C4:

#### C4. Hvor finner du inspirasjon til å drive med matematikk på jobb? \*




Svar	Antall	Prosent
Temahefte "Antall, rom og form"	17	58,6 % 
Faglitteratur	14	48,3 % 
PPT	4	13,8 % 
Statped	3	10,3 % 
Utdanningsdirektoratet	11	37,9 % 
Internett: Matematikk.org, Matematikksenteret, Facebook, andre nettsider	18	62,1 % 
Andre	10	34,5 % 

For question C4, the respondents were asked about where they find inspiration to work with mathematics in the pre-school. The two options with more than 50% selection was the course plan for pre-school mathematics and internet. Internet was the most popular, and I

think this could be activities found on for example Facebook-groups specific for pre-school teachers, as I know there are several of these kinds of groups for teachers. Course-literature was close to half of the respondents, which also can be expected.

### Question C5:

#### C5. Synes du det er nok fokus på matematikk i barnehagen? \*

Svar	Antall	Prosent
Ja	9	31 % 
Sånn passe	13	44,8 % 
Nei	7	24,1 % 

One of the most important questions (and most divided responses) was when I asked about if they think there is enough focus on mathematics in pre-schools. 31% said yes, 44,8% said it was okay, and 24,1% said no. Those seven who said no, are all pre-school teachers with a bachelor's degree, but their responses differ in almost every other question, so I could not find any coherence between them to find what might indicate the agreement.

### 5.1.3 Employees use of mathematics with given situations

#### Part D- 4 questions

In part D of the questionnaire, I laid out four claims for the respondents that they would answer using the Likert scale. They will be commented after presenting all four.

#### Question D1:

“I use mathematical terms actively and reflected at work.”

##### Del D- 4 spørsmål

Her kommer noen påstander om deg, og du blir bedt om å angi hvor mye påstandene stemmer for deg på en skala fra "stemmer svært lite" til "stemmer svært mye".

##### D1. Jeg bruker matematiske begreper aktivt og reflektert på jobb.

###### Svar fordelt på antall

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	0	1	4	19	5

###### Svar fordelt på prosent

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	0 %	3,4 %	13,8 %	65,5 %	17,2 %

### Question D2:

“I stop and expand the daily situations for the children where mathematical contexts are present.”

**D2. Jeg tar tak i og utvider dagligsituasjonene til barna hvor matematiske sammenhenger kommer til syne.**

Svar fordelt på antall

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	0	1	4	17	7

Svar fordelt på prosent

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	0 %	3,4 %	13,8 %	58,6 %	24,1 %

### Question D3

“I ask follow up questions to the children after they have used mathematics to see how conscious they are of the usage.”

**D3. Jeg stiller oppfølgingsspørsmål til barna etter at de har tatt i bruk matematikk for å se hvor bevisst de er på bruken.**

Svar fordelt på antall

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	0	1	4	19	5

Svar fordelt på prosent

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	0 %	3,4 %	13,8 %	65,5 %	17,2 %

In the first three claims, I noticed that the combined percentage of those that selected “agree” or “strongly agree” were the same with 82,7% (24 out of 29 respondents). The only person who opted for “disagree” had selected it every time and had earlier in the questionnaire put that she rarely used mathematics actively at work.

### Question D4:

“I think it is challenging to take the mathematics down to the children’s level.”

**D4. Jeg synes det er utfordrende å ta matematikk ned til barnas nivå.**

Svar fordelt på antall

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	8	15	3	2	1

Svar fordelt på prosent

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	27,6 %	51,7 %	10,3 %	6,9 %	3,4 %

For the final claim (D4), there were still a broad agreement amongst the respondents, with a combined percentage of 79,3%, or 23 out of 29 respondents not finding it difficult to take mathematics down to the children's level.

### 5.1.4 Employees use of mathematics related to the curriculum

#### Part E: 4 questions

In the final category for the questionnaire, I asked the respondents about the usage of aids from the curriculum for mathematics for pre-schools, "Numbers, space and shapes" (Directorate for Education and Training, 2017). From the curriculum, I brought four aids: *Games, books, play and digital tools*, all intended for working with mathematics in pre-schools. The responses brought varied responses and distribution of percentage between the respondents, and they answered using the Likert scale, as the previous category. All the questions had the same structure, only changing in the aid they mentioned.

#### Question E1:

"I use games to inspire the kids to mathematical thinking."

##### Del E- 4 spørsmål

Her blir du spurt om spesifikke hjelpemidler eller andre materialer som du kan bruke i løpet av en dag innenfor matematisk tenkning (Hentet fra *antall, rom og form*). Velg det alternativet som stemmer mest for deg.

##### E1. Jeg bruker spill for å inspirere barna til matematisk tenkning.

##### Svar fordelt på antall

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	2	1	2	18	6

##### Svar fordelt på prosent

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	6,9 %	3,4 %	6,9 %	62,1 %	20,7 %

For the first question of the category regarding the use of games, an overwhelming 82,8% of the respondents answered that they agreed or strongly agreed to using games to inspire the children to mathematical thinking.



### Question E2:

“I use books to inspire the kids to mathematical thinking.”

**E2. Jeg bruker bøker for å inspirere barna til matematisk tenkning.**

Svar fordelt på antall

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	0	1	8	16	4

Svar fordelt på prosent

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	0 %	3,4 %	27,6 %	55,2 %	13,8 %

For the second question, I asked about using books for mathematics. This one I expected would be the least popular, because it would require the text to include numerical principles read aloud by a teacher. 69% of the respondents answered that they agreed or strongly agreed to using books to inspire the children to mathematical thinking. Note that this question had the highest percentage of “neutral” responses, with 27.6%, and only one respondent (3,4%) selecting “disagree”.

### Question E3:

“I use play to inspire the children to mathematical thinking.”

**E3. Jeg bruker lek for å inspirere barna til matematisk tenkning.**

Svar fordelt på antall

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	0	1	2	21	5

Svar fordelt på prosent

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	0 %	3,4 %	6,9 %	72,4 %	17,2 %

The third question was about using playing to inspire to mathematical thinking. I thought this would cause the second most unison response in agreement, but a whoopingly 89,6% agreed or strongly agreed that they use it. After my interviews and reading up on pre-school mathematics, I found out that this is probably the most frequent way of using mathematics in pre-school. Only 3 out of the 29 respondents did not agree, with 2 of them being neutral.

