Teaching and learning mathematics in India
Abstrakt
Våra tre månader i Indien har resulterat i en studie av olika perspektiv på lärande, inom ämnet matematik. De synsätt på lärande som vi observerade hos de indiska lärarna har kopplats till studiens fyra valda perspektiv; det behavioristiska perspektivet, det kognitiva perspektivet, det pragmatiska perspektivet och det sociokulturella perspektivet. Fältstudien genomfördes i en skola i den södra delstaten Kerala. Elever och lärare på skolan deltog under våra observationer, intervjuer och undervisningsförsök. Vår slutsats är att undervisningen innehöll influenser från alla fyra valda perspektiv, och att somliga perspektiv förekom mer än andra.

Nyckelord
Perspektiv på lärande, Matematik, Problemlösning

Abstract
Our three months in India included a field study of different perspectives on learning the subject of mathematics. The chosen perspectives were; the behaviouristic perspective, the cognitive perspective, the pragmatic perspective and the socio-cultural perspective. The study was implemented with teachers and students at a public school in the state of Kerala, which is situated in the southernmost part of the country. They participated in our observations, interviews and teaching experiments. We sought to ascertain which of the four chosen learning perspectives the faculty and students at the host school use for educating. Our conclusion is that the observed teaching methods had influences from all four chosen perspectives, some more than others.

Keywords
Perspective on learning, Mathematics, Problem solving

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1. Introduction

We have had the privilege to receive a scholarship from SIDA; Minor Field Studies (sida.se, 2013). SIDA has cooperation with the Swedish Government and Parliament. It is a state agency who fights to reduce poverty around the world and work for global development. The scholarship has made our overseas studies possible. The Minor Field studies mean that we will implement our studies in a developing country over three months, focusing on Mathematics.

The reason we wanted to implement our Field studies abroad was threefold; our interest in other cultures, our desire to improve education in developing countries and most importantly, to broaden our perspective on education abroad and at home. The culture of India is multicultural, vibrant and colorful. India is a religious center and many people visit India searching for the "meaning of life”. The degree project expanded our knowledge of learning processes we already knew as well as new ones. Exchanging ideas between two countries on the valuable topic of education has a twofold effect, each country is challenged to defend the way they teach and also to learn from the other. It was important to remain critical so that our skills and attitude as student teachers could develop. We wanted to expose our Indian colleagues and students to group work and problem solving through mathematics. We were interested to find out how they would react to the lessons. Through their feedback we hoped to see how this could correlate to the differing perspectives. Our degree project will present the four perspectives of learning; the behaviouristic perspective, the cognitive perspective, the pragmatic perspective and the socio-cultural perspective and how these perspectives through the choice of approach is manifest in mathematics. Therefore, the aim is to investigate different theoretical perspectives manifested in education with a focus on mathematics.

1.1 Background of India

In the south of Asia you find India. India has the second largest population in the world with 1269 million people. The capital city is New Delhi in the North, however our study took place in Kerala situated in the South. Calicut, the city where we completed our field research, has a population of 500 thousand. The climate in Kerala is tropical. Kerala experiences two extremes, a hot humid season followed by a monsoon period (NE.se, 2000). The monsoon lasts for four months. We arrived in Calicut, Kerala at the end of this period and the climate quickly changed from rainy to dry and hot.

India is a democratic republic with a president and the republic has a Parliament that decides on taxes and laws and also appoints a Prime Minister and a Government. The country is divided into 28 different states. All states have their own Government and Parliament which decides on health, education and agricultural issues et cetera. In 1950, a constitution was introduced which meant that India now had a society based on equality regardless of gender, religion or caste and that discrimination on these grounds are banned (NE.se, 2000). As a result of this, the caste system, known as Varna, has weakened in modern India. Varna is a hierarchy consisting of four different class affiliations that you are born into and they cannot be changed or altered. The majority marry someone of the same caste. It leads to difficulties breaking the caste system (Jacobsen, 2004).
India has a rich culture, especially when it comes to religion. There are many different temples and Mosques. The most famous is Taj Mahal in the North of India. There are also many religious pilgrimage sites. Throughout the history of India there has been mass immigration giving us the multicultural India of today. Hinduism is the main belief system in India, however there are large numbers of muslims, buddhists, christians, sikhs, jains, parsis and hundreds of tribal religions. In India there are two official languages, Hindi and English. Every state has its own language beside (NE.se, 2000). In Kerala the official language is Malayalam. Most of the schools in India teach both English and Hindi and also their own language according to the state where the children are living (Personal communication, October 11, 2013).

A long time ago, people in India needed a system to count and pay for their goods and the modern number system was therefore created. We often say that our present numbering system comes from the Arabic numerals. Dahl and Nordqvist (1994) challenges this claim and writes that the truth is that our modern numbers actually come from India (Dahl & Nordqvist, 1994). The Indian merchants spread their knowledge about their number system to the Arabic world and the Arabic people brought it to Europe. Much later, in the year of 1637 the number system reached Sweden. Before that the Roman numeral system was used (Kuijl & Lindberg, 1999).

1.2 The school system in India

The school system in Kerala is built on four levels: preprimary school (age 4-6), primary school (age 6-12), high school (age 13-15) and higher secondary school (age 16-18). Education is of paramount importance demonstrated by the feast in honor of every three year old child. During this special ceremony Indian children of all different faiths are presented with a pencil, taught to write and begin studying the core subjects of English and Mathematics. There are two types of school in India, Government schools and those owned privately. The Government schools are mostly free of charge, while you have to pay fees to attend private schools (Devagiri CMI Public School, 2013).

India was a British colony until 1947. After independence, India concentrated on building the public education system; even Indian universities and other higher education institutes have expanded. Literacy varies across different states of India. In 2001, the literacy rate in Bihar was only 47 % compared to Kerala where 91 % of the population could read. Today, by the year of 2013, almost everyone in Kerala can read and write however the standard varies greatly between schools. Today there is an investigation in the Parliament of India to introduce a universal compulsory schooling as legislation but most states already have a minimum of five years compulsory attendance (NE.se, 2000). In Kerala, all children have the possibility to go to school. Indians are moving towards a more practical way of teaching preparing its students for vocations (Devagiri CMI Public School, 2013).

1.3 Our school

Devagiri CMI Public School is located in Calicut and it is where we have completed our Field study. The school belongs to the CMI (Carmelites of Mary Immaculate) congregation which currently has 520 schools worldwide. There are 1500 students in our school, ranging from kindergarten age to higher secondary. It is a private, paying
school but there are a few scholarship places for underprivileged children. Class sizes range from 30-50 students. Our school is built on a catholic value system but the students come from different faith backgrounds, which influence the school. The school wants to be inclusive, without any prejudice towards students or staff of different castes, gender or creed. The compulsory school age is four (Devagiri CMI Public School, 2013). All subjects are taught in English, except Hindi and Malayalam lessons. The school wants to maintain an open, inviting atmosphere through various activities as dance, art, music, physical education, chess, skating and yoga. The main goal of the school is to create students that are intellectually competent, psychologically integrated, socially acceptable leaders, spiritually mature with good physical health and good moral standing. Devagiri CMI Public School does not want students to merely survive but wishes for each student to make great improvements.

The school is financed by money from the students' families. The school has economy in order to assign scholarships for families who otherwise would not have been able to place their children in this public school. Devagiri CMI Public School is a private school that follows the CBSE (Central Board of Secondary Education) syllabus. CBSE is found in both Government schools and Public schools and is controlled by the Government of India. CBSE decides which books all Indian schools will use in their teaching. At local level, the school is governed by CMI and the headmaster of the school. Every year CMI hands out a handbook to all the teachers and students in their schools. The handbook is including the school's goals and purpose, statutes and regulations that apply to the school. In the book there is also an annual calendar as well as a parenting guide for parents. According to the handbook, the goals achieves through"teachers who are committed to their vocation, professionally competent, morally upright, just and humane in dealings” (Handbook 2013-14, 2013:10, own translation). Their goals also include a hope for cultural sense among the students and that they will value education. According to the handbook, the school's motto is: Pro Deo Et Patria - For God and Country (Devagiri CMI Public School, 2013).
2. Purpose and Research questions

The aim of this degree project is to investigate different theoretical perspectives manifested in education with a focus on mathematics. Our degree project will present four perspectives of learning; the behaviouristic perspective, the cognitive perspective, the pragmatic perspective and the socio-cultural perspective and how these perspectives through the choice of approach is manifested in mathematics. These perspectives are the foundation of many western schools today and in history. The chosen school is Devagiri CMI Public School. In partnership with this school we will describe and explore the above mentioned theoretical perspectives on mathematics.

2.1 Research questions

• How was teaching organized, in relation to the four perspectives on learning?

• What factors motivated students to study mathematics?

• How did teachers and students find the self-teaching attempts, carried out by the Swedish student teachers, regarding students' ability to learn mathematics?
3. Theoretical background

In the theoretical part of this degree project we will explain four different perspectives of learning. The concepts will be examined through the subject of mathematics. We will focus on the main perspectives that have been prominent in the Swedish school in the last one hundred years. Teachers' didactic way of teaching is often influenced by several different perspectives but this essay will focus on the main perspective that many teachers employ in their classrooms. The main aim of a school is to educate its students. In what way, what the students learn may partly be due to the perspective that a teacher uses. Learning is happening in all classrooms; however effectiveness of learning will vary. Teachers' didactics affects all areas of learning including mathematics. One approach within mathematics is problem solving, which is a way of teaching that we want to explore in this theoretical part. Finally, choice of perspective and approach of teaching mathematics are linked together, a relationship that will be explored and expanded through this study.

3.1 Perspective on learning

In the last one hundred years there have been several different theoretical perspectives that have been dominant in how we believe people learn. Håkansson and Sundberg (2012) writes that a number of different classifications of these perspectives can be done but that Säljö's and Lundgren's classification in the book Learning, school, education (2012) explains the Swedish school history in a good way. It is also the classification that student teachers in Sweden today may have access to during their training. The classification is based on four perspectives; the behaviouristic perspective, the cognitive perspective, the pragmatic perspective and the socio-cultural perspective. The perspectives are one of many factors that may influence how school is organized. The behaviouristic perspective has been the dominating perspective for a long time in psychology and pedagogy. The perspective was widespread during the 1900-1970's and had no competition until the 1950's. This time scope, the other perspectives can not compete with (Håkansson & Sundberg, 2012).

To answer the question of why people develop as they do usually requires more than one perspective. Examining the different perspectives in light of each other provides an entity. They are like pieces of a puzzle that help us understand the process of learning (Hwang, 2003). The understanding of learning has varied through time and has been created by the theoretical perspectives that have been most prominent. Generally, learning is seen as something positive and the fact that children learn is considered as something good. One view is that"if people learn more, society will be better” (Lundgren, Säljö & Liberg, 2012:142, own translation).

3.1.1 The behaviouristic perspective

An original thought within the behaviouristic perspective is that the whole life is a way of life long learning and that the environment is important in this learning process (Hwang, 2003). The perspective has an empirical approach to learning and emphasizes the importance of experience for knowledge to arise (NE.se, 2000). In the early 1900s, scientists began to study outside factors that affect behavior because they thought that psychology needed to become more measurable. The focus of the studies was centered on the process of how humans and animals learn. The measurable
includes what is visible, such as behaviors. Thoughts and feelings are considered invisible and therefore not measurable or interesting to study within the perspective (Hwang, 2003).

The behaviouristic perspective has specific laws for different behaviors. Many concepts were developed that made these laws visible. One of the concepts is instrumental conditioning. The meaning of this concept is that certain behaviors a human display create certain responses in his surroundings. If the response is good providing positive reinforcement it leads to that the human will continue displaying the good behavior, in hope of receiving the same response. The idea of reward and good consequences thereby controls our behavior (Hwang, 2003).

Two extremes within instrumental conditioning are positive reinforcement and negative reinforcement. Positive reinforcement can be a reward, like a good rate or encouragement. Negative reinforcement means that something unwanted happens, like punishment, and thus it can be taught that "something negative ends by doing right" (Hwang, 2003:32, own translation). Reward is considered, according to the behaviouristic perspective, as a way to motivate students. Negative reinforcement such as punishment does not reveal any alternatives to the unwanted behavior. In contrast to a punishment a reward demonstrates how the students should behave. An other concept within instrumental conditioning is extinguishment. This means that a particular behavior can be extinguished if a response never comes. Today learning can take place even without direct reinforcement. In that case students can learn by observing others and thus learning occurs on the basis of people in the students' environment. In this way students learn both positive and negative things through observing others in their social circle (Hwang, 2003).

