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PERCEIVED EFFECTS OF SUPPLEMENTARY TRAINING

A PHENOMENOGRAPHIC STUDY OF MATH TEACHERS' ONGOING DEVELOPMENT



Master's Thesis at Learning and Leadership

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Abstract

This phenomenographic study entitled “Perceived Effects of Supplementary Training – A Phenomenographic Study of Math Teacher’s Ongoing Development” presents the results of a survey taken by 189 math teachers regarding the perceived impact their supplementary training has had on the quality of their teaching. Five of these teachers were interviewed to provide in-depth data. The author, Robin Wilsson, is a student at the Master Program “Learning and leadership” at the department of Mathematical Sciences at Chalmers University of Technology. The survey contained questions about the types of supplementary training the teachers had participated in, and what their thoughts were on this. Matematiklyftet, a type of supplementary training developed by Skolverket, is of special importance because it aims at involving every math teacher in Sweden. A description of the phenomenographic approach is provided, and this method is used to evaluate the data from two survey questions. The semi-structured interviews are aimed at furthering the data gained from the survey by getting the personal views of teachers. The main conclusion is that Matematiklyftet was well received by the teachers involved in the study, and that supplementary training using similar methods should be implemented. Other conclusions include the fact that few of the teachers regard their official supplementary training as being effective, and that they wish to find new ways of teaching without using a text book.

Key words: Phenomenographic Study, Supplementary Training, Survey, Interview, Math Teachers, Matematiklyftet.

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This report is dedicated to my grandmother.

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1. INTRODUCTION

During my studies at the master program “Learning and leadership” at Chalmers University of Technology, I served as an intern at a school at the gymnasium level. While talking to some teachers in the lunch room, I asked if they observe each other teaching students, something called auscultation. The answer was that such things never happened. When I asked for a reason, some said they did not have time, while one man said it was a matter of principle; that only he should interfere with his teaching, not anyone else, even other teachers¹. I was appalled by this, and inquired further. One teacher admitted that such observations should occur, but does not, because the principal of the school dare not press the matter². The teacher I was following during my internship said that there was no time to spare on the schedule, and that if supplementary training was to happen, the teachers would have to pay the costs themselves.

This made me curious to find out if it really is this bad in every school, and thus I made it the objective for this report, because it is important to have a good school system. Unfortunately, when I started working on this report in early 2016, the results from the international evaluation reports PISA and TIMSS were steadily becoming worse. This was despite updated control documents, a new teacher education program, and the recent investment in supplementary training made by Skolverket called Matematiklyftet. Last year, this negative trend was broken. My intention is to shed some light at the situation we find ourselves in, and provide some ideas that may provide some much-needed help in these troubled time.

1.1 AIM

The aim of this study is to use surveys and interviews to find out what math teachers think and feel about supplementary training, and especially about Matematiklyftet. The phenomenographic approach will be used to analyze two of the survey questions. This and other results will allow some conclusions about supplementary training to be reached.

1.2 RESEARCH QUESTIONS

- RQ1. How do math teachers perceive that their received supplementary training, if any, has affected the quality of their teaching?

- RQ2. What important experiences have the teachers had in regards to supplementary training in general?

¹ The quote was “Mitt klassrum, min sandlåda!”, roughly translated to “My classroom, my playground!”.

² From what I remember, the quote was “Lärarkåren är en oerhört svår personalgrupp med många åsikter. Rektorerna varken vågar eller orkar tvinga på lärarna fler arbetsuppgifter.”

1.3 DELIMITATIONS

Only math teachers teaching at the upper secondary level, or gymnasium level, in the counties of Västra Götaland and Halland are considered. The participants in the survey and interview must have been teaching mathematics to children at the gymnasium level for at least three years during the last five years. To receive the invitation to participate in this survey, the teachers must have participated in either Matematiklyftet or been working at a school listed on the Gothenburg official web site. Also, the results and conclusions make no claim of being general; they are just based on the teachers having returned my survey or answered my interview questions.

1.4 THESIS OUTLINE

The second chapter of the report, Background, contains a short history of Sweden's school system up until today. It also presents two international assessment programs, TIMSS and PISA. Matematiklyftet, as well as a select few other types of supplementary training is detailed. Lastly, this chapter introduces the phenomenographic approach used to analyze two survey questions later in the report.

The third chapter, Method, contains information on how the teachers were selected for the survey and the interviews, as well as details about how these were created and used in this report. It also discusses ethical aspects of this study.

Chapter four contains the results of the survey and the interviews, and the final chapter is a discussion of the methods used in the report, as well as of the results presented in the previous chapter. It ends with conclusions being made based on these discussions, as well as recommendations for other studies resulting from the experiences made during this thesis.

2. BACKGROUND

In this chapter the context of the report will become evident. The theoretical framework will also be presented. In more detail, it contains the following:

- The chapter will start with a summary of some of the history of the educational system in Sweden. This summary will show that there are some problems with regards to student's results in school, among other things.
- Next, two international assessment programs are discussed, TIMSS and PISA. The results of Swedish participants in both these programs reveal a negative pattern, although in both programs, the most recent result is showing an improvement.
- A description of Matematiklyftet, a state sponsored project, which is designed to alleviate these and other problems related to students' results. It is aimed at increasing the educational level of math teachers by having them read math related texts, doing suggested activities with their students and discussing the results.
- The seven other types of supplementary training that teachers can be asked about in the survey are presented, and since teachers report to have been participating in them, two specific types are detailed: Kleindagarna, and Matematikbiennalen.
- Phenomenography will be used to analyze the two survey questions. This chapter will thus conclude with a summary of this theoretical framework. In short, phenomenography tries to find as many different points of view as possible from the available data.

2.1 A SHORT HISTORY OF THE SWEDISH EDUCATIONAL SYSTEMS

During the 19th century the number of people living in cities doubled (from 10 to 20 percent of the number of people living in all of Sweden), and doubled again during the first 40 years of the 20th century. By 1950, more than 50 percent of the Swedish population was urbanized. This demanded much of the school system, which was also becoming more including. Whereas before, the education was more suited for children coming from the highest echelons of society, it was now easier for children from all families to get an education, and thus compete for the most desirable jobs. Per Lundgren, this was in a large part due to experiences made during the Second World War; democracy demanded development, and inclusion. Because of much discussion and controversy, a nine year long involuntary basic level school system was called for in 1948. However, the older systems of education were still in use until 1962. (Lundgren, 2012)

Due to the cold war between USA and Soviet, education was viewed as a means to compete: a better educated population produced more goods and could consume more, boosting the economy. Thus, from 1950 to 1970, almost unbelievable changes occurred in the productive capacity of the nation. People could afford things before seen as pure luxury, such as cars and refrigerators. (Lundgren, 2012)

In 1958 *International Association for the Evaluation of Educational Achievement* (IEA) was founded and compared countries against each other, spurring on the development of the educational systems. It is of importance to this report that in 1995 IEA created *Trends in International Mathematics and Science Study* (TIMSS) and that it started to evaluate, every four years, the levels of mathematical understanding found in children. Later, in 2000 *Organization for Economic Co-operation and Development* (OECD) began a similar but different program called *Programme for International*

Student Assessment (PISA) which also studied mathematical development every three years. (Lundgren, 2012)

Even though in 1962, the system of 9 years of basic involuntary education was implemented, it did not solve a specific problem that had plagued the educational system: differentiation due to the students' social backgrounds. Basically, before 1962 there were many different school systems, and this meant large differences in educational quality. As teachers began teaching in the new system, they still used their old methods, which was based on the specialized systems of the previous schools. Even though the plan was for the teachers to individualize their teaching due to each child's needs, this did not happen. (Lundgren, 2012) Instead, the system of "special teaching" was the main system used to help those children whom had problems understanding the teacher. At first, it was used only for students with bodily defects (blind, deaf, et cetera), but was eventually expanded to include students with other problems, and in the end involved students with, for example "*emotional difficulties, special learning disabilities and cultural and social handicaps*"³ (SOU 1974:57, 1974, p. 137). In 1972, approximately 40 per cent of the children had to use this sort of teaching. (SOU 1974:57, 1974)

In addition to these nine years of basic education, there were five sorts of voluntary higher education. Comparison in terms of merit proved difficult, which also added to the differentiation problem. Starting in 1960, this system was evaluated and found lacking, and in 1964 the number was reduced to three sorts, and finally in 1971, there was only one sort of higher education: the gymnasium level (Lundgren, 2012). The gymnasium is an upper secondary school, two to four years of length, which prepares the students for a higher education at the university (Skolöverstyrelsen, 1970).

In 1965, in connection to the changes of the higher educational system, the math teachers at this level were offered an in-service training program, containing new materials to teach, but no help was supplied with regards to how to use the material when teaching. The new content was vast and many teachers found it complicated. Also, the time the students spent in class learning math was drastically reduced. Thus, much of the new content was being skipped entirely. This resulted in lowered test scores and grades for the students. In 1972, the contents of math were divided into two parts: essential and non-essential. Since the non-essential part was not on any centralized test, it meant that almost no teacher taught it to their students. But, since the contents of the math course was still too vast, another revision was made in the late 70s. One major problem resulting from this was that eventually some of those students became teachers themselves. This was especially problematic since some of those teachers had just received two years of gymnasium level education, in programs not designed to teach mathematics. This, among other things, resulted in suboptimal scores from the next generation of students. As a way of trying to help solve these problems, new textbooks were developed. The next major change to the gymnasium level was in 1994 (more on this later). (Emanuelsson, 2001)

Following the curriculum of 1969, a new project called Delta was developed for use in the nine year long basic level education system. There was a need to boost children's level of mathematical understanding, since few children applied to scientific and technological programs at the gymnasium level. Delta was an in-service training program for around 40 000 math teachers, but sometimes other teachers and even parents were involved. Set theory was included among the many changes of the math that was to be taught. However, even though many people were involved, and many healthy

³ "emotionella svårigheter, speciella inlärningssvårigheter och kulturella och sociala handikapp"

discussions about math were taking place in Swedish society, the Delta project did not have a large impact on the actual teaching. Many teachers refrained from using this “new math” in their classrooms, since it was not clear how it was to be used and implemented. Thus, they used their textbooks as they were used to, and the test results showed that students were actually performing worse than before the Delta project started. (Emanuelsson, 2001)

Sverker Lundin writes that the purpose on the “new math” was to fundamentally change the way math was to be taught. To understand his reasoning and conclusion, some background on his work is needed. Lundin suggests that math as a school subject had two main goals during the 19th century through to the 1950s or so, namely to keep students occupied, and to differentiate students in two rough groups: those that can ascend into higher education, and those who cannot. He goes on to say that math is a mechanical exercise, designed as a contest, with very little to do with the real world, except basic algebra and some other things. The “new math” was a result of critique against this use of mathematics, and was supposed to change all that in order to make teachers teach math that actually has a purpose, and also change the way teaching was done, in order to make the children actually understand what was being taught. However, Lundin claims that not even this “new math”, or the “new” theories about learning, was “true” in a metaphysical sense, and that reality took back control; the implementation was just too rough. The judgement, as seen in the paragraph above this one, was hard. The international studies and the failed implementation demanded that the “new math” was to be disabled. By the start of the 1970s the old system was again in effect, and with it the cynical view that math is a time-wasting activity, and a sorting algorithm for children. (Lundin, 2008)

However, in 1975 a new project based on Delta called MALM was developed and finalized in 1979. This project had solved many of the problems Delta had, such as the implementation issue and contained a simple tutorial for teachers to follow. It was being announced in various ways but did not reach many teachers. The schools that did use this material noted an increase in student performance. (Emanuelsson, 2001)

During this time, almost no in-service training was aimed at math teachers at the gymnasium level. Of those few such programs that did happen, most did not help with mathematics, but with new technology, such as calculators and computers. Emanuelsson states that math, as a subject, has a long tradition of being textbook reliant and is a subject in which students are doing much work alone, and that even though many ways existed to help teachers to educate themselves in pedagogy, such as by reading *Nämnamnaren* (a Swedish magazine specialized in providing help texts for math teachers), very few did so. (Emanuelsson, 2001)

During the 80s, the school system was made more decentralized. It was based more on goals now than contents of the education; schools were given more freedom, but was also to evaluate their teaching and make efforts to develop it. From 1992, schools independent from the state could get financing; by 2008 nearly one fifth of every child attended such a school. Also during the 90s, many reforms were implemented to develop the educational system. This led many more people, both children and teachers, to become involved in educational activities; in fact, after this period almost twice as many were involved in basic education, or 31 per cent of the Swedish population. (Lundgren, 2012)

By 1994 all programs on the gymnasium level was set to three years of length, and a common core of subjects was created that would be the same in all programs. Mathematics was one such subject. Compared to before these curriculum changes, around 40 000 new students per year was to learn

mathematics at this level. A study material for math teachers, which was supposed to help them in this transition, was developed by Skolverket⁴, but the project was cancelled. It instead was finished by Nämnamnaren, in a theme called "*Mathematics - a core subject*"⁵. (Emanuelsson, 2001)

During the 21st century, education is seen as a way to stay competitive on the global market. The 9/11 terrorism act started a new war, per Lundgren. It led to increased control and monitoring in all areas of society. The school system is put under more scrutiny, and the number of centralized tests increases. (Lundgren, 2012)