### Question E4:

“I use digital tools to inspire the children to mathematical thinking.”

#### E4. Jeg bruker digitale verktøy for å inspirere barna til matematisk tenkning.

##### Svar fordelt på antall

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	2	5	7	13	2

##### Svar fordelt på prosent

	Stemmer svært lite	Stemmer lite	Hverken/eller	Stemmer mye	Stemmer svært mye
Grad *	6,9 %	17,2 %	24,1 %	44,8 %	6,9 %

The final question was about using digital tools to inspire the children to mathematical thinking. I thought this one would be the least used aid for mathematics, and only 51,7% of the respondents agreed or strongly agreed. This aid caused the biggest division of percentages, with 24,1% disagreeing or strongly disagreeing, and another 24,1% remaining neutral.


The last part, part F, was a question where I asked if the respondent would be willing to participate in an interview at a later stage regarding pre-school mathematics.

#### Del F- 1 spørsmål

Her blir du spurt om du er villig til å delta på et intervju. Dersom dette er aktuelt, må du skrive inn e-postadresse eller annen kontaktinformasjon slik at jeg kan kontakte deg. Svarene dine trenger ikke å knyttes opp mot intervjuet.

#### F1. Er du villig til å delta på et intervju i forbindelse med arbeidet rundt matematikk? \*

Her vil intervjuet gjøres på dine premisser med tanke på tidspunkt, sted og varighet.

Svar	Antall	Prosent
Ja	4	13,8 % 
Nei	25	86,2 % 

4 of the respondents selected “yes” and was contacted. I conducted interviews with 3 of them, and 2 of those are presented in the chapter 5.2 regarding interviews.

## 5.2 Interviews

In this chapter, I will present the data from the interviews, followed by remarks from me to put it into context. It is divided into four different sub-chapters, one for the presentation of the respondents, and one for each main category for my interviews, revolving around the research-questions presented in chapter 1.

### ***5.2.1 Presentation of respondents***

In my data collection, I interviewed 2 people who work in a pre-school as pre-school teachers. Each of the respondents are selected from both their voluntarily participation and relevance to this master thesis. The respondents work with children within the age-group of 4-7 years old. To distinguish between them, each respondent has been given a letter, A and B, so that the reader can see who says what, yet ensuring the anonymity for the respondents. The respondents' gender and age are not included, as I want the data to be as objective as possible, both for the processing of the data and for the reader.

Person A has worked for 10 years in pre-school and have a bachelor's degree as a pre-school teacher. A has studied mathematics as a normal part of the education and has participated in courses throughout the years directed by the pre-schools locally or nationally where the focus was on mathematics for pre-school, both theoretically and practically oriented. The pre-school person A works in consists of 17 children in their last year.

Person B has worked for 15 years in pre-school and have a bachelor's degree as a pre-school teacher. The education was the same as person A, where mathematics was a normal part of the education, but B differs from A by the fact that there has been no participation in courses or continuing education in mathematics for pre-school. The pre-school person B works in consists of 9 children in their last year.

### ***5.2.2 Mathematical processes in pre-school***

Mathematics in pre-school is the main part of my master thesis. As a schoolteacher, I am interested in the work done in pre-school. It is my belief that attaining an overview and understanding of what the pre-school teachers do, and what the children are doing regarding mathematical processes, is crucial for my own work with the children when they come to the school. I asked them about how mathematics takes place at their work, and this was the responses:

Person A says:

*Why do we do what we do, and say what we say? A lot has to do with mathematical awareness amongst the employees. There is a lot that is done and said that with a little twist of mathematical awareness is turned into mathematics. Just use of concepts like «Place the block over or under or aside of», and then follow up by adding another block and directives like «Now place the red brick aside...». If you are aware, then you can get far.*

Person B says:

*In playing there is a lot of construction taking place. Then the children discuss how many pieces they used, the shape it has, and colour... Sometimes we walk around in the room and look at shapes then put it into a perspective that we have on the iPad in a special program... When we are cooking, we bring along one or two of the oldest children to cut fruit, prepare fish or sausages, and then we have to see how many pieces we get, how many plates we need to set the table for everyone. Then we can talk about why the bigger children gets a bigger piece, and the smaller children get a smaller piece. That is how we work systematically every week.*

This seemed to be the common denominator for each respondent. Being aware and making the children aware of mathematics was a frequently mentioned subject during my field work. None of the two persons pre-school had one employee with extra responsibility or initiative for mathematics, but as person B said:

*I am the pedagogical leader of my section, and I can tell one of the employees to sit down and count with the children as they cut fruit, so that I make sure to hyphen the learning aspects to them so that they work with it every day.*

As for mathematical activities for the oldest children, person A said:  
*You can divide it into many categories, for example beading, drawing, getting dressed, orientation and counting. I think mathematics take place more than we know. (...) Often, we give the children instructions and procedures that they must do, so that they will understand how to use mathematics to differ between something and be more precise. "Take the purple mitten and place it in the upper, right basket." Then the child comes to me and says, "That is too high for my reach!", and then they must find a way to reach the basket, by using for example a stool. Already they have used a lot of mathematical concepts, and we have not even used numbers! If they get to work with the concepts like this, I believe they will be well prepared for school.*

*Struggling or arguing is a good chance for learning. «If I give away this, then maybe I can...» you know? Problem-solving is something that is very important to learn in pre-school, and if you able to work with a problem and look for a solution, it is transferable to mathematics. So by focusing on problem-solving as a social competence, these attributes are something that will be a tool for the children for cooperation with others or working by themselves.*

### **5.2.3 Personal beliefs and experience with mathematics**

Mathematics have both positive and negative images (see subchapter 2.4). Every person working with mathematics have their own experiences and beliefs, either positive or negative, and these affect us as mathematicians productively or limiting our interest and potential. I have an interest in this subject for my master thesis, and the pre-school teachers have probably made a stance towards mathematics already when they applied for their education. Some of my co-students had an engaging and motivating mathematics teacher during their schoolyears, and therefore they wished to work with mathematics themselves, in the hope of bringing that feeling onwards to new pupils. Others had horrible experiences, where they thought that the tasks or teacher did not interest them, and therefore wish to work with mathematics to help those pupils experiencing the same feelings. Experiences shapes beliefs, and beliefs shapes the future experiences.