The behaviouristic perspective and school

"The more you remember, the better you are at learning” (Doverborg, Qvarsell & Samuelsson, 1987:18, own translation). In this way practice and rehearsal are preconditions for skills. Memorization is a learning approach that has been practiced throughout all ages. The approach is still present within school and it arose before the written language existed. People spread knowledge further by repeating stories that were taught through memorization. Learning was passed from generation to generation in this way (Kroksmark, 2011).

Teachers can make use of instrumental conditioning to achieve the desired behavior of their students. This is one part of the interaction, within the behaviouristic perspective, that takes place between teachers and students. Håkansson and Sundberg reports that desirable behaviors can be learned through reinforcement and that bad behavior can change or alleviate by changing the environment and thus developing the student (Håkansson & Sundberg, 2012). If development is based on reinforcement, every student has the ability to learn every subject whatever social background they have. Anyone can learn advanced skills (Lundgren, Säljö & Liberg, 2010).

Lundgren, Säljö and Liberg (2010) describe the behaviouristic perspective where knowledge is seen as something divided into small parts. Each part must be accomplished before the students may proceed to the next part. Every part of teaching
is like a brick, which together are assembled together into a whole. When the students
give a correct answer the teacher offers positive reinforcement through feedback, as a
confirmation. If the answer is incorrect the student has to redo the task (Lundgren,
Säljö & Liberg, 2010). Good learning and motivation are created when students
regularly receive feedback. Teachers' role in the behaviouristic perspective is to create
good conditions for learning by motivating students (Stensmo, 2008), and to impart
knowledge to their students. The products of different tasks are given great
importance in the perspective. Since the product is measurable, unlike the process, it
is more important than in the three other perspectives. Throughout the product it may
be measurable and visible what knowledge the students actually have (Arfwedson &
Arfwedson, 2002). All students get the same knowledge through collective
intermediation, and the students are seen as recipients of knowledge (Carlgren,
1999).
According to the behaviouristic perspective knowledge is not about cognitive
abilities, such as understanding and reflection, it is about learnt behaviors and
memorization of knowledge (Lundgren, Säljö & Liberg, 2010). A typical learning
situation, within the perspective, is that students answer the teacher's questions and
listen to the teacher's explanations. The students also work on the tasks that the
teacher hands out (Fuglestad, 1999).

During the 1950s strong criticism of the behaviouristic perspective occurred and the
cognitive perspective came as an alternative and became revolutionary. The
behaviouristic perspective was considered too narrow and focused too much on the
external behaviors a human being exhibited, instead of seeing the internal features
(Håkansson & Sundberg, 2012).

3.1.2 The cognitive perspective

During the 1950s, a new approach to learning and development was found, known as
the cognitive perspective, as a counter-revolution against the behaviouristic
perspective. It peaked in the 1970s and the 1980s. The big question was: "what
happens in the brain when we learn?" (Håkansson & Sundberg, 2012:58, own
translation). Within this perspective, the way humans think is in focus, and it is
through the human capacity to reflect that development and learning can be made
possible. Details in focus are understanding, problem solving, concept formation, and
how an individual can remember things (Lundgren, Säljö & Liberg, 2010).

The cognitive perspective has a rationalistic approach to learning and knowledge.
Rationalism as a concept is derived from the Latin word "ratio" which means sensible.
A person with common sense can think, analyze and understand the world. Persons
with common sense can also learn from their own life experiences and also learn from
other peoples' insights and mistakes (Lundgren, Säljö & Liberg, 2010). Also Hwang
points out humans as conscious, thinking and rational according to the cognitive
perspective. Humans shape their world view based on experiences as well as with an
active search for knowledge (Hwang, 2003). Rationalism claims, in opposite to
empiricism, that knowledge is based on the human sense. Therefore, the cognitive
perspective claims that humans need to have a sense to organize impressions into
knowledge (NE.se, 2000). This demonstrates a significant difference in comparison
with the behaviouristic perspective, since the cognitive perspective not only
underlines the importance of experience but also an ability to analyze these
experiences (Lundgren, Säljö & Liberg, 2010).
Within the cognitive perspective intelligence tests became increasingly prevalent, because a person's development is largely based on human cognitive abilities. The first intelligence test was designed to categorize students based on cognitive abilities and "those children who did not have the ability to cope with the public school would be identified and placed in special schools" (Lundgren, Säljö & Liberg, 2010:155, own translation). The cognitive perspective wanted to do the thinking measurable by intelligence tests. Later on, other kinds of intelligences were proposed as measured of cognitive ability, including the emotional intelligence that is more about feelings (Lundgren, Säljö & Liberg, 2010). One of the main issues in the cognitive perspective is how students reason and think logically in their process of finding answers to different tasks (Lundgren, Säljö & Liberg, 2010). Within the perspective, students' thinking develops on the basis of age and intelligence. The stages are like a staircase where the premise is to take one step at a time to climb (Hwang, 2003). According to the cognitive perspective there is an intellectual maturity level that forms the basis of which stage an individual is on. If a student does not understand a concept it is because the student is not ready for this level and the teacher must then wait for the student's maturity. If a student understands the concept then the student has reached the stage where learning can take place. An educator's role is then to help the student in the learning process by providing information at the right level (Lundgren, Säljö & Liberg, 2012).

The cognitive perspective and school

The students' different needs and how all students in the class learn individually in the best way, is in focus within the cognitive perspective. A student with good verbal skills can be taught in a different way from a student with good visual skills. The student with visual skills can usefully be taught by using pictures, while this is not as important for a person with verbal ability. Teaching fully adapted to each student's abilities and potential can in some way be difficult to apply because of practical reasons with today's large classes (Lundgren, Säljö & Liberg, 2010). All students should learn the same knowledge but how knowledge is learned and what time required for each student is individual. The new knowledge that the students are given is based on existing knowledge that the students already possesses. During the learning time it is important that students may reflect on their thoughts, and that they obtain a better understanding of how they as individuals learn the best way (Dysthe, 2003).

Within the cognitive perspective students gradually develop knowledge. "Children think logically and have advanced thoughts, but their minds are still different from a mind of an adult. They need to develop at their own pace and make experiences" (Lundgren, Säljö & Liberg, 2010:168, own translation). Teaching should be stimulated through self-guided activities for students, as well as group work where students can develop together. Students are encouraged to active participation (Lundgren, Säljö & Liberg, 2010). This way of teaching can encourage students to seek knowledge and give desire to learn more (Egidius, 2005). Students then become more engaged in various activities and an internal motivation within the students may arise (Dysthe, 2003). Through activities, students receive the opportunity to actively construct their knowledge on their own (Lundgren, Säljö & Liberg, 2010). To motivate students, teachers have to adapt their teaching to the abilities, needs and interests that the students have (Stensmo, 2008).
It is important that teachers help their students to think independently and logically (Egidius, 2005). Otherwise, adults can be a barrier to students' natural development. Students should be allowed to develop learning by discovering the world through their own level of understanding and by making their own research. The teacher's role, within the perspective, is to be a support for the students in a professional manner by motivating the students to continue their learning. It is up to each student to take responsibility for acquiring knew knowledge (Lundgren, Säljö & Liberg, 2010).

Assessment is based on the process during activities, and the product is not seen as the most important (Dysthe, 2003). Thoughts about an assessment within the perspective are more in line with the view of an assessment in the pragmatic perspective and the socio-cultural perspective. Interaction with others is also seen as important in the cognitive perspective because it provides the students the opportunity to develop ideas and strategies to solve problems. However, the emphasis it not as much on the social interaction as in the pragmatic perspective and the socio-cultural perspective. The social interaction is within the cognitive perspective only a help to individual learning (Arfwedson, 2002).

3.1.3 The pragmatic perspective

The pragmatic perspective aims to anchor the learning in people's everyday situations. True knowledge, according to the perspective, is the knowledge that is possible to achieve in real life. A basic thesis in this perspective is that knowledge can be seen as those things people can practice in their daily lives. Knowledge can be useful when you meet trouble in life and when you have to handle the various life situations. Knowledge is theory and practice interconnected. To practically build a house requires both theories and practical knowledge on how to build the house for the results to be permanent (Lundgren, Säljö & Liberg, 2010). A concept within the perspective is learning by doing, which involves combining knowledge with action. This is, according to the perspective, the best way for good learning (Lundgren, Säljö & Liberg, 2010). The pragmatic perspective, and so even the cognitive perspective, claims that students learn best by being active explorers and by being curious through trial and error (Hwang, 2003).

Within the pragmatic perspective there are two different ways of looking at learning. One way is when students only obtain information and facts. The second way is that students learn something which they can apply to previous experience and, by going deep into a subject, taught to think and reason about knowledge. Knowledge must be rooted in context and in the students’ realities and the pragmatic perspective focus on the process of the task. That differs from the behaviouristic perspective, where the product of the task is in focus because it makes knowledge more measurable (Lundgren, Säljö & Liberg, 2010).

The pragmatic perspective and school

The pragmatic perspective underlines that school's main mission is to shape democratic citizens by preparing students to become competent members of society. Teaching shall provide tools for students to be involved in the development of society as adults, both in terms of knowledge and socially. The pragmatic perspective considers that knowledge taught in school should be as real for students as the knowledge they learn in the playground or at home. Lundgren, Säljö and Liberg
explain that knowledge is not only relevant for the future, but should also be applied in students' current situations. Some students sometimes have difficulties to understand the purpose with the lesson, it can be a barrier for them to feel motivation. Therefore, teachers have an important role to highlight why knowledge is important to have in real life (Doverborg, Qvarsell & Samuelsson, 1987). Learning is not only found in school, learning processes are also found generally throughout life (Alerby, Johansson, Kansanen & Kroksmark, 2000). Both students and teachers are seen as path to knowledge. Such school is opposed to the behaviouristic perspective where teachers are seen as authoritarians and the main view is that all knowledge comes from the teachers (Lundgren, Säljö & Liberg, 2010). Educators' primary task within the pragmatic perspective is to build on the experiences the students already have, and thus lead students forward in their knowledge and development (Doverborg, Qvarsell & Samuelsson, 1987). The approach is about communication. Language becomes the main tool for the students so that they together can have extended experiences and knowledge, which is comparable with the socio-cultural perspectives thoughts of communication. With language as a tool, knowledge can be formed by discussion and argumentation. That is the basis for how the lessons are organized within the pragmatic perspective. The educators' role is therefore to create teaching from the students' experiences and questions, which leads to an increased knowledge (Lundgren, Säljö & Liberg, 2010). Even Jensen highlights the importance of communication for learning to be experienced meaningful and to give students motivation to learn. Communication is the basis for learning and for forming democratic citizens. Communication should be visible in all school subjects and not just in a few ones (Jensen, 2011).

The pragmatic perspective claims that education should be about problem-based learning where students themselves are involved and where the problems will be developed by the students themselves. The problems would be based on the students' curiosity and wonder, when students solve problems both learning and motivation occurs (Lundgren, Säljö & Liberg, 2010). The school's teaching and education will be connected to the students' daily lives. Knowledge is supposed to be linked to the individual, society and culture as an integral part of human life (Håkansson & Sundberg, 2012). Mathematics, for example, can be made concrete by teaching outside of the classroom (Hwang, 2003). The pragmatic perspective and the socio-cultural perspective have some similar statements about learning and teaching, but the perspectives are still different from each other. The pragmatic perspective did not at first get such an impact in the Swedish school but was more prominent in research. The impact of the ideas within the pragmatic perspective first came when the socio-cultural perspective became current in Swedish schools during the 1990s (Håkansson & Sundberg, 2012).

3.1.4 The socio-cultural perspective

The socio-cultural perspective derives from Lev Vygotsky’s studies of humans’ development, language and learning. He had a conviction that the socio-cultural and biological belonged together. The two most important factors for learning within this perspective are language and thought, and these two are linked because they are interdependent. Lundgren, Säljö and Liberg (2010) writes that development and learning is about developing skills such as counting, problem solving and abstract reasoning. All people use different tools to understand and act in the surrounding
environment. Such tools can be counting system, letters, physical tools or various technologies. One characteristic of humans is that we think and reflect, thus using these tools. Many of these tools are rooted in the cultural community through fellowship. Tools like counting system and letters are not natural tools that will arise by themselves, but they are formed out of the traditions that a person grows up in (Lundgren, Säljö & Liberg, 2010).