In line with Emanuelsson, Skolinspektionen writes in a text in 2009, following an extensive evaluation of around 25 % of the schools at the gymnasium level, that 20 % of those schools were so reliant on the textbook that some of the teaching goals was not reached. This means that the grades of the students were reached on the wrong basis. Some of the teachers were simply not aware of the teaching goals, while others knowingly designed the teaching so that students could not reach the highest grades. Often, skills concerning analysis and reasoning about the subject taught was set aside for simple textbook exercises. Also, in 20 % of the cases, Skolinspektionen found that not enough effort was made to include students that needed more help, or that thought the subject was too easy. (Skolinspektionen, 2009)

In the new curriculum for the gymnasium level made by Skolverket in 2011, critical thinking and analyzing skills is set out to be important teaching goals. The document also says that children should work both independently as well as in groups. It defines four different aspects of knowledge, and explicitly states that the teaching cannot focus on just one of these, for example "facts" while neglecting others, for example "understanding". These are general goals. As to goals specific to the subject of math, it is stated that a variety of ways of teaching should be utilized. (Skolverket, 2011)

2.2 TIMSS

TIMSS (Trends in International Mathematics and Science Study) is a study in which Sweden has been a part since its start in 1995. Every fourth year, students in 4th grade and 8th grade is evaluated, though each participating country can decide at each instance if either or both student groups will be evaluated. The students get to do a test containing questions both requiring hand-written answers in text boxes, and multi-choice questions. The context is mathematics and natural science. There are 200 possible questions per subject and age category, but each student only answers 45-60 of these. In addition, a survey is taken by the students, their teachers, principals, and for the younger children also their parents, and even Skolverket gets a survey. Each of these groups receives a different survey. (Skolverket, 2016a)

The study is based on a model that enables an evaluation of three levels of education: the curriculum that is supposed to be taught, the curriculum that is actually taught, and the effects of the curriculum on the students learning and how they experience this. The results of the written tests have shown a steady decline ever since the start in 1995, except for the last instance: the trend was broken in 2015,

⁴ Statens Skolverk, commonly called Skolverket, and formally Skolöverstyrelsen, is a Swedish government agency tasked with overseeing education.

⁵ "Matematik – ett kärnämne"

where the results were better than those of the preceding instance. However, the results are still worse than they were at the start of the study. (Skolverket, 2016a)

2.3 PISA

PISA (Programme for International Student Assessment) started in 2000 and is created by OECD⁶. By use of questions regarding reading comprehension, mathematics, and natural science, PISA seeks to find out how prepared the participating 15-year old children are in facing the future⁷. The tests occur every three years, and each time one of the three areas are in focus. Thus, in 2015 natural science was evaluated more extensively. 5500 children in Sweden took the two-hour long test that year. Of importance is whether the children can use, gather and interpret information correctly. Also, their understanding of certain processes is tested, as well as general problem solving. The children do not all get the same questions. In this way, more areas can be covered. Thus, the test is not focused on comparing the individual children, but the knowledge level of the country. In addition, a survey is filled out by the children. This survey asks about the organization in the school, the motivation of the students, and their attitude towards natural sciences, among other things. Their principals also get a different survey to fill out. (Skolverket, 2016b)

The test evaluates the knowledge level of each participating child in each country among a six-level scale, in each of the three fields. If children do not achieve level 2, they do not “pass” the test, and if they grade level 5 or 6, they are deemed especially talented. This report is about mathematics, and in this field the results of the 2015 test shows that 21 percent of the Swedish children did not achieve level 2, where 23 percent is the OECD mean. Also, 10 percent reach level 5 or above, and the OECD mean is 11 percent. Of particular importance, however, is that the results of Sweden have shown a negative trend since 2003, broken only in the most recent test in 2015. This test is better than the preceding test, but still worse than the 2003 results. (Skolverket, 2016b)

2.4 MATEMATIKLYFTET

In 2012, Skolverket decided to create a supplementary training program aimed at math teachers of all kinds (except pre-school teachers, although they have since been included). *“The supplementary training seeks to increase the pupil’s goal completion by strengthening the math teaching”*⁸ (Skolverket, 2012, p. 1) The plan was to train certain math teachers to act as supervisors for other math teachers by use of peer learning. Principals also received instruction. The budget was initially set to 649 million SEK, and the project was a joint effort from Skolverket and NCM (Nationellt Centrum för Matematikundervisning). Funding could be granted both for the training of principals and supervisors, and for the teachers participating in Matematiklyftet. (Skolverket, 2012)

⁶ Organisation for Economic Cooperation and Development

⁷ “PISA syftar till att undersöka i vilken grad respektive lands utbildningssystem bidrar till att 15-åriga elever är rustade att möta framtiden.” (Skolverket, 2016b, p 9)

⁸ “Fortbildningen syftar till att öka eleverns målpuppfyllelse i matematik genom att stärka matematikundervisningen.”

Per my supervisor, the project started in earnest in the fall of 2013. Then, only a few modules were ready, including three about number perception aimed at children not yet old enough to attend the gymnasium level. These modules were being taught to teachers at the same time as other teachers were being educated in how to supervise these modules.

Matematiklyftet thus meant teaching the teachers. They would discuss classroom situations and didactics. The idea was that this collegial learning would continue after the end of the project. The exact implementation was left for the schools. The material, called modules, could (and still can) be found online. Each module focused on a specific teaching problem, for example problem solving, or digital content, or teaching math for students in specific programs. Some of the didactical perspectives was the same in every module, for example norms in the class room, and the teaching of math using the abilities outlined in the curriculum. This material was created by researchers and educators at many of Sweden's colleges and universities. (Skolverket, 2013)

Each module was planned to be used during a whole semester, and was done in eight parts. Each part would last for two weeks, and was in turn consisting of four steps. First, individual preparation by each teacher, mostly by reading texts. Then collegial work would commence, often involving discussing the material read and planning a lesson based on the material. *"The opportunity to develop the teaching together is an important part of Matematiklyftet."*⁹ (Skolverket, 2013, p. 9) The last elements of each part involve implementing the lesson, and then getting back together to discuss the results. (Skolverket, 2013)

Per the result of the evaluation report of Matematiklyftet done by Skolverket and their partners, the total cost of the projects was half a billion SEK, which when compared to the above stated budget of 649 million is roughly 150 million less than this budget allowed for. (Skolverket, 2016c, p. 31) Per the evaluation survey, the teacher's methods have improved. This report states that this project was well received by the teachers, and that the method of collegial learning seems to work well. The conclusion of the report is that similar supplementary learning projects should be implemented (Skolverket, 2016c, p. 2). Grants were given to over 35 000 teachers, of which 86 % had a teacher's license in math. The project reached 76 % of the math teachers in Sweden (Skolverket, 2016, p. 6). The evaluation report does not include whether the students have benefited from Matematiklyftet with regards to goal completion, but this is being investigated by an institute.¹⁰ (Skolverket, 2016c, p. 11)

Even though improvements to the teaching have been reported, teachers in the gymnasium level *"[...] both value the investment and estimate the contribution to education significantly lower than math teachers that teach in elementary schools and in other types of schools."*¹¹ (Skolverket, 2016c, p. 13) The reason for this is believed to be the difficulty of adopting the teaching to fit the contents of the modules, among other things. (Skolverket, 2016c, p. 13) The collegial talks have been very appreciated by all types of math teachers, even though there were complaints regarding the high scope of the project and the stress this caused. (Skolverket, 2016c, p. 14) Regarding the long-term benefits of Matematiklyftet, it is concluded that teachers now vary consciously their education to a higher degree,

⁹ "Möjligheten att utveckla undervisningen gemensamt är en viktig del av Matematiklyftet."

¹⁰ Institutet för arbetsmarknads- och utbildningspolitisk utvärdering (IFAU).

¹¹ "[...] både värderar satsningen i sin helhet och skattar fortbildningens bidrag till undervisningen signifikant lägre än matematiklärare som undervisar i grundskolan och i övriga skolformer."

and claim to work more evaluatively. The study shows that this is an individual enhancement, and not a cooperative one (Skolverket, 2016c, p. 17).

The math teachers seem to have worked in a similar way with Matematiklyftet, regardless of the specific module being used. The modules directed the teachers' work, and thus the variation of implementation was low. The modules, the collegial talks, and the supervisors were all key parts (Skolverket, 2016c, p. 20-21).

As stated above, the conclusion of the Skolverket evaluative report was that the method of collegial learning should be used again in similar projects. It is emphasized that it needs a focus to be effective, such as a specific learning problem, or a specific class room situation, and that this focus is relevant to the teachers involved. Some tweaking is needed to better include the principals in this. (Skolverket, 2016c, p. 21-23)

Even though the original plan was to have the project running from 2012 to 2016, an additional investment was made to reach the teachers that yet had not participated in Matematiklyftet. Applications could be filed online to receive funds for implementing a single module. (Skolverket, 2017, web page) The ruling from the Swedish government that enables this continuation grants an additional 8 million SEK to the project (Regeringsbeslut, 2017).

2.5 OTHER TYPES OF SUPPLEMENTARY TRAINING

Besides Matematiklyftet, questions regarding seven other types of supplementary training are found in the survey. These types are: seminars; courses; auscultation; official supplementary training; unofficial supplementary training; self-studies; and Lärarlyftet. Seminars, courses, and self-studies need no introduction. Auscultation involves a teacher observing another teacher's lesson without participating in it, and a discussion about the lesson afterwards. An alternative to auscultation is discussed in Chapter 5, involving discussions of video recordings of the lessons performed by the teachers. Borko et al made a study where they used video recordings to foster productive discussions about teaching and learning. They studied teachers during a two-year period, where the teachers attended several workshops during which talks about video recordings of their lessons took place. As time went by, these discussions became more productive. (Borko et al, 2008) *"Participating in conversations focused on carefully selected video clips, and with a specific analytic focus in mind, seemed to foster learning about topics that were meaningful and important to these teachers, and motivated them to want to continue to learn, improve their teaching skills, and better serve their students."* (Borko et al, 2008, p. 434)

The exact meaning of "official", "unofficial" and "other" supplementary training was left for the teachers answering the survey, and the teachers' answers are presented in Chapter 4. However, "official" supplementary training should be arranged by the school, while "unofficial" should not, and "other" should not fit under any listed description. Some teachers referred to two distinct activities when detailing "other supplementary training": Kleindagarna, and Matematikbiennalen, and both of these activities will thus be presented below.

Kleindagarna involves both gymnasium and university level teachers attending lessons given by professors. The lessons involve more or less advanced math topics. The two different types of teachers will then work in groups to try to implement the new material in a lesson of their own, that could be taught to children at the gymnasium level. It is held during three days, three times per year, at the Mittag-Leffler Institute outside of Stockholm. (Kleindagarna, 2017, web page)

Matematikbiennalen is a sort of fair, where teachers, scientists, and others interested in mathematics meet to attend seminars, exhibitions, and workshops. It is held two days every other year in a city somewhere in Sweden, and will be held in Karlstad during 2018 where over 200 different program items will be available. (Matematikbiennalen, 2017, web page)

The last type of supplementary training is Lärarlyftet: teachers of many different types are given the opportunity to attend courses mostly using distance teaching. The goal is for the involved teachers to gain additional competences. (Lärarlyftet, 2017, web page)

2.6 PHENOMENOGRAPHY

The word “phenomenography” was coined in 1979 by Ference Marton. (Marton, 1981) The word combines the two Greek words ‘phainemenon’, meaning appearance, and ‘graphein’, meaning description. It also concerns the concept of intentionality, meaning that people experience external phenomena within themselves as representations of the real phenomenon. This is done based on the context of the situation at hand. For example, a hotel room number must be remembered in its entirety, while it is seldom important to remember exactly how much money you spent when grocery shopping. In these two examples, the number might be the same. (Pang, 2003)

“Phenomenography is not a method in itself, [...] nor is it a theory of experience [...] Also, phenomenography is not merely an opportune player that can assume the role needed for the moment. Phenomenography is rather a way of—an approach to—identifying, formulating and tackling certain sorts of research questions, a specialization that is particularly aimed at questions of relevance to learning¹² and understanding in an educational setting.” (Marton & Booth, 1997, p. 111)

Of prime importance in phenomenography is the concept of “conception”. Many different words may be used to describe what a conception is. For example, it may be a way of experiencing phenomenon, but you could also substitute the word ‘experiencing’ for ‘conceptualizing’, ‘seeing’, ‘apprehending’, or ‘understanding’. Although the individual meaning of these words differ, they all help in capturing the meaning of the word conception. (Marton & Pong, 2005)

Marton & Booth points out that you cannot experience something without affecting the thing experienced. For example, the world would not be the same without humans. Also, when a human is describing something, this is filtered through the human mind, with all its limitations. Thus, the description depends on the describer. This means that our descriptions of the world are partial, and we cannot hope to find every possible viewpoint. This not needed, either. The phenomenographic

¹² See comments about this in Chapter 5.2.

approach seeks to find every description present in the data, not every description there could possibly be. (Marton & Booth, 1997)

To be able to notice a feature, there must be a variation present, so that a comparison can be made. Meaning is created from discerned variations. When analyzing transcripts of interviews¹³, Marton & Pong (2005) states that a “*unit [of conception] was formed whenever there was sufficient evidence that a particular overall meaning had been expressed*” [emphasis theirs]. (Marton & Pong, 2005, p. 337)

Answers in themselves are classed by Marton & Booth as first-order perspectives. How the answer came to be is classed as second-order perspectives, and are of interest in phenomenography. This is what is called a unit of conception in the paragraph above. (Marton & Booth, 1997)

These units of conception should form a system called the ‘outcome space’ that aims to capture all the different ways the phenomenon can be observed. It is important to note that while every observer is unique and has its own context, the goal is still to capture every possible point of view. Thus, phenomenographic research looks at groups of people in a holistic sense; no single interview or survey result should be looked at in isolation. Instead, it is the relationships between the units of conception that is of importance. (Åkerlind, 2005)

There are three criteria for the formed conceptions. Firstly, they should distinctly describe a certain point of view. Secondly, there should be a logical and often hierarchical¹⁴ relationship between the formed units. Thirdly, as few units of conception as possible should be formed. (Marton & Booth, 1997)

Once the outcome space is determined, a second stage is to analyze these units, and find “*the elements of the phenomenon that were focused upon, and to devise a description of each conception’s structural aspect*” [emphasis theirs] (Marton & Pong, 2005, p. 337). This entails studying variations of answers within the same unit. An example: in their study, one of their units of description was defined as “price as reflecting the inherent value of the object”. The structural aspect of this unit is the methods used to assign this inherent value, such as the size of the object, its quality of construction, and so on. (Marton & Pong, 2005)

Every answer need not fall within one of the formed units. There can furthermore be a shift in conception both between different questions, as well as such a shift when answering a single question, even happening without a follow-up question being asked. For example, the interviewee might at first answer in a way corresponding to one unit of conception, only to shift towards another unit. This might happen within a single sentence. (Marton & Pong, 2005)

¹³ See comments about this in Chapter 5.2.