When asked about their own experiences and beliefs towards mathematics, person B said:

*Oh, where do I start? As a child, I struggled a lot with mathematics. I thought it was very difficult. When I see my son in the sixth grade, I wonder how I could not understand it back then, is it possible that it was so simple? ... my understanding of mathematics is totally different now in the age of 50 than what it was in school. And I think that makes me into a better pre-school teacher, because I have a totally different calm inside me when it comes to mathematics than I did 20-30 years ago.*

A slightly similar response came from person A, who also had a bad experience and relationship with mathematics:

*I do not like mathematics, if I am to be completely honest. I do not like numbers mixed with letters, I am not a fan. I did not like it at school, and I thought it was dull both in school and at the university. After I had worked (as a pre-school teacher) for a couple of years, I started seeing things more differently. There is more to mathematics than what people think, the consciousness as I mentioned earlier... I think maths was terrible, and I think it has to do with the way it has been introduced at school. You can sneak in mathematics in several ways. If I take the children out to create a nesting box for birds, then we have to research what colours birds like, how big, the size of the entrance and such. We could use several days before we even touch the saw. If this were the way for the school too, then maybe people would not have a strained relationship towards mathematics. At least I think so.*

In these two responses, both teachers have had a bad experience with mathematics in school, but after working with smaller children for a couple of years re-discovered core-mathematical principles and understanding them more.

As the follow up question, I asked about is they could see a connection between their own belief and their work as a pre-school teacher.

Person B said:

*Yes, I can see that I started way too late being conscious of my own belief towards mathematics. I was pretty naive in the beginning, thinking that mathematics was just numbers and letters... and it doesn't matter if you can count to 100 when you are five years old if you can't put your shoes in the right place in the dressing room.*

Person A said:

*Yes, absolutely! Negative experiences make you want to work with a positive approach towards the subject... I think there are more people like me that have bad experience from school, and some of us wish to change that, and find new solutions and ways to do things. I don't think that you should say that some teachers are good, and others are bad, but that it has to do with the pedagogics around the whole subject (of mathematics) that has changed.*

#### **5.2.4 The transfer from pre-school to school**

The transfer from pre-school to school is where I as a teacher comes in. This is the main purpose for my master-thesis in terms of personal gains. Often labelled as “the first big step towards becoming an adult”, the expectations from the society is enormous for a 5-6-year old when they arrive in 1<sup>st</sup> grade. Therefore, the pre-schools try in some way to prepare the children for this change of environment, for example with specific organization and activities for those who are school starters in their last year of pre-school.

When asked about if the pre-schools had a special group and activities for those of the children in their last year before school, both person A and B answered that they had a “five-year club”.

Person A said:

*We have a structured plan. Every week both the employees and the children know what happens and why it happens. We practice everything from pen grip to making a bonfire, and in the spring, we visit the schools.*

Person B said:

*We have a 5-year club, and there we practice everything from tying shoes to tasks that they sit and work with that is a bit more school-related. And we don't do that just for them to learn numbers and letters, but also so that they are able to be calm and work with something for up to 15-20 minutes.*

Person A said:

*For the children, there is a new social setting and expectations from adults. I think it is tough for any children... I have a brother that works as a teacher, and he says that he spots the differences between those who comes from a «good» and a «not so good» pre-school... My goal with the school-starters is the social competence. I do not care if they can't write their own name or count to 10. If they can cooperate, wait for their turn and keep order, they will have better prerequisites for school and later in life.*

When person B was asked about how the teaching should be organized in 1<sup>st</sup> grade:

*I would make sure that the learning became a type of play. Learning through playing. You can use big Lego-blocks and teaching shape, colours, construction and numbers. Just like using songs and music for learning letters. You can use things found in nature to write and count, the approach from something concrete.*

Person A had somewhat of the same thoughts as person B:

*I think that if you are 6 years old and have a 45 minute lesson with this, a 45 minute lesson with that, go out and run for 15 minutes, then come back and do it again, how much are you left with? I think it could be too much division of the day, instead of saying «Okay, this week we will be doing this», and then work with a project for the whole week. I do not think that small children are not made for having 45 minute-blocks. The idea is good with variation and all, but I think it will cause an overload.*

I asked them both if there were some elements of mathematics that they thought the children should wait until school for, but both said no.

Person B said:

*Mathematics is a subject that the children generally are interested in. We have for example two-year olds counting to 20. We don't tell them to wait until school or ignore something they wonder about. Sometimes when they come up with ideas and comments, we as*

*adults see things differently from their perspective. So, we do not limit learning, but take advantage of their interest once it's there, so called «golden moments».*

Person A said:

*I think it is difficult, because the children are so different. It has to do with interest: Some like numbers and letters, others don't like it. Some don't like letters, but love drawing and writing their name. Sometimes you as an adult can limit the situation, but it is okay to be pushed sometimes.*

### ***5.3 Main findings and interpretation***

In this sub-chapter I will present the main impressions and findings from both the questionnaire and the interview. For the questionnaire, you will see traits from chapter 4.4 regarding phenomenology and summarizing. The principle of seeing the whole, mentioned in chapter 4.3 regarding hermeneutics will be central for the interview.

#### ***5.3.1 Questionnaire***

The questionnaire indicated that not every pre-school had a structured yearly plan for mathematics and that they bake the mathematics into most daily situations. It seemed that the collegiate did not discuss mathematics, but that it was something everyone did at their own initiative and daily work. The most popular aids for inspiring to mathematics proposed by the Directorate of Education were play and games, leaving books and digital tools less popular. Especially digital tools seemed to have a great room for improvement and could be something we can see the development of in the coming years as digitalization grow ever bigger and further. None of the respondents had a specialization within mathematics.

#### ***5.3.2 Interview***

The biggest take from the interviews was the focus on mathematical awareness. Both respondents mentioned it several times, and it seemed as central principle for teaching mathematics in pre-school. Having the children being made aware of and reflecting upon the mathematics they are using during activities was the most used method for teaching. There was not a big focus on formal teaching, and they used an inductive way of teaching.