When the socio-cultural perspective increased, the behaviouristic perspective was seen as prominent its view of development and learning. According to the socio-cultural perspective, the behaviouristic perspective did not explain well enough about how these processes are function to humans. The socio-cultural perspective claimed, like the cognitive perspective also did, that abilities such as advanced problem solving, creativity and deep thinking could not be understood by the behaviouristic perspective principles of instrumental conditioning. Many representatives of the pragmatic perspective and the socio-cultural perspective focus language as the most important of all tools. Communication between people is the most important tool of them all, within the socio-cultural perspective. Communication is found in all four perspectives but becomes visible in different ways, through interaction between teachers and students. However it is given differing importance of communication as a tool for learning (Lundgren, Säljö & Liberg, 2010).

The socio-cultural perspective and school

Each student develops constantly and acquires learning throughout life. Lundgren, Säljö and Liberg (2010) write that learning usually takes place when students get to know cultural tools in meetings with other people, parents, classmates and teachers. Everyday concepts and scientific concepts differ from each other. The everyday concepts are those that every person learns in everyday interactions with other people. The scientific concepts are more abstract and require explanations to be understood, and the school can be seen as an instrument for the acquisition of such concepts (Lundgren, Säljö & Liberg, 2010). According to the socio-cultural perspective, social interaction is considered to be the main driving force for students to develop. In practice, social interaction with others is forming students' ideas and verbal ability. The teaching is based on dialogues where all students have the ability to raise their voice. Teachers' role in the dialogue will be to explain and ask questions that lead to new thoughts. To make social interaction work well in a classroom it is important that all participants take responsibility for creating a good environment, where respect for each others differences take place (Williams & Pramling, 2000). The perspective claim that a good learning environment and that students are stimulated to actively participate is crucial for the students' motivation to learn. Within the perspectives the students are made involved in the assessment process, and the assessment are seen as something ongoing (Dysthe, 2003).

Learning occurs through interaction with others and the students shall, in accordance with the socio-cultural perspective, be challenged in their learning with support of a knowledgeable person. "Initially the knowledgeable person provides a lot of support, but gradually the aid can slow down and eventually cease when the learner masters the skill" (Lundgren, Säljö & Liberg, 2010:192, own translation). With too much support the students risk to become passive in their learning and the goal of education is that the teacher should adjust assistance on the basis of the students' needs. Thus,
the students gradually take more responsibility for solving problems (Lundgren, Säljö & Liberg, 2010). Through increased responsibility students can be motivated to continue their learning. A great concept within the perspective is the zone of proximal development, which represents a challenge for students when teaching all the time is slightly ahead of the students' existing knowledge level. Hwang (2003) points out that student, within their zone of proximal development, need challenge and in the same time it is important that the requirement of the students does not become too big. If students are not being challenged enough or experiencing high demands, the risk is that the students' motivation to learn disappears. It is important that there is a more experienced person who can provide support to the students. The supporting person of the students' development will act as a scaffold to the house of knowledge gained (Hwang, 2003).

3.2. Problem solving

Students learn in different ways, therefore, the teacher requires paying attention to students’ differences and thus making use of various learning styles (Egidius, 2005). Variation in the choice of practices is important, but Sollervall writes that no definite approach is right (Sollervall, 2007). Something that stimulates creativity and facilitating learning is that teaching is challenging, inspiring, and that it is diverse (Håkansson & Sundberg, 2012). One way to achieve this can be by working with problem solving (Doverborg, Qvarsell & Samuelsson, 1987). Mathematical problems can be solved in various ways and one of them is through Polya's (1970) four stages. The first step involves understanding the problem and the task. The second step is a matter of planning the execution. The third step is then to carry out the plan from step two, and finally executed. The fourth step means that the learner reflects and controls the results (Polya, 1970). After completing problem solving, it is important that students get to reflect on how they performed the task, and how work can be improved for next time (Doverborg, Qvarsell & Samuelsson, 1987). Taflin mention three factors that are critical to develop in the process of problem solving. The three factors are; 1) "Students have to solve many problems in order to improve their problem solving skills. 2) Problem solving ability develops slowly and over a long period. 3) Students need to believe that their teachers think that problem solving is of importance" (Taflin, 2007:38, own translation).

Three main criteria for a task to get defined as problem is that”the problem shall introduce important mathematical ideas or some solution strategies”,"the problem should be easy to understand and everyone should have an opportunity to work with it”, and that”the problem shall be perceived as challenging, requiring effort and allowed to take time” (Hagland, Hedrén & Taflin, 2005:54, own translation). Problem solving lacks provided procedures, because the procedure is supposed to be unknown for the students. The opposite pole to problem solving within mathematics is "routine tasks" where the methods are already known to the students and where skills training are trained (Taflin, 2007). Problem solving can be used for all ages, regardless of students' previous knowledge. The teacher therefore needs to select the task, in light of the student's precondition. It is important with a knowledgeable guide, and a challenge within the zone of proximal development, that socio-cultural perspective stands behind (Hagland, Hedrén & Taflin, 2005). If the tasks are not at the right level the teaching can become a barrier to learn (Lundgren, Säljö & Liberg, 2010). Problem solving requires a lot from teachers, both subject knowledge and didactic knowledge
about how problem solving is taught (Hagland, Hedrén & Taflin, 2005). The teacher's role is to lead mathematical discussions where students get to present and discuss their solutions. According to Taflin’s (2007) study, students risk to leave the classroom with false ideas if joint review is missing after completing the task. The teacher's role will be to lead and highlight everyone's individual competencies so that all students' thoughts together can create a mathematical symphony (Taflin, 2007). Teachers' knowledge and material resources are critical to how teaching is organized, because teachers can only give out of what they have. Besides knowledge and resources it is also important whether teachers and schools are willing to develop new approaches (Schoenfeld, 2012).

Problem solving involves the process leading to the answer and not just the answer (Taflin, 2007). Problems that are useful in school are the problems that the students can connect to everyday situations, so-called "everyday problems" (Löwing & Kilborn, 2002). For some students mathematics is visible in everyday life while other students are growing up with the image of mathematics being invisible in society (Dahl, 1991). There are different ways to work with problem solving, both individually solving and reflecting on a problem or discussing and solving problems in groups (Hagland, Hedrén & Taflin, 2005). Interaction with others is an important part of problem solving (Taflin, 2007), and this approach aims to make students active and involved (Doverborg, Qvarsell & Samuelsson, 1987). When students perform work with problem solving the idea is that they should choose an appropriate method. These methods are the choice of calculation method and the choice of strategies such as searching patterns, drawing pictures or making a chart (Taflin, 2007). The purpose of problem solving is to help students develop their ability to think independently and creatively as well as thinking logically and structured. Through problem solving students can develop strategies that can be used throughout life (Hagland, Hedrén & Taflin, 2005).

Approaches like problem solving have been criticized because it made goals and results difficult to measure, using group projects and discussions (Boaler, 2011). When problems connected to the students’ everyday life are used in school curriculum students can find it difficult to see mathematics connection to the problem, and what method of calculation should be used. If students do not understand the connection, problem solving can become a barrier to learning mathematics. This makes the choice of problems crucial, and a great responsibility lies on the teacher, which sometimes makes it easier to select other ways of teaching than through problem solving. Another difficulty may be how the classroom should be organized for teamwork and discussions to function. Problem solving can provide space for group sessions where students become each other's resources and help. If the problems are connected to real life, students can use their knowledge to solve problems in other situations and of a different nature, resulting in a bigger general competence. Part of the process of problem solving is about learning to formulate and creating own problems. The problems can be made complicated for those who need to be challenge in their creativity. Students can also create task similar to the ones they have experienced before. How students cope with problem solving may depend on how experienced they are at the approach (Taflin, 2007).
3.3 Review summary of the Theoretical background

Based on the behaviouristic perspective students would learn through memorizing and by using instrumental conditioning. The cognitive perspective underlines the importance of the individual's search for knowledge as a prerequisite for learning because all students learn differently. The pragmatic perspective focuses on interaction with others and to connect teaching with students’ everyday lives. The need for interaction is also central in the socio-cultural perspective and it is through interaction knowledge is constructed (Lundgren, Säljö & Liberg, 2010). The four perspectives appeal to different teachers and school types, thus one can see elements of all perspectives in different schools worldwide (Doverborg, Qvarsell & Samuelsson, 1987). What is considered to be the right values and norms in society creates a picture of what valuable knowledge is. Through that, different theoretical perspectives on learning are created. It is in the interaction between teachers and students the current perspective become real and will have consequences (Lundgren, Säljö & Liberg, 2010). Hwang points out the importance that teachers have the knowledge of the perspectives, because it gives understanding for the reality and tools to be able to manage it (Hwang, 2003).

The knowledge and skills within mathematics can be useful in everyday life (Johansson, 2004). Sollervall writes that the importance of mathematics education must be visible for the students, to achieve motivation (Sollervall, 2007). For good learning to occur, motivation is of great importance, but depending of perspective motivation is created in different ways. One way to achieve motivation within mathematics is through problem solving, because that approach aims to make the students involved in their own learning process (Doverborg, Qvarsell & Samuelsson, 1987).
4. Method

A study can be based on qualitative or quantitative study area. Depending on the nature of the survey observations and interviews can be done in various ways. Our study area has a qualitative character. Therefore, our observations (appendix 1) and interviews (appendix 2) are based on methods suitable to this purpose. We have chosen three different survey methods to answer our questions. The methods chosen are observation, interview and self-teaching attempts (appendix 3, 4, 5).

There are two different methods to use that Johansson and Svedner (2010) describe; the qualitative method and the quantitative method. Observations based on quantitative survey areas could be tallying accuracy in basis points, and the outcome results in figures and tables that can be clearly read. An observation where the study is qualitative in nature means that observations are interpretable and can be performed by, for example, diary entries and operating protocols (Johansson & Svedner, 2010). The observations were carried out through diary entries, since the study was qualitative in nature.

We have also chosen to use interview method based on varied and open-ended questions without obvious answers, which did not follow a specific schedule during the interviews. The open-ended questions allowed relevant follow-up questions that did not have a predetermined order. An interview like that is like a conversation with a common thread and a specific subject. Johansson and Svedner write that if the research area is of qualitative character, this is the best way to perform the interview (Johansson & Svedner, 2010). Trough self-teaching attempts we wanted to find out what the teachers and the student thought of our way of teaching. We wanted to investigate whether the teachers felt able to implement our way of teaching problem solving and if the students benefitted from the new approach to learning mathematics.

4.1 The selection

Through the University of Lund, we got a contact person in the city of Calicut. Our contact person in Calicut helped us to find a school by two criteria: that teachers and students would be able to speak English and that the school was a primary school. We did find a school that corresponded to these criteria, namely Devagiri CMI Public School with their 1500 students. Through this degree project, we wanted to study mathematics education at our field study school. Both observations and interviews were selected to see the different grade levels and teachers of different ages, with different backgrounds and approaches. We also wanted to interview both boys and girls among the students as well as male and female teachers.

We observed 12 different classes from kindergarten up to 8th standard. Number of lessons in the different grades varied and in some classes, we observed only one lesson while in other classes we observed several times. There were three classes in each grade. The teachers interviewed were teachers that we had previously observed, and were 10 in number. We desired a selection of teachers from different backgrounds, teaching different subjects and in different ages. We hoped to interview both male and female teachers. Nevertheless we only interviewed one of three male teachers. On the other hand, there were only female teachers available; therefore, we interviewed one male and nine female teachers. We also interviewed 12 students,
from 3rd, 5th and 8th standard, about their views on learning. After completing observations and interviews, we compiled the material. From there, we made complementary observations and interviews among some teachers that we previously observed and interviewed. We carried out the new observations during four lessons and asked some complementary interview questions to four teachers. The supplements were made in order to clarify our materials to better answer our research questions. During a week, we conducted five self-teaching attempts. We carried out the lessons based on problem solving in 5th standard. The grade was chosen by us since we considered it being an appropriate age for our problem solving tasks. During the first lesson, there were only boys attending, and after that we wanted to get both boys and girls, which we achieved. We asked for 20 students and the students were selected by the teacher. What class we wanted to come back to, we could wish for, in this way we were able to partially control the selection. Group interview regarding our lessons was done in the class where we had several self-teaching attempts.