¹⁴ See comments about this in Chapter 5.2.

3. METHOD

This chapter covers, in order, an outline of the work done, then the ethics of the study is disclosed, then details about the survey, and lastly details about the interviews. For instance, it contains information on how the teachers that would receive the survey and take part in the interviews were selected, which program were used to create and send the survey. An analysis of the data gathered is found in Chapter 4, and comments on some important results is found in Chapter 5. For the complete list of untranslated questions used in both the survey and the interview, see their respective appendices.

3.1 IMPLEMENTATION

In this section, a breakdown of the work done in this report is presented.

Email addresses were gathered in February 2016. See Chapter 3.3 for details. LimeSurvey, a free open source program found online¹⁵ and set up on a Chalmers server with the help of Samuel Bengmark (Head of the Masterprogram Learning and leadership), was used to distribute the 574 surveys. A few teachers had problems filling out the survey, but almost all their concerns were due to user error, like not being able to proceed because of not having provided answers in the correct manner. However, in one case, the errors encountered was not resolvable for some unknown reason, and the teacher could not complete the survey.

In this report, semi-structured *“life world interviews”*¹⁶ are used, each containing fifteen main questions. “Life world” simply means the day-to-day world in which the interviewee lives in: it is experienced directly and independent of explanations. This view is based on phenomenology. (Kvale, 2014, p. 46) These interviews are defined as follows: *“an interview with the goal of getting descriptions of the life world of the interviewee in order to interpret the contents of the described phenomenon.”*¹⁷ (Kvale, 2014, p. 19) These interviews are also called *“unstructured”*¹⁸ by Kvale. Because of this, many decisions must be made during the interview. Five teachers were interviewed in April 2016 using fifteen prewritten main questions. See Chapter 3.4 for details on the selection process. The interviews were taped, and transcribed in April 2017.

Both the survey and the interviews were tested on volunteers (eight for the survey and one for the interview) and adjusted per their feedback before being sent to the teachers.

The gathered data was analyzed in 2017. The survey questions were analyzed first. For most questions, the technique used was to simply organize the data in usable form: count many answers of each kind there were. This data was then presented in either text, tables or diagrams as appropriate. A few questions were treated with the phenomenographic approach outlined in Chapter 2.5. For these two

¹⁵ <https://www.limesurvey.org/>

¹⁶ “livsvärldsintervju”. (Kvale, 2014, p 19)

¹⁷ “Den definieras som en intervju med målet att erhålla beskrivningar av intervjupersonens livsvärld i syfte att tolka innebörden av de beskrivna fenomenen.” (Kvale, 2014, p 19)

¹⁸ “ostrukturerad” (Kvale, 2014, p 32)

questions, both of whom used text boxes as a means of providing answers, the answers were grouped per the discovered units of conception, and organized in hierarchies as needed.

As for the five interviews, the method used to analyze the data was to organize the questions in four categories, and then simply post relevant information. An alternative would have been to present the results of each teacher in order, but this method was deemed inferior.

3.2 ETHICS

This report has been produced in accordance with the ethical guidelines presented by Vetenskapsrådet¹⁹, which is a Swedish government agency. It is commissioned by the government, and its goal is to help researchers by providing support and advice. They have four basic demands:

1. The researcher must inform the people affected by the research about the purpose of the study being performed.
2. Participants in a study shall decide for themselves how they want to partake.
3. The information gathered from the participants in a study shall be given the highest possible confidentiality, and this information shall be stored in such a way as to prevent unauthorized people from gaining access.
4. The information gathered from individuals shall only be used for purposes of research.

These four demands are named Informationskravet (the Information demand), Samtyckeskravet (the Consent demand), Konfidentialitetskravet (the Confidentiality demand), and Nyttjandekravet (the Usage demand).

The first demand is satisfied by two texts given to the teachers before they took the survey. First, the email containing the link to the survey. This email contained basic information about me and that the purpose of the survey is to study how supplementary training is performed by teachers at the gymnasium level. This text can be found in Appendix 1.3. Second, immediately before answering the first survey question, a longer and more detailed text was presented. This text can be found in Appendix 1.1. It informs the teachers that the purpose of the survey and the interviews is to gather and analyze opinions and experiences regarding supplementary training. The text tells of the scope of the survey, and that it is used as the basis for my master's dissertation.

The second demand is satisfied by the fact that the teachers completed the survey. Per Vetenskapsrådet, this is accepted practice. In the introductory text prior to the first survey question, it also says that the survey is voluntary, and that the act of completing the survey is taken as permission to use the information provided for research purposes, which satisfies the fourth demand.

The third demand is satisfied by the fact that the web page used to make the survey, LimeSurvey, uses a random code for each participant to make the list of survey responses downloaded to my computer anonymized unless the list of survey respondents is also accessed, which can only be found on the LimeSurvey web page. Only myself and the one responsible for my Master's Program, Samuel Bengmark, can access this web page (since he set it up for me to use). In the introductory text prior to

¹⁹ The reference for this section is (Vetenskapsrådet, 2017).

the first survey question, it also says that no one besides me will be allowed to access the information. The text erroneously says that the data will be stored for just three months.

3.3 THE SURVEY

Skolverket provided 354 addresses to mathematics teachers teaching students at the gymnasium level that had been involved in Matematiklyftet during any or all the semesters of 2013-2016. A further requirement was that they had been working in either Västra Götalands län, or Hallands län.

The official homepage of Gothenburg²⁰ contained a list of around 50 schools. For each of those schools, one of two things were done. Either there was a list of employees on their home pages that could be used to identify mathematics teachers and gain access to email addresses. If this was not forthcoming, the addresses were gained by contacting someone on the school and asking for an email containing contact information to their mathematics teachers. By this method all the mathematics teachers employed to every one of these schools were identified. This method yielded 241 addresses.

These lists were checked for doubles, and 21 such doubles were found. The remaining 574 addresses was used as a basis for the survey.

When the program used for the creation and distribution of the survey, LimeSurvey, sent out mails asking for participation in the survey, 21 such mails were found to be undeliverable. 1 of these were found to originate from the list gained by using the official Gothenburg website, and 20 of these were from the list submitted from Skolverket, and from among these 20 addresses 15 used the same web domain.

From the 574 surveys that were sent out, 159 completed surveys were collected. 122 of those teachers answered "Yes" on the first survey question, and thus qualified for taking the whole survey. Those 122 completed surveys were the basis for the survey results found in Chapter 4.1. A spot-check was made to ensure answers originated from both lists, and this was found to be the case.

3.4 THE INTERVIEW

The selection process involved sorting out, from among the survey results, the teachers that were willing to be interviewed. This amounted to 49 teachers.

Since this were too many to justify a detailed selection, the second step in the selection process was to find 20 teachers that wrote long and/or detailed answers to the survey questions that allowed the respondent to write answers in text boxes. This is based on the idea that these teachers showed a desire to answer the survey with more than the minimum effort, and thus might have more to say.

The third step was to read the answers submitted from these 20 teachers and find 10 teachers that wrote interesting comments, and that also answered the questions as differently as possible. This method is in line with the choice of phenomenography as the means of data analysis. What was

²⁰<https://goteborg.se/wps/portal/start/forskola-och-utbildning/gymnasieskola/gymnasieskolor/>

deemed interesting is, naturally as well as unavoidably, a subjective thing. The criterion of needing the answers to be different from each other was set in order to maximize the chance of discoveries being made in the interviews because of different viewpoints being explored.

The fourth step was contacting these 10 teachers to find out if they still were interested in the interview. The email being sent contained this inquiry, as well as general information about how the interview could be performed. It also contained the information that only five teachers were to be chosen, and thus that their responding positively might not result in them being chosen.

From among the responses, five teachers were sent a confirmation that they had been chosen, and practical details regarding the interview.

Despite the goal of having different sorts of people interviewed, there are some similarities between all of them. For one thing, they all teach math as one of their primary subjects, and they all have a license to teach mathematics. For another, they all participated in Matematiklyftet, and all of them except Eric responded that Matematiklyftet had a highly positive impact on their teaching (Eric did not choose Matematiklyftet as one of the three most impactful kinds of supplementary training). More detailed profiles on each of the five interviewees can be found in chapter 4.2.

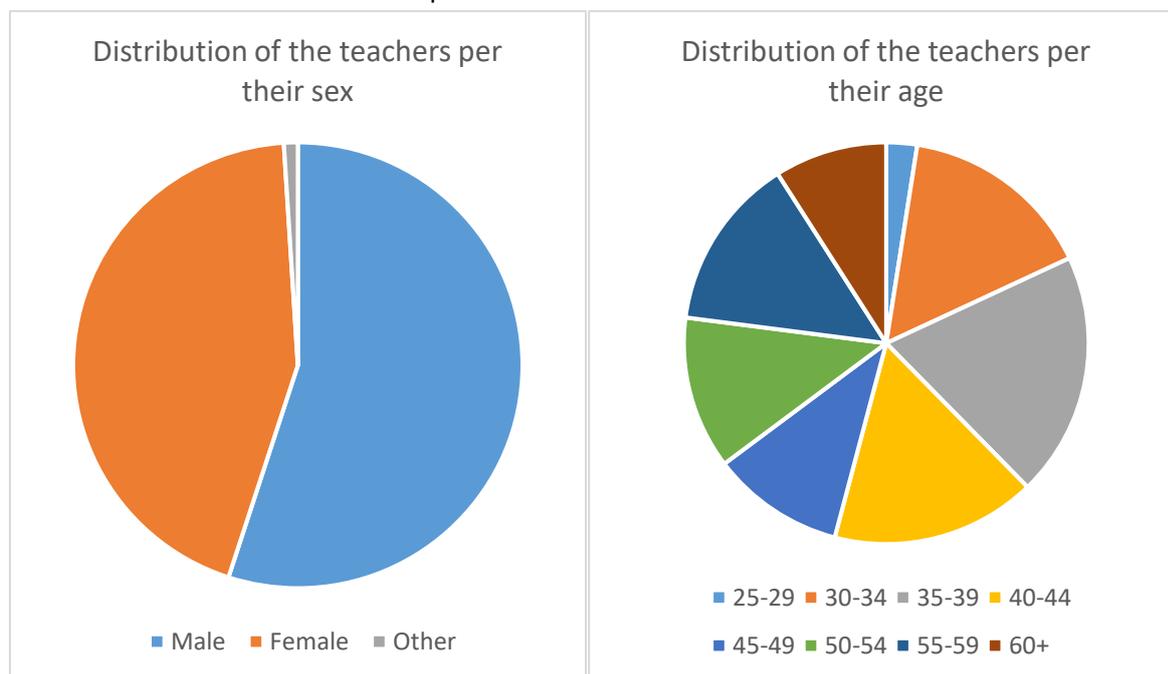
4. RESULTS

This chapter contains analyzed data from the survey and the interview.

4.1 THE SURVEY RESULTS

BASIC RESULTS FROM THE SURVEY

The group of teachers that answered “yes” on the first question of the survey about whether they have been teaching math for at least three years, and thus are of interest with regards to this report, consists of 122 teachers out of the possible 159.



Diagrams 1 and 2: Distribution of the teachers per their sex and age.

All but 15 have a university/college education, with just three only having a gymnasium level education. Half of them have studied between three and four semesters in college, while one out of four have studied four semesters or more in college. All but six of them have a permit to teach mathematics at the gymnasium level, and all but three teach math as a core subject. One out of three have worked as a teacher for between six to ten years, and ten percent worked longer than 20 years.