For the beliefs, both respondents had a not so good experience with mathematics and seemed deemed to give children a different experience towards it. They both felt their beliefs



and experience affected their daily work, and it had turned better during the years. It seemed they thought of mathematics as a tool for daily life, and not a skill you use in school.

For the transition, both respondents had a structured plan for preparing the children for school. It mainly consisted of grouping the oldest children together and practice situations that takes place in school and making them more self-dependant. They both agreed that for school-starters, the preferred way of organizing the teaching would be through play and discovery and having a slightly “loose” structure and organization that would benefit the children more in the early years. Lastly, they thought that you should not limit mathematics by waiting with specific concepts or activities until school but taking advantage of the interest in the situation and using it to learn about the mathematical concept.

## **6.0 Discussion**

The purpose of this study is to research the pre-school mathematics, and what type of beliefs and attitude the children are faced with in the years before school. All in order to better facilitate for the school-starters in the early years in school, to optimize a smooth transition. I doubt that what I find will be the be-all and end-all of transitional pedagogics, but something that can indicate or confirm previous research or inspire future projects.

The discussion and results will be presented in the three categories based on the research-questions presented in the introduction.

- To what degree is there an active and conscious focus on mathematics by pre-school teachers?
- How can the teachers previous experience with mathematics affect their belief and work with mathematics and young children?
- How can teachers in pre-school and school ease the transition between pre-school to 1<sup>st</sup> grade?

The discussion revolves around three categories. The first (6.1) is a discussion of how mathematics is organized in pre-school, both in theory and practice. The second (6.2) is a discussion of how the experience and beliefs of pre-school teachers could affect their daily work, and their relationship with mathematics. In the third and last category (6.3), the organization of the transfer from pre-school to school will be focused on, both in pre-school activities and organization and how the pre-school teachers in the interviews think the transfer should be.

## ***6.1 Mathematics in pre-school***

In order to discuss the first research-problem, three parts will be discussed: 1) What type of mathematics the children are exposed to, 2) how the pre-school teachers work, and 3) how the pre-schools plan and organize for the mathematics curriculum. These are the main core of pre-school mathematics if we look specifically at the activities and content.

### ***6.1.1 Pre-school mathematics***

One of my key questions in the questionnaire, were also the most divided. Do the pre-school teachers think there is enough focus on mathematics? 24%, 7 out of 29, said no. This is not in itself a big result, but the two other responses were “yes” (31%) and “okay” (44,8%). But what does pre-school mathematics include? The course plan for pre-school mathematics is sounded out in a way that indicates that the children should familiarize with mathematics and use it as a way of discovering and sorting the world (Norwegian Directorate of Education, 2013), not focusing on skills, as it tends to indicate in the course plan for school (Norwegian Directorate of Education, 2010).

The course plan for pre-school shows much of the core from *early mathematics*. As previously mentioned, early mathematics is the term for all mathematical development before 1<sup>st</sup> grade. It revolves around mathematical awareness in daily situations, and understanding shapes, sizes, measurements, time, numbers, location, patterns etc. Its aim is to be a way of describing measurable relations between objects in the surrounding world (Schoenfeld, 1994, in Garvis & Nislev, 2017). As person A explained: *“I think mathematics take place more than we know. (...) Often, we give the children instructions and procedures that they must do, so that they will understand how to use mathematics to differ between something and be more precise.”* By telling a child to put something in a specific place using only language, to then see the child find a way to reach the specific place, there is a whole lot of orientation and comparing going on. No numbers or calculation, only working with how to get something to a specific place. Person A interpret this as: *“If they get to work with the concepts like this, I believe they will be well prepared for school.”*

There is a difference between school-mathematics and mathematical thinking. Where school-mathematics are heavily built around symbols, procedures and calculating, mathematical thinking is broader. It is more like a tool for reflecting, systematizing, discovering and solving problems (Nakken & Thiel, 2019, p.25). Mathematical thinking is much like early mathematics, with the same principles.

*“If I take the children out to create a nesting box for birds, then we have to research what colours birds like, how big, the size of the entrance and such. We could use several days*

*before we even touch the saw.*”. This is a good example of a *rich task*. Björkqvist (1999, in Nämnaren nr 3, 1999, p.35-39) says rich tasks can stimulate and motivate all pupils regardless of their level. Everyone has a change for progression, but it offers a challenge for everyone (Maugesten, 2013, p.55-56). In the work of creating a nesting box, there are several details you could add in, just creating a box or planning every detail. It is a LTHC-task (Low Entry High Ceiling) and offers a chance for every child to find a solution, both those who struggle with mathematics and are motivated by this task, or stronger children who are forced to expand their answer (Norwegian Centre for Mathematics Education, n.d.).

Bruner (1966, p.10-14) had a theory about that there are several levels of representation that can be used for teaching mathematical knowledge, both in an enactive-, iconic- and verbal-symbolic level. This knowledge develops throughout childhood, going from a concrete to a formal way of mathematics. They test out phrases they have picked up from a daily situation, and is a risk-free environment (Björklund, 2013, p.66-67).

Often the teachers could initiate a learning-process at the enactive level by showing a concrete object, but one misconception is that children only learn mathematics by interacting with concretes as Sun Lee & Ginsburg (2009, p.34-35) says: “Mathematics is not tangible; it is a set of ideas. Mathematics in the early years does not need to be limited to the concrete or tangible.”. My outtake of the focus for the pre-school teachers’ response show that they focus on creating an understanding of mathematics, but they did not explicitly mention only using concrete materials.

In part E of the questionnaire, I asked about the usage of four specific learning tools regarding teaching mathematics; Games, books, play and digital tools. As expected, play (82.8%) and games (82.8%) where the most popular, leaving books (69%) the third most used, and digital tools at the lowest percentage (51.7%). Even though digital tools where the least used, we have seen a big increase in the usage of for example iPads in school, and it is possible that they take it further to pre-schools. Some pre-schools already use digital tools and certain programs for mathematics, as person B said:

*Sometimes we walk around in the room and look at shapes then put it into a perspective that we have on the iPad in a special program...*

### **6.1.2 Pre-school teacher’s role in teaching mathematics**

*“Why do we do what we do, and say what we say? A lot has to do with mathematical awareness amongst the employees. There is a lot that is done and said that with a little twist of mathematical awareness is turned into mathematics... If you are aware, then you can get far.”* as person A said. Mathematical awareness is according to Nakken & Thiel (2019, p.34-

35) the best tool for adults. By conversating with the children and expanding and exploring the mathematical concepts, the children can be stimulated to bring out their thinking.