4.2 Choice of methods

We have chosen three different survey methods to answer our questions. The methods chosen are observation, interview and self-teaching attempts.

4.2.1 Observation

The ability to observe should be a professional skill that all teachers have and use. Björkdahl and Dimenäs (2007) write that the reason for working educators to observe is to see how students develop in the classroom regarding their learning. There are two main ways to perform observation; either a continuous observation from the class teacher or an observation based on the specific area the teacher wants to study more closely. Regardless of what method teachers are using, the documentation is important. It is important that teachers can observe which is something that we will do in our entire professional career as teachers. In our degree project we have been focusing on performing observations based on a survey with qualitative character. We did that by taking notes in the classroom that we then analyzed. Our observations were based on the nine points that Björkdahl and Dimenäs (2007) recommends. From these points, we created an observation schedule (appendix 1). Björkdahl's and Dimenä's observation points are about studying the environment, actors, objects, actions, activities, events, time, goals and emotion (Björkdahl & Dimenäs, 2007).

Johansson and Svedner (2010) state that the observation may seem difficult to implement, unlike interviews or surveys. They write, however, that observations are a good implement, when it comes to studying the behavior of students and teachers as well as in studies of educational processes. Through our investigation, we have studied the educational processes and therefore we chose to observe. A good method is to study the educational process in reality where the process takes place (Johansson & Svedner, 2010). It is through classroom observations that you can see how the teacher's goals and objectives for the lesson are actually put into practice (Löwing, 2006). Observation is, according to Backman a good way to collect empirical data to study reality (Backman, 1998). That was the reason why we chose this method.
4.2.2 Interview

Interviews can be an addition to observations in order to gain a broader picture of reality. The results of the observations made can be confirmed or disproved through interviews and vice versa. In this way, the interview provides more validity to the observations (Johansson & Svedner, 2010). Therefore we have chosen to combine observations and interviews to make validity greater.

It is important that the interview is not controlled by leading questions, and Johansson and Svedner (2010) state that there is a risk with this kind of interview. The risk is that the interview is either transferred to a structured interview with closed questions or becomes a regular conversation without specific subject or theme. Therefore, we have tried to ask open questions during the interviews. One technique that can be useful during the interview is to give feedback. Summarizing and retelling the answer brings clarity. It makes sure that both the interviewer and interviewee have fully understood the question/response and often provides further details and development. We have used this technique during the interviews. Johansson and Svedner (2010) also write that it is important to ask the right kind of follow-up questions. Further they claim that it is to prefer to ask the interviewee to talk about his or her own experiences or their concrete practices related to the relevant interview theme. Good questions might be: How? When? Where? or to ask the interviewee to give examples of his or her everyday life. We understood the importance of trying to set the right kind of questions. We tried to practice that when we compiled our interview questions as well as in our spontaneous follow-up questions during the interviews. After the interview, it is helpful to observe again, observations that match the interview with the reality. Johansson and Svedner (2010) state that a risk that when interviews are being made, the interviewer unwittingly demonstrates what he or she expects as a reply. Another risk is that the opinions and thoughts that the interviewer may have about the interview theme can shine through during the interview (Johansson & Svedner, 2010). We were aware of the risk Johansson and Svedner mention and tried to avoid showing our values to the interviewee.

During an investigation of a qualitative character, interviews along with observations is a method commonly used in studies of this kind, according to Johansson and Svedner. Then the study can receive a fruitful outcome that can be analyzed and discussed in order to provide answers to the questions examined (Johansson & Svedner, 2010). Interview is a great way to get to know the students and the informants and thus get an understanding of how they think and value the school and teaching. In this way the educator can design their teaching with students' best interests at heart (Björkdahl & Dimenäs, 2007).

4.2.3 Self-teaching attempts

Within the Swedish teacher training we are, among others, influenced by the socio-cultural perspective and we therefore decided to implement self-teaching attempts where students solve problems in groups. Problem solving can be used both in groups and individually (Hagland, Hedrén & Taflin, 2005). The reason we chose to implement problem solving in groups was that students would get together to reflect
and discuss solutions to problems. Another reason was that through observation we had only seen the individuals working in the classroom, and therefore, we wanted the students to try out a different approach.

We chose tasks that we thought would encourage the students to think creatively, logically and independently. Hagland, Hedrén and Taflin write that this leads to increased motivation and that students have the opportunity to develop strategies that can be used in everyday situations (Hagland, Hedrén & Taflin, 2005). We chose problems that we thought the students could connect to their daily lives, to make lessons more meaningful and applicable to their everyday lives. Ahlberg and Wallby write that when students are used to meet varied tasks they can be challenged by create their own tasks. It requires students to think creatively and to use past experience and knowledge (Ahlberg & Wallby, 2000). We had limited time but still wanted the students to try creating their own task. Therefore, students were creating their own problem tasks even though they were not used to this kind of approach. Our survey method was that we used three different problem-solving tasks as well as we let students create their own problems.

4.3 Ethical aspects

For research involving humans it is of paramount importance that these people are treated with respect and that nobody is harmed in any way. The Human Rights (FN.se) declared in the UN Declaration, can be seen as the foundation for the ethics of human equality that is important to apply in research. Whether we are aware or not about the ethical considerations they will always be there and affect our daily lives (Björkdahl & Dimenäs, 2007). What we have observed, and the information gained through interviews, we have dealt with privacy. Information has not spread to either the headmaster, or to other teachers or students.

If the interviewee does have questions regarding the purpose or the survey he or she shall have the opportunity to ask questions and be answered according to truth. Many teachers asked about the purpose of the study, and we responded according to the truth. No one should have to worry about being able to be recognized in the study and all should have the opportunity to cancel their participation at any time, and know that this does not bring negative consequences. Some teachers felt concern both during observations and interviews that “negative” information would be spread further to the headmaster. However, they asked us to speak well of them to him. We kept neutral and gave no information to the headmaster of the school. When sensitive issues, which the interviewee did not want to answer, we proceeded to the next question. Johansson and Svedner (2010) say that in studies in schools where students are minors, the guardians should be asked whether they want the student to participate or not. They shall also be informed about the purpose and procedures of the study. We asked the headmaster if we could provide information about the study to the parents and ask them for permission to interview their children. However, he thought that this was too complicated and not necessary. While giving response to the participants, the aim is at building confidence, which is based on a trusting relationship. If there is confidence, results are usually more truthful, because the participants are encouraged to be honest. They may be more motivated to participate if they know they do not get into trouble (Johansson & Svedner, 2010). We tried during our field study to have an
open mind and a positive attitude to everything we saw and heard at school, in order to build confidence and a trusting relationship.

4.4 Implementation

During the first two weeks of the field study, we observed different teachers every day, in several classes. Our observations then gave us a basis to create interview questions for teachers and students, which we then implemented during the third week. In the same week we also implemented five self-teaching attempts. A few weeks later we came back to the school for one more day with complementary observations and interviews.

4.4.1 Observation

Our observations focused on the subject of mathematics, but in order to gain a broader perspective about the school’s teaching we also observed other subjects. We chose to start with an observation schedule where we wanted to observe a specific area within the school. Our observations concerned how teaching was organized and what methods were used to motivate students to learn. During the observations, we observed continuously specific events that exposed the different approaches to learning. Our observations were based on Björkdahls' and Dimenäs (2007) observation points. We focused on the relationship between teachers and students as well as how teaching was organized. As we observed, we sat most of the time in the back of the classroom. Mostly we sat in silence but could ask the student next to us discreetly about their work. Sometimes the teacher came to us to explain something special, though very rarely. Notepad was performed with pen and paper, and each observation was about 40 minutes long.

4.4.2 Interview

To complement our observations we decided to make use of interviews (appendix 2). This we did because of the importance of making use of both observations and interviews to get a fruitful result (Johansson & Svedner, 2010). When we carried out the interviews, we made sure to give response to the interviewee on the answers that were given. Feedback was given in the form of trying to summarize and retell the answers with the words "You mean ..." (Johansson & Svedner 2010:32, own translation). We also used follow-up questions, where we, for instance, asked the respondents to give examples from their teaching. We also kept in mind not to show our own opinions during the interviews.

We carried out the interviews to 22 people; 12 students and 10 teachers. The students interviewed were in 3th, 5th as well as 8th standard. These interviews were conducted outdoors during break in groups of 4-5 students. All the interviews with the teachers took place in private, in a study room where both teachers and students could come and go. Interviews were conducted with teachers that we have observed and come to know during our time at school. All the interviews with both teachers and students were recorded and were between 20 and 60 minutes long. The interviews gave us documentation that confirmed, or in some ways opposed, to the observations that we have previously completed. Johansson and Svedner claim that this is a good approach to increase the validity and reliability of the study (Johansson & Svedner, 2010).
4.4.3 Supplementation of the observations and interviews

After the interview has been made it is helpful to observe again. The new observation matches the interview with the reality (Johansson & Svedner, 2010). Therefore, we chose to supplement our interviews with new observations. Once we had compiled our observations and interviews, we understood the importance of supplementary observation when new issues emerged. The new questions emerged due to that new aspects of learning in schools were shown. The additions of the observations and interviews were conducted in one day among some teachers that we previously observed and interviewed. We carried out the observations during four lessons and asked some supplementary interview questions to four teachers.

4.4.4 Self-teaching attempts

We completed five mathematics lessons with problem solving in 5th standard. The first lesson was held outdoors, with 19 students, with a mix of boys from different classes. The students were divided into groups of 2-4 students and worked with problem solving 1 (appendix 3). The other four lessons were carried out in a classroom. During the second lesson, we had 16 students, in groups of two. They worked with problem solving 2 (appendix 4) and the group consisted of both boys and girls. The third class had 16 students, and did problem solving in similar types of groups as in lesson 2. The students worked with problem solving 3 (appendix 5). The fourth lesson was held in another 5th standard with problem solving. 20 students participated, divided in groups of two, and they worked with problem solving 1 (appendix 3). During that lesson two mathematics teachers were observing us. Later on we did an interview with these teachers regarding our lesson. The fifth lesson was held in the same class as lesson 2 and 3 and was the conclusion of previous lessons, with a review of solutions to problems and reflection in the entire class.

4.5 Data Processing

During the observations we recorded specific events that we processed together. Based on them, we created our interview questions and the interviews were also recorded by us. The material was processed by compiling and comparing the interview responses. Based on observations and interviews, we made a new observation, with the same points as the previous observation had, to watch the reliability of the result. Then we returned to school for new observations and interviews. Our material from self-teaching attempts, we got by observing the students approach to their problem solutions and through student reflections. We also made a class interview with the 16 students about problem solving. Even an interview with two mathematics teachers who observed one of our lessons was conducted, and processed like the other interviews.

When observations were made we took notes continuously during the time of lesson. Afterwards the notes were processed on the basis of our observation charts. The results from observations were categorized in order to answer the first and the second research questions. In the processing of the interviews, the material was first given a category as we gathered all answers to a particular question. We also compiled questions where the different responses were similar and could be linked together.
Next, we categorized our interview answers according to the research question 1 and 2. The supplementary observations and the interviews were written down and processed. No new recordings were made since the questions were few in number and designed to confirm or contradict what we previously had seen and heard at school. During our self-teaching attempts, we observed the students when they were working on their task, and we walked around in order to listen to their thoughts. At the end of the lessons we did some reflection with the whole class about the task. During the last lesson we finished with a more structured conversation in class about problem solving, which was recorded and then intercepted and processed on the basis of research question 3.