Based on survey questions using five stages of consent, the majority like their school, have a close relationship with their coworkers, continuously reflect on their teaching, and discuss problems and opportunities about their teaching. In the comments section, four teachers complained about their work load. One says that the work load affects happiness, and the other three says that it results in not enough time to meet other teachers; even if Matematiklyftet allowed for this, it will not affect next year. One teacher says that Facebook is a great arena for discussions and supplementary training.

The number of teachers thinking that their principal has a somewhat clear understanding of the quality of math teaching in their school is 46, and 25 agree completely. However, 30 do not fully agree with

this, and 13 do not agree with this at all. One teacher says in a comment that the principal at the school is result focused, and does not know about the subject of math, nor about the quality of the teaching. Another teacher says that principals do not know much about math problems, or the pedagogic challenges it brings. On a more positive note, one teacher says the principal got conversant with math through Matematiklyftet.

Two of the most important questions of the survey were the following: “Have you participated in the following types of supplementary training **during the last five years?**”²¹ ²² and “Which types of supplementary training, in which you have participated, did in your opinion have the greatest impact on your role as a mathematics teacher?”²³ For the former question, there were nine possible answer choices, detailing different kinds of supplementary training, and no limit on how many of these answers the survey taker could select. For the latter question, there were ten possible answers: either the survey taker could select up to three of the previous nine choices, or it was possible to select only the tenth answer, which was that supplementary training had had no impact. The answers to the first question is presented in table 1 below.

Have you participated in the following types of supplementary training during the last five years?	Yes	No	Don't know
Regular seminars/meetings within the same subject	104	15	3
Concluded/ongoing course, for example through Konvux or the University (regardless of subject)	39	81	2
Auscultation, at least once per semester (Auscultation means that you have been present when other teachers have done work in the classroom throughout their whole lecture, without having participated, and perhaps given feedback afterwards)	67	55	0
Official supplementary training arranged by the school	82	36	4
Unofficial “supplementary training” (having had talks that developed you as a teacher, for example with colleagues or friends)	104	15	3
Self studies (evening/weekend/other free time)	78	42	2
Matematiklyftet	104	18	0
Läraryftet	13	105	4
Other type of supplementary training (specify in a later question)	33	80	9

Table 1: A compilation of answers to the question “Have you participated in the following types of supplementary training **during the last five years?**”

The answers shown in Table 1 show that 85 percent of the teachers had attended seminars, Matematiklyftet, as well as had productive talks. While this and other results might be interesting, such as the fact that few teachers participated in Läraryftet, perhaps even more interesting is whether the teachers believed these activities were among their top three most important types of supplementary training. Table 2 below shows how many of the teachers selected a particular type of supplementary training as one of their three choices. It also shows the relative frequency of the teachers whom had done a specific type of supplementary training **and** that also thought this had the greatest impact on their role as a mathematics teacher.

²¹ The emphasis in bold text was part of the original question, so it is kept here.

²² “Har du deltagit i följande sorters vidareutbildning **under de senaste fem åren?**”

²³ “Vilka sorters vidareutbildningar, som du genomfört, anser du haft störst inverkar på din roll som matematiklärare?”

Which types of supplementary training, in which you have participated, did in your opinion have the greatest impact on your role as a mathematics teacher?	Number of answers	Relative frequency
Regular seminars/meetings within the same subject	51	51/104 = 49 %
Concluded/ongoing course, for example through Konvux or the University (regardless of subject)	13	13/39 = 33 %
Auscultation, at least once per semester (Auscultation means that you have been present when other teachers have done work in the classroom throughout their whole lecture, without having participated, and perhaps given feedback afterwards)	20	20/67 = 30 %
Official supplementary training arranged by the school	10	10/82 = 12 %
Unofficial "supplementary training" (having had talks that developed you as a teacher, for example with colleagues or friends)	50	50/104 = 48 %
Self studies (evening/weekend/other free time)	42	42/78 = 54 %
Matematiklyftet	73	73/104 = 70 %
Lärarlyftet	5	5/13 = 38 %
Other type of supplementary training (specify in a later question)	13	13/33 = 39 %

Table 2: Answers to an important question, and a comparison of answers.

As can be seen in Table 2, many teachers thought Matematiklyftet was impactful. It also shows that even though many teachers had attended seminars and had productive talks, self studies won second place as the most impactful type of supplementary training. Another important fact is that teachers seldom seem to think that official supplementary training has much impact.

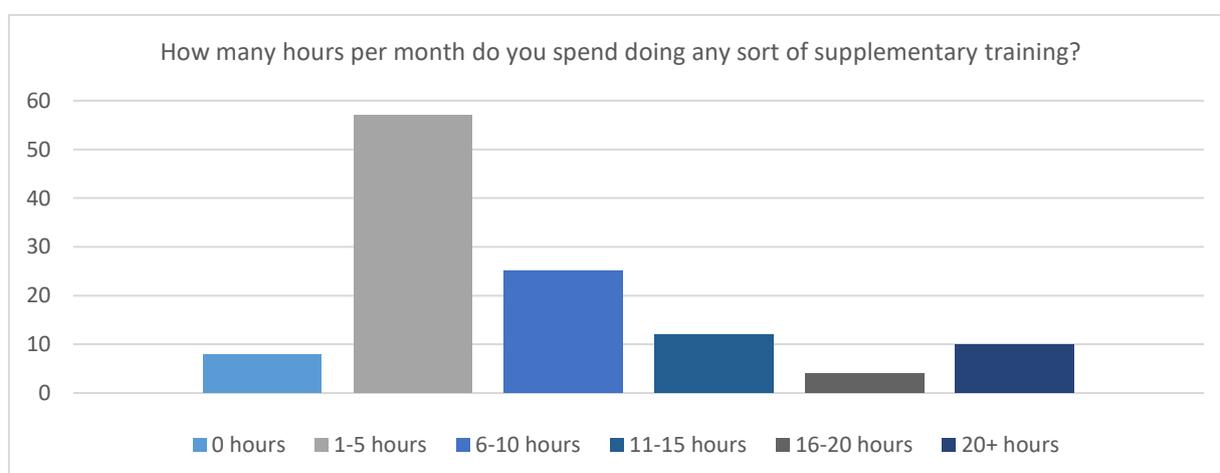


Diagram 3: A visual presentation on how much time teachers spend on supplementary training every month.

Diagram 3 shows that most teachers spend 1-5 or 6-10 hours per month doing supplementary training. This translates to around 1-2 hours per week.

Almost all the teachers, 93 %, believes supplementary training is needed to develop as a teacher. Some teachers, 39 %, have had a lot to say about how their supplementary training was implemented, and 42 % has had some say in this. Only 23 % believes the school supports their supplementary training fully, although about half the teachers state that this is mostly the case. One in four think that it mostly isn't the case that support is given.

ANSWERS ABOUT THE NINE KINDS OF SUPPLEMENTARY TRAINING INCLUDED IN THE SURVEY

This section covers the middle part of the survey dealing with the nine different types of supplementary training the teachers could select from in the two questions analysed in the above section (see Table 2). The teacher could only answer questions pertaining to a specific kind of supplementary training if he or she had selected it as being one of the three most impactful types of supplementary training. Thus, many teachers answered questions about Matematiklyftet, but few answered the questions about Lärarlyftet.

What follows is a summary of the answers to the different sections. There were either six or seven questions in each section, depending on the demands of the different kinds of supplementary training being investigated. The questions come in two categories: general questions about details pertaining to that type of supplementary training, and questions about the perceived impact this had on their teaching. The second category of questions are of particular interest to this report.

PART ONE: GENERAL QUESTIONS

This data comes from teachers answering the middle part of the survey, about the up to three specific types of supplementary training that they believe has had an effect on their teaching. All answers in this section is described here, except answers to the last question, which is described in Part 2: Questions about perceived impact.

Seminars

Most seminars were both initiated and, when needed, financed by the principal of the school. They were almost always held during work hours, as well as either during hours dedicated to supplementary training, or slightly less commonly in addition to the usual lectures.

Courses

Almost always initiated by the teachers, and more than half the teachers say the courses were payed for by themselves, and taken on their free time. Often the teachers participated in many courses.

Auscultation

In the most cases, both initiated and financed by the teachers, otherwise likely the principal. It is almost always done in addition to usual lectures, and almost never more than three times per semester.

Official

Almost always initiated and financed by the principal, and held during seven or more occasions per semester. The execution varies. This is a special sort of supplementary training category, because as the teachers described what they considered this category to be about, the following diverse activities were specified: Matematiklyftet, "*learning evaluation*"²⁴, Matematikbiennalen, collegial learning, a learning study, as well as an ambitious project involving seminars, teacher discussions, and teaching

²⁴ "Bedömning för lärande", also known in Sweden as "bfl".

exercises. Some teachers have thus classified Matematiklyftet as belonging here as well as in its dedicated section.

Unofficial

Half the teachers specified that this category meant talking to colleagues, and a few mentioned Internet and Facebook groups. Some had more specific things in mind, like learning about “flipped classroom” or reading books about physics. One teacher mentioned that a lot can be learned from teaching math to students with special needs. Another says that the teachers in the school meet and construct exams together.

From the comments on financing, most of these activities is either free, or financed by the school where applicable. Half of them did these activities on their free time, and they seem to be done frequently: the most common answer was that time is spent doing unofficial supplementary training more than once a week (28 %), and the second most common is once a week (24 %), and the third most common is a few times per month (20 %).

One teacher mentions that if scheduling is done so that you have a colleague to work with, it *“gives a lot of energy and development”*²⁵. Another mentions a great course, taken on the teacher’s behalf, titled *“math teaching and its hindering mistakes”*²⁶. Another has developed *“self-correcting digital exercises/tests for a business”*²⁷ and that this has led to positive pedagogical effects regarding math teaching. This teacher employs a version of the flipped classroom.

Self-studies

Almost always initiated and financed by the teachers, though the principal sometimes finances it. The most common answer is that self-study activities are performed just a few times during the last five years. It is mostly performed during free time, though not always.

Matematiklyftet

Mostly initiated by the principal, but a few teachers regard it as a central decision (one in five). Sometimes teachers themselves initiated it, and in one comment a teacher claims to have had to nag to get permission. More than half of the answers state it was done during normal work hours during time allotted for supplementary training. Most of the other answers say it was done in addition to the normal work schedule. Many teachers say that the principal financed it, though some say it was payed for by a state agency, or simply that it was a central decision.

Among the 73 answers, 41 of them indicated that teachers had done exactly two modules. Other amounts of modules were far less common. Some teachers claimed to have done all modules, or all but one, but it is impossible to know how many modules this meant, since new modules were released after Matematiklyftet had started. Also, a few teachers did not remember which they had done, or even how many in total.

²⁵ “ger mkt energi och utveckling”

²⁶ “matematikundervisningens blockerande misstag”

²⁷ “självrättande digitala uppgifter/läxförhör för ett företag”

53 answers had identifiable modules, either through the teacher having made specific mentions, or through having written “the first three” or similar. In the latter case, it is assumed that the ordering on the Skolverket website²⁸ is the same as the ordering in the list of modules the teachers had to select from. The table below shows how many teachers had done each of the seven different modules found.

Name of the module (in Swedish)	Number of teachers
Undervisa matematik utifrån problemlösning	44
Undervisa matematik utifrån förmågorna	34
Bedömning för lärande och undervisning i matematik	18
Matematikundervisning med digitala verktyg	5
Undervisa matematik på yrkesprogram	3
Språk i matematik	1
Undervisa matematik på högskoleförberedande program	2

Table 3: The different modules and the number of teachers that had done each of them.

As can be seen in Table 3, four in five teachers that have participated in Matematiklyftet did the one about problem solving, and two out of three did the one about the abilities. This is also the most common pairing of modules.

The answers to the “other comments” question were generally positive. Many answers were about the possibility of discussing math with other teachers and the benefits that brings, such as a better social environment and a feeling of cooperativeness.

One teacher has this to say: *“The best thing about this supplementary training is that time was committed to discussions about planning, implementation and reflections with other teachers. The material may not be perfect but is a great starting point were your experience and that of your colleagues can make up the difference. The big merit of the material is that everyone studies the same aspect of the teaching at the same time.”*²⁹

Some teachers have negative comments, such as the material being dry or that not enough time was dedicated to it to reap the full benefit. From this and another question a few teachers bring up the fact that Matematiklyftet will not be around much longer as a negative, and one teachers says that it *“would be fantastic if we could continue with [it].”*³⁰

Läraryftet

Only five teachers chose this option, so an analysis is omitted. Thus, Läraryftet is missing from the below table.

Other

Mostly initiated by the teacher, but paid for by the principal. The answers indicate that the teachers chose this section because they had attended Matematikbiennalen or Kleindagarna, but also taking a

²⁸ <https://larportalen.skolverket.se/#/moduler/matematik/Gymnasieskola/alla>

²⁹ “Det bästa med utbildningen är att det avsätts tid där man får diskutera planering, genomförande och efterarbete med andra lärare. Materialet är kanske inte perfekt men är en utmärkt startpunkt där kollegors och egna erfarenheter kompletterar. Materialets stora förtjänst är att alla undersöker samma aspekt av undervisningen samtidigt.”

³⁰ “vore fantastiskt om vi kunde fortsätta med.”

Master's degree. A few teachers chose it for other reasons, such as going to seminars and lectures, working at a college, or being a member of an association that arranges study trips.