Being *mathematically aware* seemed to be one of the thing that the respondents in my questionnaire agreed on, with 24 out of 29 (82,7%) opting for agree or strongly agree for the claims regarding this subject (D1, D2 and D3 in the questionnaire, attachment 2).

Person B said: *“When we are cooking, we bring along one or two of the oldest children to cut fruit, prepare fish or sausages, and then we have to see how many pieces we get, how many plates we need to set the table for everyone. Then we can talk about why the bigger children gets a bigger piece, and the smaller children get a smaller piece. That is how we work systematically every week.”* This confers with the five terms for a mathematical conversation (Fosse, 2016). By having the children discuss the mathematical concepts, in this case: preparing food, they reflect about what they do in a structured way. Discussing why the size of a child have a coherence with the size of their portion is a great opportunity for learning the usage of mathematics for real-life, concrete situations.

A lot of the data gathered from my collection, previous research and theory revolves around the principles of Lev Vygotsky and sociocultural learning. The role of the adult can be labelled as a mediating helper, as they have a higher level of knowledge and can expand the children’s zone of proximal development into a higher level of understanding (Säljö, 2017, p.169-171).

This was exemplified by person B, saying: *“I am the pedagogical leader of my section, and I can tell one of the employees to sit down and count with the children as they cut fruit, so that I make sure to hyphen the learning aspects to them so that they work with it every day.”* Here, the adult is encouraged to work as a mediating helper by both bringing focus to the mathematical concepts, but also being there to make the children expand their knowledge, and confers with Vygotsky’s ZPD (Vygotsky, 1978, in Säljö, 2017, p.170-171).

Only through language can a question be asked and answered. Teaching through language is essentially interacting with someone else to show how and why you do something. That is why Vygotsky claim that language is a tool for learning (Lyngsnes & Rismark, 1999, p.67-68).

### ***6.1.3 Organization and planning of mathematics in pre-schools***

In the questionnaire for question B3 I asked if there was a structured year plan that the pre-school followed. 16 (55,2%) of the respondents said yes and 12 (41.4%) said no. As mentioned earlier, I do not exactly know where each respondent worked, but it at least shows that not every pre-school has a year plan. Previous research indicates that pre-schools deemed

as low-quality greatly benefit from having a structured plan with mathematics (Rege et al., 2019). I did not study the type of pre-schools, but this could be interesting to have a closer look at for future research.

Not only low-performing pre-schools benefit from structured work with mathematics, but children do as well. The study by Vogt et al. (2018) proved that low-performing children partaking in structured, play-based learning benefitted greatly from it, compared to the instruction-based learning normally used. As a side note, so did high-performing children.

Play-based learning confers with differentiation and *student resource*. Holm (2012, p.98-102) says that you can group a couple of students together, and this enables them to discuss and explain with each other. The teacher can pair students with similar development together, allowing them to cooperate while solving mathematical problems and are getting good practice in explaining their mathematical thought process. Having the children exploring mathematical concepts in a play-based, risk free, safe environment together with the student resource, they will be able to better understand and distinguish the concepts, facilitating for a better understanding.

I asked about using play as a method to inspire the children to mathematical thinking, in question E3 of the questionnaire, with 82.8% agreeing or strongly agreeing, so this is clearly a widespread method for the pre-schools in my study. Interesting enough, I asked about methods where there is facilitated for mathematical teaching in question C1, and the least selected option was “free play” (69%). This does not have to be contradictory to question E3, because the question C1 revolved around planning for mathematical teaching. Free play differs from playing “grocery store”, as “grocery store” could be defined as mathematics in play, while free play could be done with absence from adult influence and learning aims (Jahn & Øygaard, 2006, p.20).

The results for question C1 and C2 in the questionnaire gave me an interesting indication. In C1, the average percentage of situations where there is facilitated for mathematics was 89.2% for all the listed situations that was intended to cover everything. This is a strong indication that the respondents think mathematics are used every day in most situations. Then again, C2 showed that the collegiate in the pre-schools do not discuss mathematics often with parents (31%) or in courses (37.9%). They ticked off for focusing on mathematics in the year-plan (93.1%), but these two questions indicate that mathematics is done “in the now”, and that there may be other subjects that are more important for pre-school teachers when discussing the child’s development with the parent. What that could be is not covered in this master thesis, but we see from my questionnaire that mathematics outside of

the daily work in pre-school is not forwarded as much to parents. In C3, the most selected option for guidance for mathematics, 82.8% selected for “internally in the pre-school”. So, they have an internal focus for mathematics.

## ***6.2 Experience and beliefs of pre-school teachers***

To discuss the experience and beliefs of pre-school teachers, this sub chapter will be divided into two parts; Focus on images of mathematics based on their experiences, and how their beliefs affects their work and how their work affects their beliefs.

### ***6.2.1 Images of mathematics based on experiences***

*I do not like mathematics, if I am to be completely honest. I do not like numbers mixed with letters, I am not a fan. I did not like it at school, and I thought it was dull both in school and at the university.*

This is the answer person A gave when asked about own experience with mathematics, and it is correct to assume that this is a negative image of mathematics. The personal images are affected by own experiences and beliefs towards mathematics, mental pictures, and personal philosophies of mathematics. *Negative images* of mathematics are based on that it is difficult, cold, abstract, theoretical, masculine, and often thought of as something only accessible to highly intelligent, big headed professors (Walkerdine, 1995 in Ernest, 2014, p.11).