4.6 Reliability and Validity

In order to make the result of the study reliable and relevant, it is of great importance that the survey is linked to current research. This link is an example of how theory and practice are united (Björkdahl & Dimenäs, 2007). In a study like this, it is important to ensure the reliability of the result. Good reliability means that the study is reliable. The study linked to scientific theory, and the combination of observations, interviews, and self-teaching attempts, can increase the study's reliability we believe. Johansson and Svedner (2010) state that observing is a good method to use in studies of educational processes. This indicates that our study can provide good validity. The validity refers to that the study does investigate what was intended from the beginning (Johansson & Svedner, 2010). Because we studied various self-teaching processes, we wanted to investigate how students and teachers acted and reacted to our self-teaching attempts as these differ from what we have seen during our observations at Devagiri CMI Public School. By doing several lessons, and interviews regarding these lessons, we believe that the surveys increased the reliability. Since we have been using both observations, interviews and self-teaching attempts, we believe that we have been able to measure what was intended to be measured and that the study therefore has good validity.
5. Result

What perspective on learning was visible at our field study school, and how was it manifested in mathematics education? Through our result we would attempt to get an answer to that question. The aim of our study was to find out how different perspectives could be reflected in the school teaching at Devagiri CMI Public School. Through observations and interviews, we wanted to answer the first research question; how was teaching organized, in relation to the four perspectives on learning? We also wanted to answer the second research question; what factors motivate students to study mathematics? By self-teaching attempts we wanted to answer the third research question; how do teachers and students find the self-teaching attempts, carried out by the Swedish student teachers, regarding students' ability to learn mathematics?

5.1 How was teaching organized, in relation to the four perspectives on learning?

School organization should teach students how society works, according to the teachers, for the students to become good citizens. The teachers also pointed out that welfare could only be provided through education. The teachers believed that the school provided good opportunities for students to learn to integrate with others, and to learn how to behave, something the students also mentioned. The classes at Devagiri CMI Public School consisted of between 30-50 students. Through our observations we could see that the classrooms were relatively small compared to the number of students, and all students sat on low benches with a table in front. On each bench sat four students and the benches were lined up. At the front of the classroom there was a blackboard and a teacher's podium that was centered in the middle of the classroom. Each lesson was approximately 40 minutes long and ended when the school bell rang. Some teachers had short breaks during class to calm the students and regain concentration. It was done by including songs, physical exercises or the students closing their eyes and being silent for a few minutes. There was one teacher in every classroom. Every teacher had one subject and taught in different classrooms. What we observed was that communication in the classroom was based on the textbook and often the teacher both read and wrote word by word from the book. During the lesson the teacher gave feedback to the students by encouraging them when they gave correct answers, as well as by correcting their books with right or wrong.

Many teachers said that they planned their lessons on their own but they also discussed their planning with other teachers and got tips, advice, and reflected on their work. Another method that many teachers used was that they allowed students to be involved to evaluate the lessons. The reflections took place anonymously by writing or through conversations and tests. One teacher used student projects to see if everyone understood. Another teacher pointed out that teachers do not have all the knowledge and that the students actually could teach them something. According to the students, teachers know almost everything and the students felt that they could not contribute knowledge to their teachers.

Folding paper to find the center point instead of just counting it out is one example the teacher gave to make the lesson more practical. She pointed out that a balance and variety of different teaching approaches was important and she believed that "do and learn" was a mindset within the modern school. When teachers introduced a new area,
for example, percentage, they first taught the basic for the topic so that everyone had the same base and the ability to keep up. They told us that it was done about once a month. In the beginning of a new area, there were lessons that often included one activity with concrete materials or any video about the work area. When a teacher planned to have a practical feature during her lesson that required concrete materials, she told us that she asked her students to purchase it themselves. One teacher told us that sometimes she used the Information Technology room as an introduction to a new work area. She thought that class time was too short. But she said it was not so common to use the IT room for mathematics; it was more common in other subjects she thought. After the teacher had given her student the basic for the topic, she advanced the level and each lesson had some repetition to the previous lesson.

When students answered a question, it often seemed to be based on given answers according to our observations. That is because the answers seemed to be expected in a certain word order and with predetermined words. That meant, that if the students did not respond with a right answer the teacher asked others until she found the correct answer with another student. Sometimes all students answered in unison. In mathematics lessons, most teachers had a review of some tasks on the board and how to solve them through a chosen approach. The same procedure was repeated throughout the lesson. The teacher wrote the question, the statement, and the answers of the tasks. Then the students copied the same that the teacher had written on the blackboard in their books. As homework, students were asked to solve similar task but then they only needed to write the answer and no approach in the calculations.

Most teachers said that they found it difficult to individualize their teaching because they had to consider a whole class. One teacher mentioned her strategy to help students by putting the class in independent studies so that she had time to walk around and help students individually. One teacher pointed out that some students learned best by listening to the teacher and some learned best by doing, for example, drama. Therefore, she tried to teach in different ways, but the class size made it difficult. The same teacher felt that it was important to have practical elements of the lesson as songs or to concretize by cutting shapes. She also said that teachers needed to be a model, for example by having the napkin in the lap while eating.

One teacher mentioned that it was important for her to use an easy grammar, as the teaching was given in English and her students in 1st standard were not used to English. To make all students understand, she complemented her teaching with their mother tongue Malayalam. She meant that repetition, or rote memory, was the key for students to learn. For students who did not understand her teaching or needed extra help. She usually gave help when the class was having drawing or playtime, periods she did not consider that important in comparison to theoretical subjects. Several teachers also mentioned that they gave extra time for students who needed it. Students could also access the staff room and ask for help by themselves.

Most of the teachers wished the students to be involved, listening and answering questions. They also wanted students to not be afraid to express their opinions or to ask if they did not understand. One teacher said that students should complete what the teacher asked them to do. A good student, according to themselves, should listen and answer questions, be on time to class and respect the teachers. They should also be helpful, cheerful, behave well and not be crying. Yet another teacher indicated that
students should be disciplined, but that was nothing that she as a teacher could take
for granted because all students came from different backgrounds. Something that was
important for one of the teachers was that students dared to tell her about their
thoughts and feelings regarding school and home; as she saw them as her own
children.

The key to being a good teacher was to be a good friend and like a mother to the
students, according to some teachers. The students also mentioned that a good teacher
was like an extra-mother. The term "mother" was explained, as a person who has
raised and guided the children to maturity into good citizens who could then behave
well as adults. A teacher expressed that the key was "love and affection". The younger
students, according to one teacher, needed someone who cared about them and not
just someone who taught them subject knowledge. One teacher said she never took
time off from her job and that she walked around among the students during the
lesson to help them. She also said that sometimes she as a teacher had to raise her
voice and bang the table to show that it was serious. Two teachers emphasized the
importance of coming down to the little ones level and explain so that everyone could
understand the teaching. According to students in 8th standard, a good teacher was
someone who told facts that students needed to know. Students in 5th standard thought
that a teacher should ask many questions and give homework. A girl in 3rd standard,
explained that a teacher should be kind to their students but tell them when they did
wrong, without beating the students.

We saw during our observations that the teacher's role was to make sure that everyone
understood. The student’s role was to write down what the teacher wrote on the
blackboard, and to be involved by answering the teacher's questions. The students
sometimes got individual time to solve the task. When the first student had solved the
task he or she explained the answer to the entire class, and the individual time was
over. The teacher could at any time request a specific student to come forward to the
board and solve a problem. Through our observations, we could see that the teacher
chose among the students those that we thought were the most passive ones.
Repetition took a large portion of class time. During one lesson some individual
students were standing in front of the class to share their reports, the teacher
interrupted them by adding facts. She also pointed out what was the most important
thing to remember of the report. Sometimes the teacher asked one student to
demonstrate mathematics solution in front of the class, and sometimes it ended with
her giving the explanation instead of the student. The same thing often happened
when she asked one student to read a text item from the book. The student began to
read, but the teacher took over and finished reading the entire text. However, some
occasions differed when the teacher let the students finish reading on their own
without interrupting.

One teacher said that all teachers at the school needed to be more critical in their role
as a teacher. An example she gave was that girls and boys were often treated
differently. Once she heard one teacher say to a boy, "don’t cry like a girl". She
considered that people in India generally were quite introvert but the growing English
skills in the country allowed integration with other parts of the world. She also
expressed that she did not believe that memorization was the way of learning. She
meant that discussion was an example of a better approach. She saw memorization as
an old approach and considered that the school tests were built on memorization.
Therefore, it was difficult to break such practices. She said "I do not teach what, I teach how" and thought that the process was more important than the product. By getting students involved in discussions about their own thoughts and ideas, learning occurs. Because of the major size of the classes, she believed that it was difficult to obtain functional conversation of such nature. "If we want them to learn we need smaller classes”, something she said that everyone at the school were aware of.

A dream of change has been made visible by several of the interviewees. One teacher expressed her views on the matter by the words;  

We should not dream of anything else, then we are no longer teachers. All students are different. Anyone can teach a small class, the challenge lies in having large classes. That shows if you are a good teacher or not. Changes are always welcome, but I do not think I would change anything (One teacher from various standards).

We have interviewed many teachers. The teachers had many wishes; one wish was to get smaller classes in order to give all students "much more personal attention" and to have access to Information Technology in the classrooms. The student would like to have a class with a lot of technology and also their own individual chairs and benches. Wishes from the teachers, were also more space in the classroom, more accessible books, more time and that all students reached the same level. One teacher wanted the students to listen better and not to be distracted by other things, but underlined that it was up to the teacher to achieve that. The student wished for more interesting lessons. One teacher said;"I don't think I can expect a perfect classroom” but if she could choose, the most important thing would be that the students would listen better and better response.

5.2 What factors motivated students to study mathematics?

Education is generally valued in Kerala, and because it is regarded as important, many teachers assumed that their students understood the value of education. One teacher believed that ratings/grade motivated but that job was just too far in their future. Although, the girls in 8th standard all had high ambitions for their education and their future regarding a job. Those made them understand the importance of school. Students in 5th standard also said that future job in which to earn “a lot” of money was one reason why they were in school. A boy expressed the school's purpose by saying "it makes me know more things about the world, people and things". A little girl in 3rd standard said that the school is important for everyone and that the school's purpose was that students should learn to answer questions and to get jobs when they became adults. The purpose of the school, according to many teachers, was to provide the student with knowledge necessary to live. One teacher of mathematics said that it was important that students learned some basic skills, such as "how to react in situations". The same teacher said that the school also gave them practical knowledge, such as how much money to pay and get back in the shop. Through problem solving, students could get practice in "how to solve problems in their life". She meant that students in school were taught to cooperate and how to solve problems in life, something she believed that one could only learn in group.

Some teachers believed that the students did not value their education and that they did not understand how privileged they were to go to school. One of the reasons was the emergence of Information Technology which competed with school and provided
easily accessible knowledge. One teacher said that she tried to get her students to realize how good their lives were, and that there are starving children without a school to go to. She tried to make that clear, for example, when she saw her students wasting food. Another teacher told us that the students at the school had low motivation to attend school. She believed that the primary reason was that the students came from fairly wealthy families and therefore were spoiled; they had everything they needed and did not understand their need of education. She told us that those from lower caste often had more motivation to educate themselves in order to achieve development. She meant that the responsibility to motivate lied with both teachers and students and that there was a 50/50 ratio. "The teacher had an important role of helping the students to understand the usage of varied education but students' motivation must also come from within themselves" the same teacher told us. In contrast, most teachers emphasized that the greatest responsibility to motivate students belongs to the teacher. One teacher pointed out the importance of school through the words; "who else would teach them?"

At one time the teacher told us, so that the entire class could hear, about some "weak" students in class and what their "problem" was. Some teachers continued to teach despite the fact that all students were not yet ready, while other teachers waited for their student to finish the task. Some students were often quite passive, during our observations, and were not active in answering questions, though they wrote in their books what the teacher wrote on the blackboard. Although, in some lessons, the students were active by answering questions as well as listening to the teacher. All teaching was performed with the whole class and all students had the same homework.

"Heart to heart" said a senior teacher,"is the foundation for good learning and motivation". Such a relationship was created when the teacher treated the students like friends and was like a mother to them. Another teacher said that the students needed "some fun and some serious. Just serious, they won't listen”. In this way, the teacher should mix both fun and serious for the students to learn, as students according to him stopped listening if it was just serious. He believed that games created motivation. One thing he pointed out was that if you were friend with the students, they would listen better. All teachers saw their role as important to motivate students, but they raised some different things of how motivation would best be created. One teacher said that "motivation is a part of all teaching". She meant that it was important to motivate students by encouraging good performance, and to praise students' performance in public in the class. She felt that it was easier to encourage those students who were good at mathematics, but all students were talented in some subject and therefore they got encouragement in that topic she meant. Encouraging achievements could also be given by a star in the student's book. By that the teacher wanted more students to be motivated to continue their work so that they also received a star like their classmate did.