PART TWO: QUESTIONS ABOUT PERCEIVED IMPACT

This data comes from teachers answering the middle part of the survey, about the up to three specific types of supplementary training that they believe has had an effect on their teaching. Only answers to the last question is presented here. The rest of the answers were described in Part 1: General questions.

Lasting effects on your math teaching?	Semi ³¹ (51)	Cour (13)	Ausc (20)	Off (10)	Unoff (50)	Self (42)	Mat (73)	Other (13)
Higher commitment	82 %	15 %	90 %	100 %	80 %	71 %	78 %	100 %
Higher confidence	47 %	31 %	45 %	50 %	60 %	67 %	55 %	62 %
More ways of teaching	78 %	31 %	70 %	100 %	82 %	71 %	92 %	69 %
New insights into how teaching can be performed	82 %	15 %	80 %	100 %	80 %	79 %	92 %	85 %
Better ability to individualize the teaching	35 %	38 %	25 %	50 %	62 %	57 %	45 %	62 %
Other	18 %	77 %	5 %	10 %	12 %	19 %	11 %	31 %

Table 4: Comparison of the different types of supplementary training by the question of lasting effects. The percentages are calculated from numbers of answers stating that each effect was achieved, divided by the total number of teachers being able to answer that question. This data comes from teachers answering the middle part of the survey, about the up to three specific types of supplementary training that they believe has had an effect on their teaching.

Table 4 shows clearly that official supplementary training can yield some good results, and that many other high scores can be found. Remember, though, that this table is generated from answers from teachers that have already chosen these types of supplementary training as their top three, so the scores are inflated and cannot be used as an indicator of what teachers in general think about this. It can be used to compare *successful* supplementary training only. Also, note the different numbers of answers in each column, which is a direct result of this survey design choice (as mentioned, Lärarlyftet got cut due to only five teachers choosing this type as the top three).

General results from Table 4 include that higher commitment, new ways of teaching, and new insights, can all be expected to be generated from any kind of supplementary training, except from Courses. Excepting the special Other supplementary training type, the category with the lowest scores is the one about individualizing the teaching. Table 4 also shows that even though Courses score low, its Other category shows a high number, indicating that Courses may have effects on their teaching not mentioned in the other options.

³¹ Semi = seminars, Cour = courses, Ausc = auscultations, Off = official supplementary training, Unoff = unofficial supplementary training, Self = self-studies, Mat = Matematiklyftet, Other = other types of supplementary training

“WHAT DO YOU THINK ABOUT WHEN YOU HEAR THE WORDS “SUPPLEMENTARY TRAINING”?”³²

This compulsory question is answered by the teachers writing a reply. It is thus suitable to analyze using the phenomenographic approach. From the answers, five different units of conception can be found. The first unit concerns those answers which express a view of supplementary training as meaning ‘personal growth’ (conception A), a way to enhance yourself. Examples of answers: *“That I become a better teacher”*³³ and *“That you will learn more about something. A possibility to evolve.”*³⁴

A different point of view is also found in which supplementary training is described in terms of ‘adding knowledge’, and thus the answers involves new courses and activities to be taken and understood. This second category contains two sub-categories with answers involving the subject of math and/or related subjects such as didactics (conception B1), and answers explicitly concerned with other subjects (conception B2), for instance special pedagogy. *Note: If an answer involves the teacher stating that growth can happen by doing specific things, this is categorized as conception A only, because of its focus on development rather than the broadening of knowledge.*

There is also a category of answers which express opinions about supplementary training overall. This category has two sub-categories: that “supplementary training is good, or gives positive thoughts” (conception C1), or that ‘supplementary training is bad, or not good enough’ (conception C2). For an example on conception C1, one teacher wrote *“Fun Exciting Healthy”*³⁵. Two conception C2 answers are also provided: *“Something that is expensive for us teachers. I only attend the 200-crown-courses at Chalmers or in the worst-case scenario seminars where GR³⁶ offers standard-lectures to hundreds of teachers... Nothing that is specific for my needs as a math teacher and the kinds of students I teach.”*³⁷ The second example: *“Too much focus on collegial learning and too little focus on skills development within your subject.”*³⁸

There is also a category of ‘non-answers’, were the respondents just filled in the answer box but did not provide any relevant information. These answers do not correspond to any unit of conception, but are counted for completion’s sake. The units of conception are summarized in table 5 below.

Conception type	Description
A	Personal growth
B1	Adding knowledge involving mathematics and/or related subjects
B2	Adding knowledge involving subjects other than mathematics
C1	Supplementary training is good, or gives positive thoughts
C2	Supplementary training is bad, or not good enough
-	Non-answers

Table 5: Summary of units of conception.

³² “Vad tänker du på när du hör ordet “vidareutbildning”?”.

³³ “Att jag blir en bättre lärare”

³⁴ “Att man skall lära sig mer om någonting. Möjlighet till att utvecklas.”

³⁵ “Kul Spännande Nyttigt”

³⁶ ‘GR’ refer to Göteborgsregionens kommunalförbund, which is an organization involving 13 municipalities.

³⁷ “Något som är för dyrt för oss lärare. Jag går bara på 200-kronors-kurserna på Chalmers eller i värsta fall föredrag där GR erbjuder standard-föreläsningar för hundratals lärare... Inget som är specifikt för just mitt behov som mattelärare och den typ av elever jag har.”

³⁸ “För mycket fokus på kollegialt lärande och för lite fokus på kompetensutveckling inom ämnet”

Table 6 below shows that almost one in two teachers views supplementary training as something that makes you grow as a teacher and/or human being, while one in three believes it to be more a matter of taking in new information. 13 teachers expressed negative views on supplementary training.

Teachers	A	B1	B2	C1	C2	-	Total
122	62	41	7	6	13	4	133

Table 6: How many teachers providing answers in each unit of conception, as well as providing non-answers.

As is evident from Table 6 there were 11 shifts of conception, in which a teacher expressed viewpoints from two units of conception in the same answer. This was most common between unit B1 and B2; some teachers expressed a view that supplementary training is not tied to studies only concerning your main subject. In fact, only one teacher supplied an answer only categorized as being of conception B2.

The structural aspect of conception B1 consists of the different ways the teachers provided as a means of adding to their knowledge base. For example: Matematiklyftet, lectures, courses, and higher studies at the university.

“WHAT KIND OF SUPPLEMENTARY TRAINING WOULD YOU THINK WOULD CAUSE THE STUDENTS TO PERFORM BETTER AT THE UPCOMING INTERNATIONAL COMPARISONS?”³⁹

Like the previous question that was analyzed using phenomenography, this question is also answered by the teacher by writing text and is thus also suitable for this approach. It was not compulsory to answer it, however. The point of this question was to find out specific kinds of supplementary training which teachers thought could reverse the trend of poor results from Swedish students in the PISA and TIMSS comparisons. However, the answers were instead often about assigning blame for this crisis. They described what is wrong, and often what things, other than supplementary training, could be done to enhance the student’s results. Thus, three main categories were found within the answers to this question, as well as a category of non-answers. The first main category blames some external source, the second blames the school system, and the third blames the math teachers themselves. See Table 7 below.

Conception type	Description	Nr. of answers, of 69 teachers
A	Someone or something else’s fault	18
B	The school system does something wrong	15
C	The math teachers need something	43
-	Non-answers	6

Table 7: The three main units of conception, and the category of non-answers.

Conception A can be further divided into three sub categories depending on where the blame is directed: the students, the teachers which the students have had in previous courses, or on Swedish society. For example, this quote “How would it be if the students worked?”⁴⁰ is of the first sub category,

³⁹ “Vilken typ av vidareutbildning tror du skulle kunna leda till att eleverna presterar bättre i kommande internationella undersökningar?”

⁴⁰ “Hur skulle det vara om eleverna jobbade?”

called A1. Here is another example from this category: *"The students need early to realize the importance of knowing mathematics. The student material we get at the gymnasium is too weak overall."*⁴¹ The next sub category, A2, often have specific teachers in mind, like this quote shows: *"Supplementary training of primary and middle school teachers' understanding of pupils with special needs."*⁴² A3, on the other hand, paints a more complex picture: *"The problem with poor results in international comparisons cannot be solved by the schools. It is a social problem where the school is unappreciated."*⁴³

Conception B is blaming the school system for imposing rules and regulations that hinder the work of teachers, for example by not assigning them enough time to enable necessary changes. For example: *"The main thing that would increase student performance is if the teachers got more time for each student/group. The number of hours for teaching is often too short and so also the time available for preparation/collegial learning/supplementary training."*⁴⁴ Another example: *"It is about recruiting qualified students as early as undergraduates. The demands on the teacher education must increase."*⁴⁵

Conception C can also be divided into two sub categories: either they teach in an incorrect manner that can be cured by a change of view, or math teachers lack the proper education. The first sub category, C1, is exemplified in his quote: *"That we teachers work more in accordance with the goals than to let a boring textbook direct the teaching."*⁴⁶ Most teachers state that some form of education is needed: *"Education in how to make the students to take more responsibility and be more active in their own learning."*⁴⁷ Two answers were found to be of both the C1 and C2 categories.

See Table 8 below for the 6 conception types identified as well as how many answers could be found to conform to these conceptions (*non-answers are omitted*).

Conception type	Description	Nr. of answers, of 63 teachers
A1	The students are at fault	10
A2	Other teachers are at fault	5
A3	Society is at fault	3
B	The school system does something wrong	15
C1	The math teachers need a different point of view	11
C2	The math teachers need education	34

Table 8: The final units of conception found among the answers.

⁴¹ "Eleverna behöver tidigt inse vikten av att kunna matematik. Elevmaterialet vi får till gymnasiet är för svaga över lag."

⁴² "Vidareutbildning av lågstadie- och mellanstadielärarnas förståelse av elever med särskilda behov."

⁴³ "Ingen. Problemet med dåliga resultat på internationella undersökningar kan inte lösas av skolan. Det är ett samhällsproblem där skolan nedvärderas. Tex av föräldrar som gör att elever inte tar skolan på allvar."

⁴⁴ "Det som framför allt skulle öka elevprestationerna är om lärarna fick mer tid för varje elev/grupp. Antalet undervisningstimmar är ofta för kort och även den tid som finns tillgänglig för förberedelse/kollegialt lärande/vidareutbildning."

⁴⁵ "Ingen, det handlar om att rekrytera kvalificerade studenter redan till grundutbildningen. Kraven på lärarutbildningen måste höjas."

⁴⁶ "Att vi lärare jobbar mer efter målen än att låta en tråkig kursbok styra undervisningen."

⁴⁷ "Utbildning i hur vi får eleverna att ta mer ansvar och vara mer aktiva i sitt eget lärande."

As can be seen in Table 8, there were 15 observed shifts in conception. Unlike in the previous question, there was not a particular pairing that was the most common. Here is an example of an answer that shows both conception A1 and C1. *“I believe it is more a matter of creating structure and drive among students. That they will be independent. They can do the math when they want to and puts up the time. **But** for me as a teacher to not become tired and run down there is a need for some inspiration to find motivation for the students.”*⁴⁸ The bolded word marks the transition from A1 to C1.

Earlier in this report, it was mentioned that 93 % of the teachers believes supplementary training is needed to develop as a teacher. As can be seen in Table 8, 34 teachers out of 63, or 54 %, indicate that math teachers need education. Yet, these results are very different: the first result means that almost no teachers believe they are skilled enough to not need any more development outside of teaching experience in their classrooms. The second result means that about one in two teachers believes math teachers need education in specific areas, such as additional mathematics or pedagogy courses. The remaining 40 % might think other areas need improving. Also, the first question is a simple “yes” or “no” question, whereas the other involves writing a detailed answer.

An interesting opinion was found in one of the answers, classified as C2. Per this teacher, supplementary training is not the path to better student performance. In fact, the teacher states that it can do more harm than good. Here follows a key part of the answer. *“Supplementary training can lead to teachers trying on a bunch of weird teaching methods, such as flipped classroom et cetera. And because no one checks what grades you set you can decide to grade however you want regardless of if the National test states otherwise. You don’t want to set a low grade after you have started a new way of teaching...”*⁴⁹

Almost half of the answers agreed that math teachers need supplementary training, and mainly in the form of courses. Some teachers gave examples of such courses that could lead to better results in the international comparisons, and thus provided the sorts of answers the question was aimed at getting. The courses mentioned included the following:

- Formative assessment
- Motivational psychology
- Matematiklyftet
- Talk to other teachers
- How to “make the students structure their studies”
- How to get students to “accept lectern education”
- General courses in pedagogy, methodology, and in mathematics.

4.2 THE INTERVIEW RESULTS

Interviews were conducted with five teachers. They contained fifteen premade questions each, but follow-up questions were also asked. They were thus semi-structured. The fifteen main questions and

⁴⁸ “Jag tror det snarare handlar om att skapa struktur och driv hos elever. Att de ska bli självgående. Matten kan de egentligen när de vill och lägger ner tiden. Men för jag som lärare inte ska bli trött och utsliten behövs de lite inspiration till att hitta motivation för eleverna.”