When person B were asked about the same, the response was:

*As a child, I struggled a lot with mathematics. I thought it was very difficult. When I see my son in the sixth grade, I wonder how I could not understand it back then, is it possible that it was so simple? ... My understanding of mathematics is totally different now in the age of 50 than what it was in school. And I think that makes me into a better pre-school teacher, because I have a totally different calm inside me when it comes to mathematics than I did 20-30 years ago.*

So as a child, there was a negative image of mathematics. When person B became an adult and got to see the mathematics again after a couple of years, the image became less negative, but there must have been something wrong with the way mathematics was presented. Both persons gained a positive image of mathematics after working with it as a pre-school teacher. As person A said:

*After I had worked (as a pre-school teacher) for a couple of years, I started seeing things more differently. There is more to mathematics than what people think, the*

*consciousness as I mentioned earlier... I think maths was terrible, and I think it has to do with the way it has been introduced at school.*

Walkerdine (1995 in Ernest, 2014, p.11) say that a *positive image* of mathematics is that it is a dynamic, problem-driven and expanding field of human creation and invention. It revolves around that there are several ways to find an answer to the problems, and that the answer is verifiable. This confers with the way mathematics is viewed upon by the pre-school teachers and in their work with children. This does not mean that the respondents have a positive image of mathematics as their personal view, but it indicates a positive image as a professional view.

Both respondents had a negative image personally of mathematics, but it seemed they had a positive image professionally. Mathematics in school was a strained topic for both respondents, but pre-school mathematics is something the respondents thought of as fun, real-life tasks where there is a high motivation for solving a problem. As person A reflected on:

*If this were the way for the school too, then maybe people would not have a strained relationship towards mathematics. At least I think so.*

### **6.2.2 A change in beliefs**

When asked about if the respondents could see a link between their belief towards mathematics and their work as a pre-school teacher, person B said:

*Yes, I can see that I started way too late being conscious of my own belief towards mathematics. I was pretty naive in the beginning, thinking that mathematics was just numbers and letters... and it doesn't matter if you can count to 100 when you are five years old if you can't put your shoes in the right place in the dressing room.*

Person A said:

*Yes, absolutely! Negative experiences make you want to work with a positive approach towards the subject... I think there are more people like me that have bad experience from school, and some of us wish to change that, and find new solutions and ways to do things. I don't think you should say that some teachers are good, and others are bad, but that it has to do with the pedagogics around the whole subject (of mathematics) that has changed.*

Both pre-school teachers showed a change in their belief towards mathematics, and my general impression of them is that they had a dynamic approach towards their own professional development. The best teachers are always trying to improve their methods by gaining new knowledge, staying curious and searching for situations where they can attain new insight, as Van de Walle et al. discussed (2015, p.35-36). They had a change in beliefs,

and portrayed motivation to facilitate for positive experiences with mathematics for the children.

### ***6.3 Transfer from pre-school to school***

“The early years of a child are important for mathematical development... What they know when they arrive in pre-school and school, predicts their mathematics achievement for years to come- even throughout their school career. Moreover, what they know in math predicts their reading achievement later.” (Clements and Sarama, 2009, p.1-2). Therefore, the mathematics is a subject beneficial for their performance in school years for both reading and mathematics.

For the pre-school teachers in the interviews, both said that they had a specific “club” or “group” where the school-starters work with specific tasks and activities in order to be better prepared for the transition to school. As Nilsen says 2011, p.50-51), it is important for the school-starters to experience a good transition, and therefore the methods and contents must be familiar from preschool. They do not practice writing and calculating but familiarizing with the structure of a day in school and being more self-dependent. Person A stressed the fact that it is a new environment for the children, and that social competence would be an important tool for dealing with a bigger group of children. They both agreed on that small children could struggle with having a day divided into lessons, and that it would be good to use project-based learning, teaching cross-curricular. A project gives the teacher the possibility to use a variety of activities and methods and eases the learning for the student by giving it several channels to learn from (Dammsgaard & Eftedal, 2014, p.169-170).

None of the respondents from the interview thought that you should exclude certain topics or concepts from pre-school within mathematics. As person B said: “*Mathematics is a subject that the children generally are interested in ... So, we do not limit learning, but take advantage of their interest once it's there, so called «golden moments».*”

If the interest were shown by the children, they would not tell them “You will learn more about that in school” but take advantage of their curiosity and learn about a concept or theme.



## ***7.0 Conclusion***

Previous research mentioned in this thesis have showed improvement in mathematical for children from low-quality pre-schools (i.e. the education of staff, number of children per adult, limited planning and organization) in the shape of levelling the differences from those pre-schools with higher resources by setting aside several hours every week (Rege et al, 2019), or by having low-performing children improve by use of play-based learning instead of instruction-based learning (Vogt et al, 2018).

Other research such as the SMIL-project (Ridar, 2008) or Tromsø-undersøkelsen (Salomonsen, 2007) have indicated the same results, with the general impression of that the children's' mathematical understanding was improved when they arrived in school compared to previous years.

My research focused on the mathematics in pre-schools in a specific municipality in Norway and the beliefs of the pre-school teachers. The questionnaire indicated that the pre-schools could create mathematical situations during the entire day, but that some of the pre-schools do not have a structured plan. None of the respondents had a specialization within mathematics, and that mathematics seemed to be something the pre-school teachers do with the children often, but do not discuss largely the mathematical development with parents. The questionnaire also indicates that each pre-school has their own culture of doing mathematics, given that they would guide each other internally, and not searching for guidance externally.

From my interviews, the outcome is that mathematical awareness was a key point, and that is connected to the beliefs towards mathematics and requires having a positive image. Experiences shape the beliefs, and the beliefs shapes the methods and focus for the pre-school teacher. The adult role and awareness have been indicated to be a major part of the potential for learning, and this confers with previous research and theory listed. The interviews also showed that both person A and B had a positive image of mathematics as their professional view, while showing signs of a negative image as their personal view.

I am satisfied with the interviews conducted, and I think recruiting them voluntarily from the questionnaire gave me respondents interested in mathematics, and thereby more insightful and reflected answers. For the questionnaire, I recommend contacting the pre-schools leader, asking them to distribute it to their employees. In that way, you may not only receive the answer from motivated respondents, but possibly the entire collegiate of the pre-school. For later research, I would highly recommend observation as a method for cross-checking the responses from the questionnaire and interviews to find a common denominator.

It is possible that the children the pre-school teachers have will experience the same negative images of mathematics in the later years of school, but that is the area for another study. For now, I can conclude with that the experiences shapes beliefs, and sometimes the negative beliefs turn into a positive professional belief, as portrayed by the two pre-school teachers I interviewed. My studies indicated that pre-school mathematics consists of play-based learning, where the adult highlights the mathematical content with mathematical awareness. It does not have to be a mathematical goal planned for the activities, but more like when the children do something, the pre-school teacher make them reflect around the mathematical concept, as a way of hidden learning.