According to our observations the teacher used both reward and punishment to motivate good behavior and learning. We did not see reward in the same grade as punishment. In some cases we observed that the teacher gave rewards throughout praises. During a lesson on our solar system, the teacher asked one boy about which neighbors the planet earth had. The boy responded by lining up the entire solar system and the teacher was impressed. The teacher praised the boy and everyone in the class
clapped their hands. We have also seen a teacher give rewards to students who have written correctly and nicely in their books. The teacher often wrote a math problem on the board and asked for the answer. The first one who responded with a correct answer got the teachers attention. Many teachers used threats, as a punishment, with sending the students to the headmaster if they did something wrong. During our time at the school we did not see it come through. Although, one time we saw a first grader leaving the classroom with his backpack after repeated warnings. One teacher considered that it was as dramatic to threaten them to go to the headmaster as to threaten to go to the police. The teacher also threatened the students by saying that they could go to a "regular" school, where the children were taught in Malayalam, if they did not speak English in class. Furthermore another teacher threatened the students when she said that they could be sent back to kindergarten if they did not write correctly on the lines. We could see by our observations that many teachers found it very important that students wrote properly in their books with spaces, capital letters and correct script, etc.

One teacher threatened with a student's ruler, but we never saw her hit any children. One teacher told us about physical punishment and said that "those days are gone". Thus, the students told us that there is still physical punishment practiced in form of strokes on the hand with a stick. One boy said he has reduced sensibility in his hand because he was "king of punishment". Punishment could be done if the students, for example, had the wrong shoes or arrived late for the lesson. It seemed that there was a disagreement among the students about if it is good or not to have physical punishment in school. One teacher said that she usually glared at the students and that they in that way understood that they made a mistake. The teacher then called them after class to talk with them. If the bad behavior was repeated several times she called the parents, but she first wanted to give them time to change their behavior. A senior teacher said that she made use of "small beating with a stick", when the other students had left the classrooms. She said that the teacher sometimes have to scare the students, usually it was enough to show the stick. One day an English teacher gave the students their homework back, she stopped and said; "there are some students here who do not understand English". She held up a notebook and asked a boy to stand up. The teacher asked the other students to explain how the boy should have done his homework and the boy had to stand up and listen while everyone responded in chorus. Afterwards, the teacher said "you'll never have any English?" The boy answered "I will". Then the teacher said, "then, why did you do this?"

The teachers called each task within mathematics for a math problem. One day, during a math lesson, a girl asked the teacher of another way to solve a mathematics task because she did not understand the teacher's approach. Then the teacher gave another approach to solve it. Another time the teacher gave two different ways to solve one problem. She explained that the different solution could be useful at different times. The teachers pointed out that the pupils should always take the easiest route and select the strategy that was best suited for the character of the task. A boy in the class wanted to explain a third solution method to the class. The teacher explained that his strategy worked, but they did not need to have more than two strategies at the time. During our time at the school we only saw the teacher give more than one solution twice. One teacher told the students that she wanted them to make full sentences when they gave her an answer. She also wanted them to explain by using their own words.
During our second last math lesson, something happened that we had not previously observed. The teacher made several connections between the teaching of percent and the student's everyday life. She explained the concept of percent on the students' mother tongue and said that "in daily life you are using these words". She also explained the concept of percent by explaining the meaning of the Latin word "percentage". The teacher told the students that percentage could be used to calculate "population of the country" and "how many of these children has two siblings". She also said that percent could be used in the store when it was 20% off on an item. Another teacher once used concrete materials where pupils would cut out and fold triangles.

The teachers considered that teaching was connected to students' everyday lives. According to one interview one student in 3rd standard did not see everyday connection within mathematics. This, however, the students in 8th and 5th standard told us that a good teacher should explain so that "every subject is connecting to the real life". They said that they could use mathematics outside the school, for example, while shopping. The teachers meant that as a teacher, you need to show that mathematics is a basic subject used everywhere in society. They said that they did the relationship between mathematics in school and real life clear for the students. The teachers thought of a single example, during the interviews, namely when they used money in mathematics education. A mathematics teacher told us how she introduced a work area like division through games, to concretize the work area. She said that it was difficult to find time for such activities and therefore she did it most as an introduction to a new work area. She maintained that the responsibility laid with the teacher so that all students understood the teaching. Another teacher was to initiate new areas with one activity by showing images, play a game, sing a song to bring interest among the students' and create motivation. The same teacher also had a weekly test, to see which students understood and which ones did not. Based on the tests she wanted to give individual attention. She also called home to some parents, to teach them how they could help and teach their children at home. She also used mathematics cards, which she had made herself, to make students interested in numbers and math.

One teacher told us that she used"good stories" and many examples in her teaching. She made up a story which made the pupils understand and in that way create motivation. Another teacher explained that it was important to explain the purpose of teaching for older students. For the younger ones, however, it was not necessary, because they did not think along those lines yet. The teacher believed that the most important thing for the younger students was that teaching was made fun and creative. A good approach according to another teacher was to allow students to lead and be the "teacher" in front of class, as it usually created challenge among the students. Some teachers mentioned the importance of doing mathematics attractive to students by visual elements as well as the use of Information Technology. The teachers considered that these tools were great for introducing a topic and new work areas. It simplified the continuing education if the students got a good foundation. The school had a large room with a projector and white cloth that could be booked before the lesson. The technology, the teachers indicated, could create interest in mathematics among the students. Technology could also create more variety in teaching and the teacher could show, for example a video.
5.3 How did teachers and students find the self-teaching attempts, carried out by the Swedish student teachers, regarding students' ability to learn mathematics?

In five lessons we worked with three different problem solving tasks within mathematics (appendix 3, 4, 5). All students were in 5th standard and every lesson was approximately 40 minutes long. The first lesson, we held outdoors and the group consisted of boys from different classes in 5th standard. At the beginning of the lesson it was 19 students, but more were added during the lesson by “just dropping by”. We divided the students into groups of four, but since pupils were added, the groups became larger. The cooperation between students was flawed and some were active while others were passive. Therefore, we divided the groups, to try to make all students active. We eventually had seven groups of 2-4 students in each group, and the students worked with problem solving 1 (appendix 3). Some groups were acclimated and did their best, while other groups wanted to quickly come up with a solution by guessing and therefore became unfocused on the task. A lot of distraction from other children disturbed the order and the students' concentration. Although many students were distracted, we had a final conversation with several students regarding their reflection during the lesson.

After reflection from lesson one, we decided to be in a classroom. This time we got 16 students and were able to form eight groups with a mix of boys and girls. Some students were the same as in lesson one. We also realized that we needed to be clearer about the order in the classroom, to achieve a good classroom environment. We said they should raise their hands for assistance instead of coming to us, and that they would discuss quietly so that other groups could not hear their "secret" solutions. During the lesson, the students worked with problem solving 2 (appendix 4) and at the end of the lesson we had time for a common reflection. Their response was that this approach was new, fun, difficult, and that they considered themselves as involved and saw the task as a challenge. We read the task aloud to all students before they got started. All students said that they understood but it turned out that no group understood how to solve a task like this. We explained separately for each group and provided guidance for them to get into the way of thinking. Then it was good order in the classroom. No team managed to find the right solution to subtask 1 (appendix 4). Students were surprised regarding subtask 2 (appendix 4) because they themselves could determine and write a problem, something they, according to themselves, never had done before. They thought it was difficult to create something of their own.

After having performed lesson two, we realized that we needed to explain the task even more clearly in the beginning of the lesson, in front of the whole class. Lack of time was our biggest challenge. Students would have needed more time to solve the task. We also wanted to talk about different ways to solve the task, and finish with a common reflection in which students could respond to the content of the lesson. The same was also true for lesson three. Students found that problem solving 3 (appendix 5) was harder than problem solving 2 (appendix 4). No group managed to come up with the right answer. However, three groups solved the task with a different mindset, which possibly could have been counted as correct.

Lesson four was an extra lesson because we wanted a teacher to observe our teaching, and then be able to interview the teacher concerning our lesson. We held the lesson in another class where we had 20 students and thus 10 groups working with problem
solving 1 (appendix 3). At the back of the classroom sat two math teachers who observed the lesson. They seemed to pay attention to our teaching, and did not interfere with our setup or what we said. Five groups solved the task and the other five groups had incorrect attempts as solutions. During the lesson, there was good order and good cooperation. We could not start on time; therefore we did not finish the lesson by explaining the task as well as reflection. That was because the school bell rang 10 minutes early and chaos arose both in the classroom and outside. Through the door flowed other students into the classroom and the lesson was thus completed. Spontaneous reaction from the students after the lesson was that the approach was new and that they thought it was exciting to create their own problem-solving task.

After lesson four we interviewed the two teachers who observed this lesson. During the interview, we told them how we would have wanted to finish the lesson. Our explanation was that we had wanted to explain our method of the task, and also take help of two boys in the class who solved the problem in a good way earlier in the lesson. The teachers said they liked the way we introduced the lesson by presenting the task. According to them, the lack in our lesson was that we did not present any alternative methods which the students could have used in the task. They said that if the figures change, students must still be able to see which method they should use. To have to figure out the right method in 5th standard will be an issue, according to the teachers, as students are not introduced to such tasks until 6th or 7th standard. Therefore, our lesson was too difficult for fifth standards, the two teachers said. One of the teachers said that some of the students did not seem to understand anything during our lesson, at the same time some students were sad because they had no time to come up with the answer. The students who were sad were, according to the teachers, sad because they had a big math interest, and that the answer therefore was important to them. We asked during the interview if they believed that the students learned something from our lesson. The teachers paused and could not give an account of anything students had been able to learn. They said, however, that "they were able to find some solution." One of the teachers also said that many students showed interest and seemed to have fun. The two teachers thought it was funny that the students got to experience this kind of task, but considered it too difficult for pupils in 5th standard.

In lessons two and three we did not have time to go through the methods and the answers to the task. Therefore we had one more lesson to complete these solutions. In the fifth lesson, we distributed the students' tasks from previous lessons (appendix 4,5) and explained a method to solve each task, which we then discussed with the students. Students had the opportunity to compare with their former solutions and thus hopefully understood the task better. Then we had plenty of time to talk about problem solving based on our interview questions (appendix 2). Students said they thought the tasks were nice, tricky, very good, fun, easy, hard and both easy and hard at the same time. The students felt that it was fun when they understood how they would solve the tasks and they also pointed out that it was fun with images. "We have never had such questions", said one student. Another said that they have had tasks similar to subtask 1. They said they sometimes got an answer from the teacher, and then would make the question on their own. The students pointed out that they had problem solving in school, though with granted solution methods. The students showed us some tasks that they associated with problem solving. The students
mentioned that they solved the tasks along with the teacher and the rest of the class and that they also had to solve some of their own. Even $70/3 = ___$ some students saw as a possible problem. Students found the picture with ice creams (appendix 4) misleading. The task was still easy, a few students said, compared to problem solving 3 (appendix 5). Problem solving 3 was more difficult, but when we explained and gave a method to solve the task, they thought it was easier to understand. "We have learned many ways to solve a problem through your lessons". They thought it was great that they could solve problems in different ways and it was fun and good to learn to make their own tasks. "We can also make our own questions", one of the students said, which was something completely new. A few students thought that if they made their own problems in the future, other students could solve them. Students said they would tell their teachers that they wanted more similar tasks in the future.

During the interview, the teachers told us how they thought that a lesson should be organized. Even their approach to problem solving was made visible during the interview. The teachers said that they followed the textbook, because the school told them to. They told us that they therefore did not have time to add additional material to the teaching as extra tasks. They also said that they did not explain other methods to the students besides from the methods mentioned in the textbook. They explained that they were starting their lessons with selecting the topic and then they went through some different methods through simple task introduction. After that the students could manage to solve their own tasks because then they could manage the methods. "They need practice, otherwise they can't answer the question” expressed one of the teachers. The two teachers found that problem solving was important, and they gave projects to their students, with tasks similar to ours, which the students could solve in groups. They considered that discussion mostly belonged in other subjects and not within mathematics, but discussions could be used rarely.