⁴⁹ “Vidareutbildning kan leda till att en del lärare kör en massa konstiga sätt att undervisa, t.ex flipped classroom mm. Och eftersom ingen kollar betygen kan man sätta vad man vill i betyg trots att nationella provet visar något helt annat. Man vill ju inte sätta låga betyg när man har börjat med ett nytt sätt att undervisa...”

their follow-ups can be arranged in four themes, shown below. The next section describes the survey answers these teachers provided, and the following four sections deals with these themes, and presents the associated questions. The original, untranslated questions can be found in an appendix.

- 1) How education is performed today.
- 2) What sorts of supplementary training the teachers have been participating in. Their thoughts on this, and how that has affected their quality of teaching.
- 3) What needs exists, and what are the possibilities of enhancements?
- 4) How the methods of education can change for the better.

Before getting to the five sections described above, one unfortunate detail must be mentioned: in an interview, one teacher asked about the difference between supplementary training and further studies, and the answer he received was that both are considered to be supplementary training for this report. Still, this was evidently not made sufficiently clear during the survey, and it is possible other responders have had this question as well.

THE FIVE TEACHERS

This section gives a summary of the survey answers provided by the five teachers, as well as a few words (in bold text) on the kinds of answers provided during the interviews. The names used for the teachers are not their real names.

Aniara – stressed out from her work, and says that the PISA assessment is not relevant

Senior woman, and has been a math teacher for 16 years. She slightly dislikes her school, and often talks about her work with others when the opportunity presents itself. She has a negative view on the sorts of supplementary training that has been offered by her school, because the school has only supplied them with cheap courses not suited for the needs of the teachers. During her free time, she has financed her own supplementary training. She only participated in Matematiklyftet because she nagged her boss, and she had to do it in addition to her usual work schedule. She liked Matematiklyftet, especially because it provided her with a means of talking with other mathematics teachers. She believes that what is needed to improve the results in schools is that the students get a good start to help with the low pre-existing skills of the students she gets handed to her. She also believes that many students have been betrayed by poorly performing teachers.

Bert – believes motivation is the most important tool the teacher can work with

Middle-aged man, and has been a math teacher for 8 years. He slightly likes his school, but does not usually reflect on how to improve as a teacher. He thinks that his boss has no clue about the quality of his teaching. He has participated in school-sponsored seminars taking place within his normal work schedule, and he thinks they have had a greatly positive effect on many things including the quality of his teaching. He sometimes visits other teachers in their classrooms to get educational insights, although this is the only effect he perceives auscultation has. He participated in Matematiklyftet as a part of his normal duties. He thinks his school supplies the necessary amount of supplementary training. He thinks that to get better results in school, teachers may need to attend courses that teach how to motivate children, and how to involve the parents in the children's education. He also believes that teachers should read up on what sort of skills the international studies look for, and prepare the students for those specific tasks if we are to succeed in getting good results.

Charles – wants to teach math directly from using the Abilities⁵⁰

Middle-aged man, and has been a math teacher for 15 years. He likes his school, and his colleagues, and he often discusses his job with others, and reflects often on how to improve as a teacher. He thinks his boss has some idea of what the teacher's work entails. Charles does not visit other teachers in their classrooms, but instead has done school-sponsored studies of his own choosing during his normal work hours, and thinks highly of this. He had to spend time outside his normal work hours to participate in Matematiklyftet. His thoughts on how to improve teaching is to let go of the school books, and work directly towards the educational goals.

Dora – teaches math in 3-hour sessions, regards teaching as a performance act

Middle-aged woman and has been a math teacher for 11 years. She somewhat likes her school, has a good connection with her colleagues, often talks about education, and is confident in that her boss is very knowledgeable about the work done by teachers. She has visited teachers in their classrooms, outside of her usual work hours, and has mixed feelings about the results, saying that it levels the field and adds do a fruitful discussion about how teaching should be performed. She complains about the fact that she had to participate in in Matematiklyftet during her free time, and says that there should always be scheduled hours for supplementary training. She has done a special kind of supplementary training that has nothing to do with mathematics, that she in part has financed herself. She was able to do a part of this during paid work hours. It did not affect her math teaching, except via an increased general commitment to her job. Despite having said that she must do most of her supplementary training during her free time, she still thinks that the school satisfied her need of supplementary training, and that no changes are needed in this regard when it comes to school policy. This is confusing and contradictory. She believes that many uneducated teachers, especially in math, have had a negative impact on the students. She is stressed by her tight schedule because she wants to reflect upon her teaching, and claims that since the 80s the time dedicated to doing so has steadily decreased.

Eric – believes language is important and that it affects the learning of math

Middle-aged man and has been a math teacher for 15 years. He likes his school and his colleagues, but does not think his boss knows about the work done by teachers. He has participated in seminars during his regular work hours, but does not think that they benefited his teaching style, although he states that such effects are difficult to quantify. He states that unofficial supplementary training, (which he defines as simply talking to his colleagues), has had a positive effect on his teaching. He has also done some research on his free time, mostly browsing the Internet or attending free seminars, that he thinks have had positive effects on his teaching. He believes that supplementary training is always needed to improve. He also states that language is important in teaching, and that many math teachers and students have the wrong idea that math is simply doing exercises in a book. Note that this teacher did not choose Matematiklyftet as one of the three most influential types of supplementary training.

⁵⁰ "the Abilities" refers to the curriculum and how it details the criteria upon which grades are granted.

THEME 1: HOW EDUCATION IS PERFORMED TODAY.

1. Describe the way you implement your math teaching. What methods of education do you use? By 'methods of education' I mean for example traditional rostrum education, group work, formative assessment, problem based learning, ICT, outdoor classes, flipped classroom, or similar. Provide examples.
2. Do you think your education differ from other math teachers'? If so, in what way?
3. How common do you think it is that math teachers mainly base their education on their text books?
4. Have your methods of education changed in the last few years? In what way, and what is the cause for this?

The five teachers all use slightly different teaching styles, especially one of them who teaches in 3-hour sessions. Two of them use flipped classroom, but neither assumes the students have watched the video before the lecture. The idea of using exercises that do not have a single correct answer is shared by two teachers, Dora and Charles, both of whom finds this stimulating and that it aids in developing in interest in math. A more unique idea is "mathematical speed dating", which involves cards the students get when they enter the classroom, and then are tasked with finding the matching cards. One card contains a mathematical equation, another a graph, and so on. Charles tries to get to know the students, and only have traditional tests when he believes they are ready for them. The answers suggest that using text books is common, and that it is a problem to become reliant on the text book, although Dora says that this could work well for some teachers, and suggests that the correct teaching style depends on the personality of the teacher. Bert tries to get his students involved in classroom discussions, to make them interested.

Dora claims that text books are more heavily used in lower grades, because a higher percentage of teachers there are missing a teacher's license. She reasons that gymnasium level teachers knows more math, and thus get more creative and even more interested in math. According to her, they want to teach the more advanced courses, and wants to vary their teaching to not get bored. She likes change, and wants to stimulate both herself and her students.

Charles believes he has become better at using the Abilities themselves, and not having to rely on the text book, or the Central Content. He also is better able to activate his students. *"It does not matter how good of a teacher I am", he says, "or how good I am at explaining and how well they understand. In the end, if they don't work and practice and do exercises and tries and tests it does not stick."*⁵¹ He realized that he failed at teaching the students who had a hard time learning math, and attended supplementary training in formative assessment and problem based learning.

Bert has better understanding of what he wants to achieve with his lessons, owing to Matematiklyftet, and now he thinks "what should they learn from this?" before he starts teaching.

⁵¹ "Det spelar ingen roll hur bra lärare jag är, hur bra jag förklarar och hur bra de förstår. I slutändan, när de själva inte jobbar och övar och räknar själva och prövar och testar så fastnar inte det."

THEME 2: WHAT SORTS OF SUPPLEMENTARY TRAINING THE TEACHERS HAVE BEEN PARTICIPATING IN. THEIR THOUGHTS ON THIS, AND HOW THAT HAS AFFECTED THEIR QUALITY OF TEACHING.

5. Describe the supplementary training, in which you have participated during the last five years, that had the largest impact on the quality of your education. By 'the quality of your education' I mean not just the student's results, but also the atmosphere, pedagogical skill, better prevention of bullying, and so on. What did you learn?
6. If you think about all the different kinds of supplementary training that you have participated in during the last few years, in which tangible way do you think that the quality of your education has been affected? Have you made differences in your education because of supplementary training, provide examples?

All the teachers have participated in Matematiklyftet, and they all liked it. Eric has learned to work with the text book in a more qualitative sense: instead of just telling his students to read passages, he now understands that many of the concepts present in the book can prove difficult to the students, and thus they have started working with the pages together. Even concepts that they understand in one way may have other uses beyond the main one. "Solving an equation" has a vague meaning for many of his students. When it comes to solving differential equations, they still think in terms of "find x".

Charles says that Matematiklyftet has given him new perspectives. He also says that his school arranges courses aimed at students who has special needs, though he claims that he did not get much out of them. They are too theoretical, and the solutions provided cannot be used in his classroom. Anira also says that Matematiklyftet has brought her new perspectives, but in another way. She got to try new types of exercises because of Matematiklyftet that she was too scared to try otherwise. She also learnt that teachers in Japan have folders filled with exercises that are both good and that contains no right answer. She says that many hours are spent trying to find such exercises by each teacher individually, and thus wastes time and resources. For Bert, Matematiklyftet has led to him working with creating exercises in just the way Anira describes: to challenge all sorts of students.

Another thing Bert has learnt more about is to try and create a better environment in the classroom, to counteract the feeling many students share that math is not only hard, but embarrassing in the sense that they feel stupid if they reveal that they are not that good at it. *"It is ok to answer incorrectly; the important thing is that we share how we think about and perceive things. There is nothing... nothing that is directly wrong, and definitely no one should laugh or [do] something else including bringing up ideas in a negative way."*⁵²

Eric believes that seminars and the like can be rewarding even if his own practice remains unchanged, because both he and the other participants gets a glimpse of the practices of others, and what that can lead to is only revealed later. For Dora, teaching is a sort of theater act, and says that teachers should bring something positive into the classroom and show that they think the lesson will be fun. To do so after many years of teaching, you need to find something that is new, even if it is just for yourself as a teacher. This makes you happier and that has an impact on the students. Charles' practice has

⁵² "Det är ok att svara fel, att det viktiga är att vi delar med oss utav hur vi tänker och ser på saker. Finns inget... inget som är direkt fel, och det är absolut ingen som ska skratta eller någonting annat liksom lyfta fram idéer på ett negativt sätt."

changed in that he now tries to think about the lesson beforehand and to anticipate problems. It is not about doing lots of exercises, but to train the Abilities. And Bert has learned more about assessment in the general sense: how to measure a student's ability, how to construct tests, how to tie the education more to certain professions, and so on.

THEME 3: WHAT NEEDS EXISTS, AND WHAT ARE THE POSSIBILITIES OF ENHANCEMENTS?

7. What kind of supplementary training would you like to participate in?
8. What prevents you from participating in supplementary training in your school?
9. Are you feeling stress because of your work as a teacher? How does that affect your teaching?
10. Are your principal or school leader positive in regards to you and your colleagues participating in supplementary training?
11. Do you feel as if you can try new ways of teaching in the class room? Do you do this?
12. Regard the following scenario: a newly graduated mathematics teacher spends a few years finding a comfortable way of teaching in his classroom, and afterwards the work methods of this teacher are only marginally affected by supplementary training. How realistic do you think this scenario is?
13. Do you regularly meet with other teachers or pedagogues to discuss how education can be performed?

In regards to the first question, Eric wants training in assessment, practical implementation, and to get to try new methods. Dora wants further math training, to increase the excitement. She remembers how teachers could get money for studying long ago. Charles would like to participate in a class that teaches how to involve the high performing students, to stop them from losing interest, and that does not just recommend more challenging exercises. Aniara was impressed of the way Matematiklyftet was allowed to take time.

The teachers all says that their school leaders are positive to them receiving supplementary training, but that time and money often stops them from helping to bring this about. For example, Aniara says that the budget is too small to pay for courses, so no one gets any money. And the next year, the budget is new and the same thing happens again. There is no forward planning. Also, Aniara also tried once to get her principal to allow her a little more time on the schedule, and to not use a text book (to save money, and to try a new way of teaching), but this request was denied.

Most of the teachers are feeling stress, for example because of development talks, or having to teach many courses at once. This affects them in different ways, for example by lowering their patience. This means that they may rush an explanation to a student, thus denying them the reward of finding out the answers themselves. There are other downsides as well, and Bert mentions less time to plan, less time for evaluations, longer between tests, they may be less legally sound, among other things, including difficulty of sleeping.

The teachers think the scenario in question 12 is not very unlikely, but heavily dependent on the teacher, and as mentioned above, Dora believes this approach can work in some cases. When prompted to explain his reasoning, Eric says that *"it is easy to say "I have 20 years of experience", but it could be one year's experience but 20 times. [...] The number of years of work does not mean nearly*

as much as how you have spent those years. [...] And certain teachers may not... Like. They do supplementary training but do not think that they may need to change something about themselves."

(The translated quote on the previous page is underneath shown untranslated in its entirety, to show a glimpse of original interview dialogue (R and E is short for the name of interviewer, Robin, and for the interviewee, Eric, respectively):

R: De flesta jobb är sådana menar jag att man lär sig någonting och sen så stannar man vid det för att det är bekvämt liksom.