I wish to end with a statement I liked from the interview with person A, making me hope that there will be fewer people with negative experiences, images, and beliefs with mathematics:

*I don't think you should say that some teachers are good, and others are bad, but that it has to do with the pedagogics around the whole subject (of mathematics) that has changed.*

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## **Attachment 1- Interview guide for pre-school teachers**

### **Checklist before start of interview:**

1. Inform about the project and purpose.
2. Inform about the structure and themes in the interview.
3. Inform about voluntarily participation.
4. Free to withdraw at any time without having to give a reason and ask that the data collected are deleted/not used.
5. Inform that the material will be anonymized.
6. Ask for permission to record sound. Inform regarding storage and processing of data.

### **Background and information**

A1. How long have you worked in preschool?

A2. What type of education do you have?

A3. Have you had any lessons/education regarding mathematics in preschool? If yes, to what extent? General/specialization?

### **Preschool**

B1. How many children is there in the preschool you work at?

B2. How many of them are in their last year of preschool?

B3. Do you have any type of a “six-year club” for the oldest children?

B4. Is there any change in the working ways/activities for the children that have their last year in preschool?

### **Preschool and mathematics.**

C1. Is there a structured plan for the year in mathematics that you follow?

C2. Can you describe a typical week in preschool for the oldest children with focus on mathematical activities?

C3. Do you have an employee that have the main responsible/initiative for mathematics?

C4. Do you feel that mathematical focus is done on your own initiative, or is it something that are encouraged and backed up by the leader and other employees?

### **Own belief towards mathematics/mathematical subject**

D1. What is the first thing you think about when you hear the term “mathematics”?

D2. What do you associate with the term “mathematical lenses”?

D3. How have your experiences with mathematics been throughout your education and growing up?

D4. Do you see a coherence between your belief towards mathematics and your work with children where mathematics are present?

**Last category:**

**Transition from preschool to school**

E1. What do you think is important to consider for teachers that meet school-starters in 1<sup>st</sup> grade?

E2. What working ways and organization are the most beneficial with 5-6-year olds based on your experience?

E3. Are there some areas within mathematics that teachers should have extra focus on in the beginner-learning?

E4. What type of mathematics do the children learn the most of in preschool?

E5. Is there something you personally think the children should wait until school to be introduced to regarding mathematics?

E6. Do you have any dialogue with teachers in school about the children after they have started at school?

**Summary/final questions:**

F1. Do you have any additional comments or thoughts regarding the theme of the interview?

F2. Is there anything you would like to know more about regarding the research?

Themes that should be covered:

The extent of focus on early mathematics

Perception/belief towards mathematics

Specific working ways/organizing withing mathematics in preschool (numbers, room and shape)



## **Attachment 2- Questionnaire**

### **Part A- 3 questions**

**Here you will be asked about your background and experience from being an employee in pre-school**

A1: What is your gender? (Woman, man, other)

A2: How many years have you worked in pre-school? (Less than a year, 1-3 years, 3-8 years, 8-15 years, 15 years or more)

A3: What type of education do you have? (Pre-school teacher, pre-school teacher-student, children- and youth worker, others, don't want to say)

### **Part B- 3 questions**

**Here you will be asked about mathematics in pre-school, both in studies and at work**

B1: Have you experienced classes regarding mathematics in pre-school? (Yes, normal part in my education, yes, specialization, no)

B2: How often do you have an active and conscious focus on numbers, room and shapes (the curriculum name for mathematics in pre-school) throughout your day? (Daily, 2-3 times a week, 1 time every week, 2-3 times every month, 1 time every month, rarer)

B3: Is there a structured year plan for mathematics in your pre-school that you follow? (Yes, no, don't know)

### **Part C- 5 questions**

**This part gives you multi-selection questions about where and when mathematics is facilitated for in pre-school, both in planning and execution. Tick off all the alternatives that suits you.**

C1: In which situations are there facilitated for mathematics in your pre-school?

- eating, playing, adult-guided play, outdoors, conversations with the children, sharing-time (reading, singing), while dressing, others

C2: In which situations do the staff have a focus on planning for mathematics in the pre-school?

- Year plan, parent-meeting, planning-meetings, courses, others

C3: What access do you have to counselling within mathematics?

- Internal in the pre-school, PPT, Statped, Others, no counselling accessible

C4: Where do you find inspiration for working with mathematics at work?

- Course plan, literature, PPT, Statped, Utdanningsdirektoratet, Internet, others

C5: Do you think there is enough focus on mathematics in pre-school?

#### **Part D- 4 questions (Answering on a Likert-scale)**

**Here comes some claims about you, and you are asked to specify how much the claims are right about you from “Don’t agree at all” to “Agree a lot”.**

D1: I use mathematical terms actively and reflected at work.

D2: I expand the daily situations for children where mathematical concepts and context are visible and present.

D3: I ask follow-up questions to the children after they have used mathematics to see how aware they are of their use.

D4: I think it is challenging to take mathematics down to the childrens level.

#### **Part E- 4 questions**

**Here you are asked about specific aids or other materials that you can use during a day within mathematical thinking (From the course plan “Antall, rom og form”. Select the option that suits you the most.**

E1: I use games to inspire the children to mathematical thinking.

E2: I use books to inspire the children to mathematical thinking.

E3: I use playing to inspire the children to mathematical thinking.

E4: I use digital tools to inspire the children to mathematical thinking.

#### **Part F- 1 question**

**Here you are asked if you are willing to participate in an interview. If this is something you are interested in, please write down your e-mail or other contact information so that I can contact you. Your answers in the questionnaire will not be tied up to the interview.**

F1. Are you willing to participate in an interview in relation to the work around mathematics? The interview will be conducted at your premises in regards of time, place and duration. (Yes, no).

If yes, type in your contact information here (e-mail, phone number etc.)