5.4 Summary of the result

The results of our observations and interviews showed that the classes were large and always directed by the teacher. The teachers based their teaching on the textbook and repetition was an important part during the lessons. Education was generally valued among the students. Two factors that generally motivated the students were their thoughts about the future and also how the teachers taught them. All teachers saw their role as important to motivate their students. One common way to motivate learning among the pupils was through reward and punishment. Throughout our self-teaching attempts, the students found it difficult not to be assigned to given methods, which they could use to solve the task. The students found that our approach was interesting and that it was exciting to try something new within mathematics, especially because the problem solving tasks were inspired from another country.
6. Analysis

6.1 How was teaching organized, in relation to the four perspectives on learning?

Many of the teachers we interviewed thought that the main goal of the school was to create good citizens, something in line with the pragmatic perspective (Lundgren, Säljö & Liberg, 2010). Some teachers explained that they would have wanted the classes to be more individualized, to get opportunity to give more personal attention to their students, but they said that it was not possible because of the size of the classes. The cognitive perspective points out the need of individual learning but also the difficulties with today's large classes (Lundgren, Säljö & Liberg, 2010).

6.1.1 The school's approaches

The teachers taught the whole class together and all students were given the same homework. The teachers mostly used one chosen approach to deal with a task, and then the same procedure was repeated all over again with the upcoming tasks. The students were supposed to copy everything the teacher wrote on the blackboard in their books and to answer correctly in a certain word order. These things are found within the behaviouristic perspective (Lundgren, Säljö & Liberg, 2010; Fuglestad, 1999). Something Arfwedson and Arfwedson (2002) write about is the focus on the product within the behaviouristic perspective. It was something that we saw was important in the teaching at our school, for example, in their homework they repeated similar tasks and just needed to write an answer without calculations. This focus on the product is not found within the other three perspectives, where the process leading to the answer is the most important (Arfwedson & Arfwedson, 2002). At this school, teachers also said that the students were able to sometimes reflect on the teachers work. Reflection is something important within the cognitive perspective (Dysthe, 2003) and within the socio-cultural perspective (Lundgren, Säljö & Liberg, 2010). According to Carlgren (1999) the behaviouristic perspective is based on the fact that all students should learn the same knowledge, which was made possible when the teachers at the school based their teaching on the textbook.

In our school, the teacher told us that they used activities such as watching videos and using concrete materials to introduce a new area, something we did not see during our observations. A way to achieve learning, according to the pragmatic perspective, is combining theoretical knowledge and practical activities (Lundgren, Säljö & Liberg, 2010). To stimulate the students, different activities can be used, which is something within the socio-cultural perspective (Dysthe, 2003). When the teachers introduced a new area they started with a common base of knowledge for everyone. From that spot they advanced the level and added new knowledge divided into small parts that everyone learned in the same way, an approach similarly to the behaviouristic perspective (Lundgren, Säljö & Liberg, 2010). The teachers wanted the students to reach the same level of knowledge, both the slow and the fast students. Both the behaviouristic perspective and the cognitive perspective claims that all students should learn the same knowledge. The difference is that the cognitive perspective points out that how they learn and what time required for each student is individual (Dysthe, 2003). The pragmatic perspective underline the importance of knowledge rooted to the students’ reality (Lundgren, Säljö & Liberg, 2010). Doverborg, Qvarsell and Samuelsson (1987) write that it is the teacher's job to highlight why knowledge is
important to have in real life. The teachers said that they did highlight this connection and made it clear for the students, but it was something we rarely saw during our observations at the school.

6.1.2 The teacher's role

A good teacher should, according to themselves, be friends and like a mother to their students by caring for them and teach good behavior. Teachers should be like a role model for the student, according to one of the teachers. This thought is found in the behaviouristic perspective, Hwang (2003) writes. The socio-cultural perspective claims that all people, even their classmates, can be seen as role models to help the students in their development (Lundgren, Säljö & Liberg, 2010).

At the school it was common to teach through repetition, which is mentioned within the behaviouristic perspective as a precondition for the students to develop skills and understanding (Kroksmark, 2011). The school had a similar point of view as the behaviouristic perspective, that it is the teacher's responsibility to achieve understanding among the students through repetition. Repetition was according to one of the teachers the key for success and understanding, especially for the "weak" students. It took a large portion of class time. Another method to achieve understanding, the teachers said, was to come down to the little ones' level and explain in an easier way. This is found within the cognitive perspective and the socio-cultural perspective, where it is of huge importance that knowledge is provided in the right level and to the student's zone of proximal development (Lundgren, Säljö & Liberg, 2012; Hwang, 2003). One teacher mentioned that a good teacher should help the students individually during class. Stensmo writes that a teacher should teach based on the students' needs, interests and abilities (Stensmo, 2008). Otherwise the teacher can be a barrier to students' natural development (Lundgren, Säljö & Liberg, 2010).

6.1.3 The student's role

Answering the teachers questions, listening to the teacher and following the teacher's instructions is something found in the behaviouristic perspective (Fuglestad, 1999) and also at our school. According to the teachers the students should also express their opinions, ask if they did not understand, and complete what the teacher asked them to do. Dialogues give the students the ability to raise their voices and express their opinions (Williams, 2000). Fuglestad (1999) writes that all students shall complete the tasks that the teachers hand out, something visible during both our interviews and observations. Good behavior and good discipline was something required among both students and teachers. To achieve good behavior, teachers often used instrumental conditioning like reward and punishment (Håkansson & Sundberg, 2012). Stensmo (2008) highlights the importance of using reward to occur good learning, as being a part of the behaviouristic perspective. However, our school practiced more punishment than reward.

6.2 What factors motivated students to study mathematics?

Good relationship and a mother like role for the students is the foundation for good learning and motivation, according to the teachers. They argued that a good mother
was supposed to raise the students and teach them good behavior to become good citizens. The idea of democratic citizens is found in the pragmatic perspective (Lundgren, Säljö & Liberg, 2010). The approach to receive good citizens was more in line with the behaviouristic approach through instrumental conditioning (Hwang, 2003).

6.2.1 The teachers' role

At our school all teachers saw their role as important to motivate students, but they raised some differences of how motivation best could be achieved. One way was through encouraging good performance. The teachers said that all students were talented in some subject and therefore got their encouragement in that topic. Encouraging achievements could be given by a star in the student's book. By doing that, the teacher wanted other students to be motivated to copy the smart students, to also be able to receive a star. According to the behaviouristic perspective the teacher can achieve desired behavior through positive reinforcement, like feedback and in this case a star. The students can also occur good behavior by observing others (Hwang, 2003). The behaviouristic perspective claims that the teacher's role is to motivate the student and to create good conditions for learning, by regular received feedback (Stensmo, 2008). A teacher at the school thought it was important to explain the goals for learning for older students. For the younger ones, however, it was not necessary, because they did not think along those lines yet. The pragmatic perspective points out that motivation is created when knowledge is connected to real life and the understanding of that is clear. Doveborg, Qvarsell and Samuelsson (1987) writes that the teacher has an important role to highlight this connection between teaching and real life, something the teachers at our school argued they did clearly but we rarely saw during our observations. The pragmatic perspective underlines that this understanding becomes the key to achieve motivation among the students (Doveborg, Qvarsell & Samuelsson, 1987).

6.2.2 Approaches to achieve motivation

The teacher chose only one method for solving the tasks, and all students followed her method. This is a usual approach within the behaviouristic perspective, when all the students are given the same knowledge through collective intermediation (Carlgren, 1999). At one time a teacher at our school gave the students varying solutions and explained the importance of knowing different solutions for solving different tasks. During that lesson a boy wanted to add his own solution method and the teacher said that other solutions were not needed. This situation showed that the teacher did not expect the students to make their own initiatives, which is a behaviouristic idea. When the boy gave his example he did not get any praise. Instead the teacher made him quiet, and in that way made use of extinguishment. According to the behaviouristic perspective students will stop giving own examples when no positive reinforcement appear (Hwang, 2003). Our observations made visible that the teacher used both reward and punishment to motivate good behavior and learning. Reward was given through praising the smart students and those who wrote correctly and nicely in their books. Punishment was more commonly used than reward. According to the behaviouristic perspective it should be the other way around, because reward is creating motivation in a bigger extent than punishment (Hwang, 2003). Punishment
was used in shape of threats, physical punishment and that the teacher made a fool of a student in front of everyone.

One teacher of mathematics said that it was important that students learned some basic skills, such as "how to react in situations". According to the behaviouristic perspective students can learn desirable behaviors through instrumental conditioning and in that way learn how to react in situations (Hwang, 2003). The teacher also said that the school gave the students practical knowledge, such as how much money to pay and get back in the shop. Through problem solving, students could get practice on "how to solve problems in their life". She meant that students in school were taught cooperation and how to solve problems in life, something she believed that one can only learn in groups. These ideas about practical knowledge and solving problems are found in the pragmatic perspective (Doverborg, Qvarsell & Samuelsson, 1987) and within the socio-cultural perspective (Lundgren, Säljö & Liberg, 2010).

The teachers sometimes introduced new working areas with one chosen activity to bring interest and create motivation but it was not that common because of the lack of time according to the teachers. Teaching where an activity is added can be find within three perspectives; the cognitive perspective, the pragmatic perspective and the socio-cultural perspective (Lundgren, Säljö & Liberg, 2010; Dysthe, 2003).

6.3 How did teachers and students find the self-teaching attempts, carried out by the Swedish student teachers, regarding students' ability to learn mathematics?

Some groups quickly wanted to come up with a solution by guessing. According to the behaviouristic perspective the product is given great importance (Arfwedson & Arfwedson, 2002). The students showed that only the product was seen as important, when they showed the answers to us and wanted to know if the answer was correct or not. The students focused on the answer and not the process. When they did not know what approach to choose, they made a guess instead of trying to find a method. They really wanted an answer quickly to have something to show the teacher and feel successful. This idea is visible within the behaviouristic perspective (Arfwedson & Arfwedson, 2002). The main idea of problem solving is to focus on the process and not the product. According to Taflin (2007) working with problem solving requires a long period and that the students have time to work with many tasks to improve problem solving skills. When we introduced problem solving to the students, we read the task before they got started. Most of the lessons the students said that they understood the instructions about the problem, but they evidently did not and we had to give an explanation separately for each group.

6.3.1 Response from the teachers

The teachers said that the answers were really important for most students. Because we did not give the students much confirmation of the answers, some seemed disappointed. This is in line with the behaviouristic perspective where the students are supposed to receive confirmation for correct answers (Lundgren, Säljö & Liberg, 2010). Taflin (2007) claims that the procedures in problem solving are supposed to be unknown to the students. The teachers who observed said that our lesson lacked presenting methods. To have to figure out the right method in 5th standard was an issue according to the teachers. Hagland, Hedrén and Taflin (2005) write that all ages
can make use of problem solving if the teacher provides problems in the students' zones of proximal development. The teachers found it difficult to see learning appear with our chosen approach but they said that the students seemed to have an interest, had fun during our lessons and made new experiences. Håkansson and Sundberg (2012) write that problem solving is meant to be challenging and inspiring. The teachers considered our approach to be inspiring and diverse, but to challenging and they did not feel that it led to learning.

The teachers said that they followed the textbook and only explained the methods from the book. They started their lessons by selecting the topic and then they explained different methods to make the students manage the methods. Through practice and repetition, the students learned how to solve similar tasks with the same method. Doverborg, Qvarsell and Samuelsson (1987) claim that the idea of practice and rehearsal is common in the behaviouristic perspective. The two teachers found problem solving important and said that they made use of it in groups sometimes. But discussions in groups did not belong within mathematics, according to them. According to Hagland, Hedrén and Taflin (2005), discussion and interaction with others is an important part of mathematics and problem solving is a good way to include discussion in the subject.