E: Ja precis, det är ju lätt hänt att man säger ah men "Jag har 20 års erfarenhet", men det kan ju vara ett års erfarenhet fast 20 gånger, såhär.

R: [skratt] Ja just det, ja det är klart. Absolut.

E: Så var det... nån som... uttryckte det, och det är ju rätt så bra... Alltså... Antalet arbetade år betyder ju inte så mycket som vad man gjort dom åren.

R: Nä, just det.

E: Om man säger, om man har tänkt när man jobbat.

R: Nä absolut, så är det ju, om man försöker utbilda, eller utveckla sig...

E: Ja, och vissa lärare kanske inte... Alltså. Dom går en vidareutbildning men tänker inte på att de själva kanske ska ändra på någonting.)

Charles mentions that this scenario depends on factors outside of the teacher, for example what programs and student groups the teacher will be educating. He says that teaching students in a science-oriented program does not demand a lot from the teacher, at least if nothing more is demanded from the students than passing the course. This is because the students often are interested in math. However, teaching math in other programs may force the teacher to adopt to rapidly changing student demands. Aniara says she has little knowledge about how other teachers teach. Auscultation is not enough.

When it comes to the last question of this section, three teachers were prompted to also answer the question "do you think that the main strength of Matematiklyftet is the discussion, and not the actual content"? To this, the teachers' answer was yes: Eric, Dora, and Charles all agree to different degrees. To be able to exchange ideas is felt to be more important than learning new ways of teaching, especially when those new methods are not applicable to the teacher's way of teaching. It is also felt that since the employer has not seen fit to provide such discussions, the teachers have been forced to do that in their free time. Charles has this to say: *"I think the benefit of Matematiklyftet was that you put math colleagues [...] that there was time for this, that you argued back and forth and you discussed and there were born new thoughts and ideas. This benefit was greater than what I did in the*

classroom."⁵³ He did not feel the implementation felt natural, but thinks that the methods could be good in the right circumstances. Overall, he liked this supplementary training, though he was skeptical at first.

THEME 4: HOW THE METHODS OF EDUCATION CAN CHANGE FOR THE BETTER.

14. How should the teaching of math be changed so that Sweden will perform better at the International assessments like TIMSS and PISA? How can this change be implemented?
15. Do you have any further thoughts about supplementary training?

Dora says that at least one subject the teacher is teaching should always contain regular discussions about something tangible that the participants are prepared to talk about. That brings engagement, and a sort of quality. Eric wants one to two hours a week dedicated to supplementary training in the form of discussion groups. He doesn't think much preparation is needed for relevant discussions to take place. The school leaders don't need to have much say in this.

Eric mentions language as important. Unless the students know how to interpret the text and get to the math imbedded in it, how can they solve exercises containing text? Thus, math is linked to the understanding of language, and Eric claims language teachers is at fault. Also, he says that math teachers should vary their language, and not always use the "correct" words. Dora also blames the earlier levels of education, and says that big changes need to be made. Many teachers in those levels are neither good at math nor interested in learning it. This means that the foundation is not good for students to learn math. It is related to the status of the profession. As an example, she provides an education for middle school teachers where more than half the students fail the course in math. Two girls attending that class complained about having to learn about fractions. Another example Dora provides is of an elementary school teacher who did not remember that four times five is the same thing as five times four, and failed a young girl at an assignment for providing such an answer. Unless we change this, we get to reap what we sow. Another problem is the individualization movement that resulted in teachers being told not to speak for more than ten minutes, because the students need to work by themselves, alone, using the text book. This is not education, per Dora.

When it comes to the gymnasium level, Dora says that it needs to feel like the students are getting a fresh start. They also need to be evaluated, so that the holes in their earlier math education can be filled. It is also related to motivation, and students can actually study outside of the classroom, Dora claims. Most students want to succeed, and many types of support exist today: libraries often provide help with homework, Chalmers have free sessions with university students providing help, and then there is the Internet.

Charles offers this advice: remove the text book. Also, Skolverket needs to be better at communicating what they mean by the Central Contents and the Abilities. A student failing a few Central Contents but

⁵³ "Det jag tycker nyttan med mattelyftet, det är just att man satt mattekollegor [...] det fanns tid för det, att man vädrade ut och in och man diskuterade och man, det föddes nya tankar och idéer. Den nyttan var större än att det jag gjorde i klassrummet."

excels in regards to the Abilities, what grade should this give? Charles recommends an education focused on the Abilities and using content as needed. Also, smaller classes. This would help with encouraging the students (since each student would get more time with the teacher). Also, different kinds of didactics depending on the situation. To use the text book and having an answer key is not helping the students develop. Having exercises with no “right answer” would help with this.

Aniara claims that the PISA assessment is not relevant, since it is about subjects we do not teach our students. We should not adopt our education to fit PISA either, she says, but states that we should teach in accordance with the curriculum. Bert says that it is more about not being low ranked, than to be ranked in the top. That is the more interesting question for me, he says, and continues: many Asian countries are top ranked in PISA, because they employ a special kind of teaching, but the students are not very efficient. If you want to score higher in PISA, he concludes, you must know more about how it works. About TIMSS and PISA, Dora says that it is not helpful to compare countries, since so much differs in regards to education. A bigger problem is that the results show that students are getting more differentiated: the stronger students get better results, and the weaker students get worse results. This is serious, she says. In her opinion, schools should offer equal education to all students.

Also, the students in Sweden do not have much respect for tests, per Aniara. If something is not on the test, then it is not worth learning. But the real problem is about our schools. We cannot put 30 students and a tired teacher in a classroom and expect good results. For one thing, the theoretical classes should be put early in the morning. Also, Aniara wants the teaching to be remade based on the student’s needs, for example by getting to choose their own teachers. Also, there are no substitute teachers anymore. Other problems are based on the low status of the profession.

Bert mentions that Matematiklyftet brings up good points. But he also says that education has changed since he went to school. Back then, the teacher wrote a couple of examples on the black board, and then the students did exercises. And that worked for some strange reason, since enough students back then were dutiful enough, and made the necessary preparatory work. Thus, they got a sense for math, and an actual interest in the subject. This has changed today. Now students are asking “why do we need to learn this”. The teachers must adapt to this new situation, to make the teaching interesting for the students.

When it comes to the last question, Aniara says that the schools should be returned to the state. Not be in private hands, nor be communal. This promotes short sightedness. Bert reminds us that teaching is about guiding students to greatness, regardless of their ability level. It is also about mathematics skill, but without being genuinely interested in people, then you cannot create excitement, and a desire to learn.

5 DISCUSSION

This chapter comments on the previous chapters, as well as presents my conclusions.

5.1 DISCUSSION ABOUT THE METHODS USED

The discussion chapter begins with evaluating objectivity, reliability and validity of the report, as well as the choices of implementation.

OBJECTIVITY, RELIABILITY AND VALIDITY

Regarding objectivity, Bengtsson & Bengtsson writes that when working on a project like this Master's Thesis, it is important not to base the report on my own thoughts and opinions (Bengtsson & Bengtsson, 2002). This means that I should not formulate questions in such a way that the person answering might feel obliged to answer in a certain way. While it is sometimes hard to be objective, it has been my goal to be as objective as I could when asking questions.

The survey and the interviews were conducted in accordance with the four basic guidelines of Vetenskapsrådet, which increases the validity of the work. (Vetenskapsrådet, 2017)

Since I chose to send the survey to teachers working in or around Gothenburg solely because I live in Gothenburg, this lowers the objectivity of my work. However, since I included every suitable teacher living in or around Gothenburg (that is, those who filled the criterion of having worked as a mathematics teacher for at least three years in the past five years) in the survey, this should heighten the objectivity.

The survey and the interviews also must show a high amount of reliability, meaning they should not generate random results. One method of increasing reliability is to ask the same questions again later and comparing the results and if the same answers was given, then you could say that the gathered data had a high amount of reliability. This is called the test-retest method (Olsson & Sörensen, 2011). For practical reasons, in my opinion, this is not a preferred method of working with surveys of this kind: I could not expect teachers to fill out my extensive survey twice, and even if they did, I do not think the additional data would be much different from the original data. Therefore, it is not possible to verify that the results are not random. However, I must assume that the teachers answering my survey and interview questions did try to answer my questions to the best of their abilities. Since I gathered the results of 122 teachers, more than a few of them would have had to deliberately try to mess with my results for the data to be unreliable. Again, whether this is the case or not is not something I can know. Also, the survey was anonymized, and this should make the answers more reliable.

Those 122 teachers I mentioned is a subset of the 159 teachers which finished the survey. This means that 37 teachers answered the first question with a "no", and thus had worked as teachers too short a time (less than three years in the span of the last five years), and where unsuited for this survey. This time span was chosen semi-randomly: I wanted the teachers to have had a chance to have felt a need for supplementary training, but the reason I chose exactly three years was because it felt like a suitable

number. This lowers the objectivity of the results. However, a length of time had to be chosen as the minimum. This choice resulted in roughly 75 % of the returned surveys being usable.

Also, 159 returned surveys out of 574 means that over 25 % returned the survey. While this might sound like a low number, consider that I had not sent out any information that I was about to do a survey. I had not “prepared the ground”, so to speak. As a comparison, only around 50 % of the teachers taking part in Matematiklyftet returned their assessment survey. Also, as I gathered addresses from schools, the people I talked to said that I should not expect many teachers to answer my survey, as teachers are very busy and receives a lot of mails. In this context, 25 % is better than I was expecting.

The people I selected needed to be representative of the population (Bengtsson & Bengtsson, 2002). Since the survey went out to all the teachers in or around Gothenburg, based on the official homepage of Gothenburg, as well as the addresses given to me from Skolverket, they were representative, and thus a reliable source of information, at least in my opinion.

The five interviews were made specifically to make these results more reliable, as well as to gather different kinds of information. The ability to ask clarifying questions and follow up questions make the results more reliable. I have transcribed all the interviews, although not in detail, and this increases the reliability of my data. I did tape them, and I have listened to them multiple times to not miss anything of importance. However, I basically chose teachers that had written well thought out answers and not on statistics or chance. This is detrimental to the reliability and to the objectivity of these results.

To be able to say that my survey is valid, the data it gathered should contain information about what I set out to investigate and nothing else (Bengtson, 2002). This is no easy task, since even straight questions with straight answers could be because of something else entirely that affected the answer (Olsson & Sörensen, 2011). For my survey, this means that for example the question “Do you believe that supplementary training is needed to develop as a teacher?”⁵⁴ might receive a negative answer from one teacher because of a recent bad experience, when a negative answer from another teacher might be the result of years of deep thought on this question. To somewhat combat this, the survey contains multiple questions asking for information about supplementary training, so that the validity can be increased by force of volume.

I sent out a pilot survey to eight people, to sort out any major misunderstandings, and thus some questions were altered. I made one test interview, for the same reason. These numbers are somewhat low, but the people I involved in these surveys and the one person I interviewed nonetheless did help make the finished result better, for the reasons outlined above.

In the same way, I have had a lot of help with formulating the questions and analyzing the answers from my supervisor, Johanna Pejläre, a lecturer at the University of Gothenburg focusing on the history of mathematics and the education of mathematics, as well as from Thomas Lingefjärd, senior lecturer in the didactics of mathematics at the University of Gothenburg. Their help increases the validity of my results.

⁵⁴ “Anser du att vidareutbildning behövs för att utvecklas som lärare?”

With few exceptions, such as some questions and definitions which could have been better formulated, I believe the questions did a fine job at gathering relevant information, and more than a few of the teachers included comments praising the survey. All in all, I am happy with the survey and the results.

THE IMPLEMENTATION

I chose to make a survey and a few interviews to get my research questions answered. There were alternatives, such as self-reports were the teachers would have written a text from associations they got in relation to my research questions, or focus groups were several teachers could have gathered to discuss questions provided to them. However, I wanted both coverage and a bit of depth. Thus, it seemed better to make sure every teacher in and around Gothenburg were invited. This avoided the problem of choosing the teachers from different schools to make as great a coverage as possible. But, since I wanted a bit of depth too, a few interviews seemed to fit. In short, I don't think any other methods could have worked as well in answering my questions.

I contacted Skolverket in regards to an interesting "problem" discovered I regards to the lists of email addresses: why were the overlap between the list so small? Or stated in another way, if the list from Skolverket were supposed to provide all math teachers in Västra Götaland county whom had participated in Matematiklyftet, why were so few of the teachers in that list included in the list I got from the teachers working in gymnasium level schools in Gothenburg? Since well over 50 % of the teachers should have been involved in Matematiklyftet by then, I expected a large overlap, but found just 21 addresses who were present in both lists. I tried to contact Skolverket again to get an answer to this question, but have not gotten a reply yet, since they do not consider my request to be a priority. One possible solution is that Skolverket has a separate list for teachers working in each of the three major cities in Sweden, and that the employee who provided me with the list from Skolverket simply forgot about this. Another possible solution is that the list from Skolverket was not updated.

A thought occurred to me when I noted the fact that almost every teacher that answered the survey had a teacher's permit: is it possible that teachers without a permit to teach avoided answering the survey? Perhaps they don't "feel like teachers" despite working as educators? On the other hand, it may be possible that most teachers that has worked for at least three years has got a permit.