### Attachment 3- Letter of information with declaration of consent

## Vil du delta i forskningsprosjektet ”*Pre-school mathematics in Norway in theory and practice*”?

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å utforske organisering av tidlig matematikk i overgangsfasen fra barnehage til skole for å se på hva som gjøres innenfor feltet, og hvordan dette kan bygges videre på i overgangen til skole. I dette skrivet får du informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

### Formål

Dette er en masteroppgave hvor formålet til oppgaven er å kunne bygge videre på arbeidsmåter som skolestartere er kjente med, med intensjon om å gjøre overgang fra barnehage til skole bedre. Hovedfokuset mitt ligger på matematiske arbeidsmåter for barna, og hvilke erfaringer og kunnskaper barnehage- og skoleansatte har til matematikk. Foreløpig problemstilling er «**Hvordan er tidlig matematikk organisert i barnehage, og hvordan tilpasses matematikkundervisningen overgangen til skolen?**».

Eventuelle forskningsspørsmål som kan belyse temaet ytterligere er:

- I hvilken grad er det et aktivt og bevisst fokus på matematikk hos barnehagelærere?
- Hva er viktig å tenke på rundt arbeid, tilpasning og planlegging av begynneropplæringen i matematikk i møte med skolestartere?
- Hva bør matematikklærere ha et ekstra fokus på hos skolestartere for å kunne lette overgangen fra barnehage til førsteklasse?

### Hvem er ansvarlig for forskningsprosjektet?

*Nord Universitet* er ansvarlig for prosjektet.

### Hvorfor får du spørsmål om å delta?

Utvalget trekkes ut fra relevans til problemstillingen, der kriteriet er at de jobber med barn i aldersgruppen 4-7 år. Noen blir rekruttert via spørreundersøkelse over nett, og noen vil bli kontaktet direkte.

### **Hva innebærer det for deg å delta?**

Hvis du velger å delta i prosjektet, vil dette gjøres på dine premisser i forhold til tidsbruk. Forventet varighet på intervju vil være på mellom 30-45 minutter, og det vil være frivillig å trekke seg når som helst uten å oppgi grunn. Der vil det stilles spørsmål mer om dine egne holdninger til og erfaringer om matematikk i barnehagen/skolen. Det er ønskelig å ta lydopptak under intervjuet, og opptakene samt all annen data vil oppbevares i henhold til gitte lover og regler for personvern. Lydopptakene vil bli tatt opp av en applikasjon som sender lydfilen til en kryptert nettside hvor kun forsker har tilgang til dem, og de vil slettes like etter transkribering. Under transkribering vil alle identifiserbare opplysninger anonymiseres, og deltaker vil gis et fiktivt navn.

### **Det er frivillig å delta**

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

### **Ditt personvern – hvordan jeg oppbevarer og bruker dine opplysninger**

Jeg vil bare bruke opplysningene om deg til formålene jeg har fortalt om i dette skrivet. Jeg behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

Det vil kun være meg og min veileder på Nord Universitet som vil ha tilgang til alt av datamateriale, og skulle det være at det vil bli lest av andre for analyse av intervju, vil dette først bli gjennomgått for å fjerne alt av sensitiv og personlig informasjon slik at det blir anonymisert.

All data vil bli oppbevart på en ekstern lagring, slik at det ikke kan nås over nett. Her vil og materialet anonymiseres, da navn eller arbeidsplass ikke vil være essensiell informasjon for min forskning.

## **Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?**

Prosjektet skal etter planen avsluttes *15.mai 2020*. Datamaterialet vil gå gjennom og anonymiseres etter at oppgaven vil være levert inn. Lydopptak under intervju vil bli slettet etter like etter transkribering.

## **Dine rettigheter**

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

## **Hva gir oss rett til å behandle personopplysninger om deg?**

Vi behandler opplysninger om deg basert på ditt samtykke.

## **Hvor kan jeg finne ut mer?**

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

- August Steffensen, epost: [august.steffensen@student.nord.no](mailto:august.steffensen@student.nord.no) eller telefonnummer 48176737  
(Student)  
Klaus-Peter Eichler, epost: [mathematikus@mathematikus.de](mailto:mathematikus@mathematikus.de)  
(Veileder, må kommunisere på engelsk)
- NSD – Norsk senter for forskningsdata AS, på epost ([personverntjenester@nsd.no](mailto:personverntjenester@nsd.no)) eller telefon: 55 58 21 17.

Med vennlig hilsen

August Steffensen

Masterstudent på grunnskolelærerutdanning 1-7

Nord Universitet

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## Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet «*Pre-school mathematics in Norway in theory and practice*», og har fått anledning til å stille spørsmål. Jeg samtykker til:

- å delta i *intervju*
- å delta i observasjon

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, *15.mai 2020*

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(Navn)

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(Signert av prosjektdeltaker, dato)

#### **Attachment 4- Approval from NSD**

NSD sin vurdering

Prosjekttittel

Pre-school mathematics in Norway in theory and practice

Referansenummer

883679

Registrert

16.01.2020 av August Steffensen - august.steffensen@student.nord.no

Behandlingsansvarlig institusjon

Nord Universitet / Fakultet for lærerutdanning og kunst- og kulturfag / Kunst- og kulturfag

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Klaus-Peter Eichler, klaus-peter.eichler@nord.no, tlf: 004915776200718

Type prosjekt

Studentprosjekt, masterstudium

Kontaktinformasjon, student

August Steffensen, auguststeffensen@hotmail.com, tlf: 48176737

Prosjektperiode

10.02.2020 - 10.04.2020

Status

10.04.2020 - Avsluttet

Vurdering (1)

20.01.2020 - Vurdert

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 den 20.01.2020 med vedlegg, samt i meldingsdialogen mellom innmelder og NSD. Behandlingen kan starte.

**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://nsd.no/personvernombud/meld\\_prosjekt/meld\\_endringer.html](https://nsd.no/personvernombud/meld_prosjekt/meld_endringer.html)

Du må vente på svar fra NSD før endringen gjennomføres.

## TYPE OPPLYSNINGER OG VARIGHET

Prosjektet vil behandle alminnelige kategorier av personopplysninger frem til 10.04.2020.

## LOVLIG GRUNNLAG

Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. 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 kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes 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 de registrerte 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

Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art.

12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine 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).



Microsoft OneDrive er databehandler i prosjektet. NSD legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

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

#### OPPFØLGING AV PROSJEKTET

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

Lykke til med prosjektet!

Kontaktperson hos NSD: Simon Gogl  
Tlf. Personverntjenester: 55 58 21 17 (tast 1)