6.3.2 Response from the students

The students’ responses were that our approach was new, challenging, funny and made them feel involved. According to Håkansson and Sundberg (2012) problem solving aims to challenge and inspire the students. They had never experienced such problems before and therefore they needed a knowledgeable guide, which Hagland, Hedrén and Taflin (2005) underlines the importance of. When the students normally worked with ”problem solving”, the methods were always given to them. They mostly solved the problems together as a whole class with the teacher as a leader. According to what Arfwedson and Arfwedson (2002) writes, this way of teaching is found within the behaviouristic perspective. The students thought it was great that they could solve problems in different ways and they could understand the learning in our lessons. They were surprised to get an opportunity to make their own problems, something they had never done before. They said it was difficult to create problems on their own but found it challenging and exiting. Taflin (2007) explains that one part of problem solving is to create own problems, which the students had the opportunity to experience. Lack of time and that we did not know the students well enough made our selection of tasks difficult, because we did not know their zone of proximal development.
7. Discussion and final conclusion

7.1 How was teaching organized, in relation to the four perspectives on learning?

All teaching was based on the textbook with a chosen approach and all students were taught in the same way as unison. The students’ role was to learn as much as possible by incorporating, listening and copying what the teacher said and wrote. The teaching at the school was mostly organized in line with the behaviouristic perspective and the teacher was seen as an authority. Although, some elements from the other three perspectives were visible in the organization of the teaching, they were not a majority and were therefore exceptions. A prominent example was one teacher, who had many influences from other countries but lacked teacher training. She considered that all teachers at the school needed to be more critical in their teaching and profession. This teacher mentioned that all teaching was built on memorization, something she did not agree as being a good approach to achieve learning. She believed teaching built on discussions and dialogue was a better approach to achieve learning. She also said that process should be in focus instead of the product, and she wanted to teach how the students could find knowledge instead of just giving them completed knowledge. But she claimed that an approach built on discussion and where the students individual thoughts were important, was difficult to manage with the school's major classes.

The school had 30-50 students in each class, and with these circumstances it would have been difficult to manage other approaches than what most teachers at the school used. Most of the teachers just handled these situations without complaining and some of them did not even dare to dream of something else. One reason seemed to be because of the headmaster who did not like changes and who also wanted many students and big classes, to bring in money. If we have had the same circumstances in Sweden maybe the Swedish schools would have been organized in a similar way. When many teachers explained their way of teaching, during interviews, it almost sounded like they had a school according to the pragmatic perspective but in real life we mostly observed teaching similar to the behaviouristic perspective. The biggest dreams were smaller classes so that they could manage an approach which includes both theory and practice and where they could give each student more personal attention. All teachers said that they made their teaching connect with the students every day life and that they made use of practical activities in their teaching, but it was things we almost did not see during the observations. An approach within the cognitive perspective would have been to let the students analyze, think independently through their own life experience and interact with other people (Lundgren, Säljö & Liberg, 2010). According to the pragmatic perspective and the socio-cultural perspective, interaction with others provides the students with opportunities to develop ideas and strategies to solve problems with others (Arfwedson, 2002). Interaction with others and communication through teamwork was something unusual during the lessons at our school. Communication and language are seen as the most important tools to achieve learning and motivation within the pragmatic perspective and the socio-cultural perspective. The socio-cultural perspective even add interaction with a more knowledgeable person, as the best way to achieve learning (Lundgren, Säljö & Liberg, 2010).
7.2. What factors motivated students to study mathematics?

According to the teachers and also to the behaviouristic perspective all responsibility for motivating the students lays upon the teacher (Stensmo, 2008). Although, one of the teachers said that both students and teachers had equal responsibility to achieve motivation among the students. We believe that the teacher has an important role to create good circumstances for learning. But then, each student has to decide how to respond to that opportunity. The most common methods to achieve motivation at the school were by using reward and punishment, according to observations and interviews. By these methods we think that the teachers wanted to achieve obedience, because good behavior was seen as the foundation for good learning and motivation at the school. The school used punishment to a greater extent than reward. We think this is because punishment often provides fast and measurable results in contrast to rewards, where result can take longer time to appear. We believe that if you punish a student, you may force the student to stop the bad behavior at once. If the teacher instead uses rewards they encourage good behavior among the other students. In that way the teachers try to get the student, who does not want to do right, to emulate the good behaviors that he or she might observe. Reward may seem to take longer; therefore we believe that teachers consider punishment as a method for rapid results. According to the behaviouristic perspective, reward is the best way to achieve motivation, because reward demonstrates how the students should behave. Punishment does not give a model for how the student should behave; it only shows what they are not supposed to do (Hwang, 2003). Once we experienced something we connect with extinguishment (Hwang, 2003). It was during mathematics class when a boy wanted to explain another approach, but did not get any response on his ideas. Before that, the teacher had just told the class the importance of many solutions which the boy responded to. We believe that motivation can be lost among students if the teacher does not encourage students to think independently. Unfortunately, extinguishment was something common as, since many teachers made committed and energetic students quiet.

The teachers found it important to be like a mother and a friend to their students to achieve good behavior and motivation. A mother raises the students to good behavior and a friend creates good relationships that can motivate the students to continue their learning, according to the teachers. We could see that the teachers acted like mothers, but we found it difficult to see the friendship between students and teachers. We think that a good relationship between students and teachers can create motivation in a greater extent than if teachers just teach without knowing their students. Maybe, the lack of friendship was because of the large classes. Without good relationship it is impossible to know the students' needs and interests, and in that way be able to individualize teaching. The teachers told us that they made use of activities and that they connected the students’ everyday life to their teaching. We did not see any practical activities but we saw the connection between teaching and the students’ realities happen twice. The teachers said that when they worked with concrete materials the material was purchased by the students themselves, which showed that the school organization did not support this type of approach. It sounded like good approaches when they spoke about their teaching, but the reality was something different. We agree with the need of these two methods to create motivation and we felt bad that we could not see the students making use of their knowledge in practice. Through our observations motivation was mostly created through reward and
punishment. During interviews teachers and students added that motivation also was created through activities, connection to real life and the students' longing for being smart and satisfying the teacher.

7.3 How did teachers and students find the self-teaching attempts, carried out by the Swedish student teachers, regarding students' ability to learn mathematics?

The main lack in our self-teaching attempts was that we did not know the students well enough. Therefore, we afterwards understood that the tasks where at the wrong level. Lundgren, Säljö and Liberg (2010) states that if the level is not in line with the students' learning the task can become a barrier to learn. We think that the teachers, because of this lack, could not imaging learning to happen during our self-teaching attempt. Even so, the students chose to accept the challenge. We think that their positive attitudes made it possible for them to believe in this approach and it felt like they actually learned something good. Our self-teaching attempts were just a temporary approach and the students were not used to it. To achieve and develop mathematics skills and strategies through working with problem solving you need time (Taflin, 2007); time we did not have. The students wanted to continue with this approach, but to make it a success it is of crucial importance that the teachers also consider problem solving as a successful approach, according to Taflin (2007), which they unfortunately did not. Our conclusion is that problem solving is found in the cognitive perspective, the pragmatic perspective and the socio-cultural perspective.

7.4 Method Discussion

A difficulty during our stay at the school and especially during our interviews was the language that made it difficult to communicate properly. It made some interviews more controlled. The result of that was that some interviews became more like interviews based on quantitative survey areas. Differences in culture and concept meanings also made it difficult to understand and reflect on their organization. Many of the teachers seemed to be afraid of the headmaster because they asked us to speak positively about them to the headmaster. Because of this fear it seemed like they chose what they wanted us to experience. Although, we believe that the result of our study has a quite good reliability because we combined observations, interviews and self-teaching attempts that we made during these several weeks. We have used these three methods to guide us in our investigation of the three questions that we have to answer and we think that these methods were a good combination to get a good validity to our study. The biggest lack in our field studies was that we did not know the students who attended our self-teaching attempts. If the communication with the teachers would had been better we could had decided which class we could use during our self-teaching attempts, and in that way we would have known the students before the lessons began.

7.5 Final conclusion

The personal goal with this study was to develop in our profession. We feel that we have obtained a broader perspective and are now more open-minded than before, in our way of looking at teaching. Hwang (2003) writes that several perspectives can be used together to achieve a true picture of the reality. At our school we could see influences from all four chosen perspectives. We can not make the conclusion that they used only one perspective in their organization of teaching, but we have seen the
behaviourist perspective in a greater extent than the cognitive perspective, the pragmatic perspective and the socio-cultural perspective. These three perspectives focus more on the students as individuals. At our school the teachers spoke about individualizing and with that they meant that they wanted more personal time with every student. To achieve more individual attention for each student smaller classes were the only option, according to them. Individual approaches were not something the teachers mentioned they would apply if they got smaller classes. Although, this kind of approach is a way of teaching within the cognitive perspective, the pragmatic perspective and the socio-cultural perspective.

7.6 Suggestion for further research

The teaching training in Sweden and our profession as teachers is based on our context and circumstances to a greater extent than we realized before this study. This study can show that teaching is based on so much more than knowledge about different views of learning. Our study has also showed us that all teachers do not consciously apply a certain perspective, even ideas from different perspectives can be found in their teaching. A teacher’s way of teaching is also based on the circumstances, the culture and what goals the country has to develop their education. In India the main goal with education, according to our field study, is to make the country’s literacy rate higher. In Sweden the goals are different because we already have achieved high literacy rate and therefore have other goals, for example, working to individualize the school. To develop this study even further, an additional study could be about what ground the teachers, at our field study school, base their teaching on. Do they have other perspectives to get knowledge about different way of teaching? How do the schools in India develop their education and what kind of research do they use?
8. Reference list


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Appendix 1 - Observations

Observation scheme

1. How was teaching organized?

- How is the classroom organized?
- What is the teaching based on?
- How do teachers practise reward and punishment?
- What role do the students have in the classroom?
- What role do the teachers have in the classroom?
- Which approaches are used during the lessons?

2. What factors motivated students to study mathematics?

- How is the environment in the classroom?
- What about the relationships between; student – student, teacher – student?
- How do teachers practise reward and punishment?
- What approaches are used at the school to achieve learning and motivation?
Appendix 2 – Interviews

Interview questions for the teachers
• Do you think that the students value their education highly? In what way can you see that?
• What is the main purpose of the school, do you think?
• How do you plan your lessons? Do you do it by your own or together with other teachers?
• Do you follow any recommendations from this school or from the government?
• How do you reflect on your work?
• How do you do in the classroom if you see that the children are not at the same level in their knowledge?
• How do you think that the student learn things the best way?
• What is your function as a teacher in the classroom?
• What are the students' roles in the classroom?
• Who has the responsibility to motivate the students?
• Do you think that the instruction at school is rooted in everyday situations for the students?
• Can you describe your dream classroom within the mathematics subject?

Interview questions for the students
• Do you value your education?
• Why do you need to go to school?
• What is the main purpose of the school, do you think?
• Are you motivated to go to school?
• What makes you motivated?
• How do you think that you learn things the best way?
• What is the teachers function in the classroom?
• What is your role in the classroom?
• Do you think that the instruction at school is rooted in your daily life?
• Can you describe your dream classroom within the mathematics subject?

Interview questions for the teachers – about our self-teaching attempt
• What was positive and negative with our lesson?
• What do you think the students have learned during our lesson?
• Is this way of approach known to you?
• How do you practise problem solving in school?
• Do you think problem solving is important in school?

Interview questions for the students – about our self-teaching attempts
• What do you think about the lessons that we have hold?
• What was positive and negative with our lessons?
• Did you learn something during our lessons? (If yes) What did you learn?
• Is this way of approach known to you?
• Do you practise problem solving in school? (If yes) How do you practise it?
• Do you think problem solving is important in school?
Appendix 3 – Problem solving 1

Candy

32 pieces of candy cost 10 Rupees.

How many pieces do you get for 25 Rupees?

Make your own problem.

When you are going to solve the problem:

- Read the problem together in your group
- Figure out how to solve it
- Try to solve the problem
- Check your answer. Do you think your answer is reasonable? (Polya, 1970)

If you are done quickly; can you, in your group, find another way of solving this problem!
Appendix 4 – Problem solving 2

Ice cream

Lisa is going to buy ice cream and can choose from four different flavors. She wants two ice cream scoops.

In how many different ways can she choose her ice cream? Make your own problem.

When you are going to solve the problem:
- Read the problem together in your group
- Figure out how to solve it
- Try to solve the problem
- Check your answer. Do you think your answer is reasonable? (Polya, 1970)

If you are done quickly; can you, in your group, find another way of solving this problem!
Appendix 5 – Problem solving 3

Mows the lawn

Eric mows the lawn in two hours.
Mary does it in four hours.

How long time does it takes for Eric and Mary to mow the lawn together?

Make your own problem.

When you are going to solve the problem:
- Read the problem together in your group
- Figure out how to solve it
- Try to solve the problem
- Check your answer. Do you think your answer is reasonable? (Polya, 1970)

If you are done quickly; can you, in your group, find another way of solving this problem!