For the survey, I used different question types for different purposes, did try to not use too many questions that uses text boxes to provide answers, and to not write the question in such a way as to "force" a specific answer. It was a bit difficult to make LimeSurvey work the way I wanted it to, but in the end, I was satisfied with the result, and I believe it provided me with relevant information.

The fact that teachers can only answer questions about the sorts of supplementary training that they have marked as one of the top three types of supplementary training that they have done is somewhat detrimental to the quality of the data gathered. For instance, it is not possible to get information about what is sub-par about the supplementary training that is not marked for the top three, unless the teacher supplies that information without being prompted to. However, the alternative would have meant that some teachers would have had to answer many more questions to complete the survey, possibly getting agitated and giving poor answers, or just stopped filling out the survey altogether.

Per Kvale, an interview is an exchange of opinions. Thus, not only is the interviewee of interest, but the interviewer as well. The questions asked, how they are asked, and the general context, is important. During the interviews conducted in April 2016, I took the role of a pollster⁵⁵ trying to gather facts and opinions, and viewed the interviewee as reporters⁵⁶, stating their opinions and facts. Their statements can be considered to be true or false, uncooperative, misleading, or fragmented, all depending on how they are interpreted. (Kvale, 2014, p. 129) Since I find no reason for them to lie about their own experiences as teachers in an anonymous interview, I trust that the information provided me is truthful, although some elaborations and speculations are sure to have been relayed. Also, their memories of past events may not be entirely correct.

Kvale states that qualitative interviews, such as those used in this report, work well when the research question uses the word “how” as opposed to “how much”. My research question fits this description; since I ask about the opinions of teachers, I think Kvale would agree that this method is correct for my type of report. (Kvale, 2014, p. 143) I interviewed five teachers. Kvale simply says that you should interview as many as you need to get to the information that you want, and that there are diminishing returns in interviewing more people. (Kvale, 2014, p. 156) I feel that I got what I needed, and that five were enough. Informed consent had been given by the interviewee before the interviews: they were informed about the general theme of the questions, they volunteered, and were informed that they could withdraw their cooperation at any time. (Kvale, 2014, p. 107)

I wrote questions before the interview. Kvale states that this guide to the interview should cover the relevant themes and give question examples. (Kvale, 2014, p. 172) Thus, when I tried hard to deliver every one of my fifteen questions in the same way to every interviewee, I did not follow this guide theme. Kvale states that the questions should be short and simple, and that the interview should start with something concrete. (Kvale, 2014, p. 176) My first question was to ask the teacher to describe their teaching methods. I think this qualifies. However, not all my questions were simple, and I think Kvale may be wrong about this. Some of the more interesting answers were from “hard” questions, such as 5, 6, and 14 (see the appendix).

When it comes to transcribing, Kvale has these things to say: describe clearly how the transcription was done, and transcribe the interviews in a way that fits your purpose. (Kvale, 2014, p. 221-222) My interviews were not transcribed in detail: a time-stamp was put on each main question in an Excel document, followed by the teachers approximate answers. Follow-up questions were noted, and additional time-stamps were also noted when needed. This was followed by the approximate answers again, and so on. This method allowed for an analysis of the interview. If an answer was found to be interesting and an exact quote was needed, this quote was transcribed in detail. I believe that this method is sufficient, as I was interested in what the teachers told me, not the way in which their answers were delivered.

Regarding the quotes, per Kvale they should relate to the text, be contextualized, interpreted, short, and so on. They should also be presented in a readable, edited way to simplify for the reader. Kvale also states that these rules are just guidelines, and may be broken if needed. (Kvale, 2014, p. 330-332) I have made references to all original Swedish quotes, and tried to choose only fitting quotes;

⁵⁵ “Opinionsundersökaren” (Kvale, 2014, p 125)

⁵⁶ “Reportrar” (Kvale, 2014, p 129)

sometimes hard decisions were made between quotes. However, I did not want to burden the reader with too many details. Generally, I believe I have followed the guidelines set by Kvale.

At the start, I meant to analyze the interviews using phenomenography, since that is how that theory is meant to be used. However, I later realized that since phenomenography is not about individual answers, but about all the answers combined, that more than five teachers were needed for that. My supervisor suggested that I could “chop up” the answers from all the interviews and analyze these without regarding the originating teacher, but this method was not used. Also, in the studies I read where they used phenomenography to analyze interviews, more than five interviews were conducted, and I suspect that they were a lot shorter than my half-hour interviews. However, I found that the phenomenographic approach worked well in analyzing a couple of the survey questions.

There are three footnotes found in the text describing phenomenology. One is about how it is mainly used in interviews, and that is covered above. One is about hierarchical units of conception. This is supposed to mean that one unit of conception is preferable, or more correct, than others, and that others are incorporated in the first. For example, conception A is of the best quality, and getting the closest to the truth. Conception B is using a slightly worse description, and conception C is worse still, and so on. In my using phenomenography, I interpreted this to mean that some units are grouped together and others were not. The third footnote relates to the fact that in their book describing phenomenography, Marton & Booth only uses it in questions pertaining to a learning context. Although, on page 129 they state that the researcher is also learning (Marton & Booth, 1997). So, I take that to mean that phenomenography can be used in all contexts, if goal is to learn.

5.2 GENERAL DISCUSSION

In this part of the chapter, I will first discuss the two research questions, based on the results from the survey and the interviews. Then I will give my personal thoughts on this study.

FIRST RESEARCH QUESTION: HOW DO MATH TEACHERS PERCEIVE THAT THEIR RECEIVED SUPPLEMENTARY TRAINING, IF ANY, HAS AFFECTED THE QUALITY OF THEIR TEACHING?

Many of the survey questions ask about details about the types of supplementary training the teachers have done, for example how it was financed, or who initiated it. However, more importantly, they also serve to focus the teacher's attention on their memories of this type of supplementary training. This is crucial because the survey questions that follow deal directly with the first of the two research questions of this report, which is repeated in the title of this section.

Table 4 answers this question in the most direct way. It compares different types of supplementary training with regards to how many of the teachers perceived certain effects. It is not surprising that this table shows high percentages, since to be able to answer this question, the teachers needed to have chosen this type of supplementary training as one of their top three. However, together with Table 2, it shows that many of the teachers have participated in Matematiklyftet, many of those teachers also placed it in the top three, and most also says it provided new insights and new ways of teaching. However, it is not great in the other categories. Especially not in when it comes to

individualizing the teaching. Some examples of concrete effects that Matematiklyftet has had on the teachers is presented below.

Eric says that Matematiklyftet helped him using the text book in a more qualitative sense, and by that he means that he reads it with the class now instead of just letting them read it themselves. Bert has a higher awareness of what the important features are of the lesson because of Matematiklyftet. It also made him implement new ways of working with exercises, and helped him create a better classroom environment. Aniara has tried new types of exercises she would not have dared do unless Matematiklyftet had enabled her to.

Other types of supplementary training are not discussed in as much detail in the interviews, because for many teachers Matematiklyftet was their main source of supplementary training. However, concrete effects include the same effect mentioned by Bert in the paragraph above: Charles mentions a higher awareness of what the important factors are. For example, he thinks about what the children may have trouble understanding. He also says that supplementary training in formative assessment and problem based learning helped him to better activate his students. Bert has learned how to better measure a student's ability, how to construct more effective tests, how to tie the education more to certain professions, and so on.

Dora makes the interesting claim that even if supplementary training within your profession, for example math courses for math teachers, has no direct effect on the teaching, it still stimulates the teacher, makes him or her excited, less bored, and happier. For her it works that way, but each teacher is different. I think it has to do with motivation, and each person need to find their own source of this precious resource.

Like stated elsewhere, the two tables show that official supplementary training can yield great results, but it is very unlikely to do so. Also, the teachers do not think courses are very good at all. And for auscultations, if it is well executed, it is great at generating higher commitment. I assume that is because of the teachers feel like they have been seen, and think they should keep up their performance.

SECOND RESEARCH QUESTION: WHAT IMPORTANT EXPERIENCES HAVE THE TEACHERS HAD IN REGARDS TO SUPPLEMENTARY TRAINING IN GENERAL?

In this section I discuss results from the survey and interview not directly connected with how the teachers have changed their pedagogy.

Many of the teachers have done official supplementary training, but only a few marked it as one of the top three. However, those who did so had greatly positive things to say about it. Different teachers assign different meanings to this form of supplementary training. Based on survey responses like the quote on page 32 that includes "*in the worst-case scenario seminars where GR offers standard-lectures to hundreds of teachers*"⁵⁷, and the interview with Aniara where she complains about these same courses, I believe that most of the teachers think about forced lectures given to hundreds of teachers at the same time. I think it is safe to say that few of the teachers like those lectures. Those who did

⁵⁷ "i värsta fall föredrag där GR erbjuder standard-föreläsningar för hundratals lärare"

mark this as the top three had different activities in mind than that, for example Matematikbiennalen. Thus, I think principals should rethink their strategy when they use their precious scheduled hours of supplementary training on lectures the teachers have no interest in. Let the teachers discuss their teaching with other teachers. That is what they both want, and need.

Auscultations score worse than I would have expected in the top three. Then again, I can imagine that it is not that fun to be scrutinized by another teacher, even if you get to do the same thing in return. However, improvement demands change. Also, some of the teachers have stated that auscultations do not really give insight into other teacher's education patterns. After all, based on the survey results, you just get to see a few lessons. Perhaps some improvements can be made on how auscultations are carried out? Perhaps instead of having a teacher sit and watch for an entire lesson, the teachers film the lessons and use interesting parts as a basis for a discussion? All the other teachers watch the film before, and then talk about this in a seminar. The study made by Borko et al, mentioned in Chapter 2.5, involves teachers using video recordings as a basis for discussions. Their setting was somewhat complicated, and I did not mention the details of it, but I feel that the main point is that if teachers get to know each other's teaching through video recordings, and get comfortable enough with discussing these videos, then they learn to make better lessons, and thus get better at helping students learn. I am certain that this process will feel painful at first, having to record all your lessons, choosing important sections to show others, and exposing yourself to others like this, but I also believe that once this practice has been around long enough for the teachers to feel comfortable with it, great things can be learnt from it. However, for this to happen, teachers must be given time and resources dedicated for this purpose.

Using the phenomenographic approach to analyze a question involves finding the best theme that fits the answers, and then reading the answers again in this view and trying to come up with another theme that fits even better. Many of the teachers were assigning blame when answering the survey question "*What kind of supplementary training would you think would cause the students to perform better at the upcoming international comparisons?*" Once I realized this, I could not imagine a better theme. However, it might be the case that when a teacher blames students for not being attentive, for example, the blame really lies on someone else, like the parents. However, this is impossible for me to know. The reason the teachers is assigning blame is perhaps because neither TIMSS nor PISA is directed towards teachers at the gymnasium level. The teachers were in effect asked which type of supplementary training could be used to good effect in the lower levels of education. However, I wanted the question to be open to interpretation. Interesting comments resulted from this question, though, so I think it served its purpose. For example, that the school alone cannot change the downward spiral and that society needs to change its outlook on education. Another interesting result is that most teachers actually blames themselves for the poor results, saying that math teachers need to be better educated.

The fact that few of the teachers used the "Other types of supplementary training" option suggests that the eight types of supplementary training I included in the survey covered most types being used. Also, some teachers who have gone to Matematikbiennalen classify this in the "Other" category, while others regard it as an unofficial sort of supplementary training. The "Other" category is thus more of a catch-all" than a real category. Also, it is a part of the result to find out how teachers think about supplementary training, and the fact that some teachers think of the same thing using different terms is interesting in itself.

Two teachers, Charles and Dora, share the idea of using exercises that lack a single correct way of answering. They both think it stimulates the students and aids them by making them interested in finding the answers. I think these exercises are well suited for a way of teaching that not uses a text book at all, something Charles and Aniara would like to try. Also, Eric tries to not use the text book.

Charles says that supplementary training aimed at helping students with special needs are hard to implement in his classrooms, a complaint also levered at Matematiklyftet by several teachers. They think sometimes it is too theoretical. With regards to Matematiklyftet, this point is also made in Skolverkets official assessment report.

The survey results show that most of the teachers believe that their principals know about the challenges posed to math teachers. That could be because Matematiklyftet did educate principals too, and some teachers say that they have noticed this as a positive change. Also, one of the goals of Matematiklyftet was that the structure taught to teachers and schools should continue after its end. That is, the meetings and discussions should continue after the end of the project. Some of the teachers seem to assume that things will revert to normal, however.

Aniara claims that there are no substitute teachers at the gymnasium level anymore. This is something I had heard about before, but not reflected on. I find it strange, and wrong. Many of the teachers are already stressed as it is, but with no substitute teachers, they are likely afraid of staying home because of sickness, since they would fall behind. Thus, some teachers are likely working even though they should rest at home. This is not a productive way of teaching children.

Dora made a strange claim in her interview. She says that since gymnasium level teachers generally know more math than elementary school teachers, they are more creative when it comes to math teaching. Thus, they vary their teaching to not get bored, while elementary school teachers mostly just use the text book. I don't think you can generalize like that. As I have discovered while working on this report, there are a lot of teacher types. She also says that the teaching style is dependent on the student group, to which both myself and Charles agree. He also mentions that if you teach in programs with students not interested in math, you must do a lot of different things to keep their interest up. Even though this is probably true, it has nothing to do with Dora's claim.

In the closing paragraph of this section, I want to remind you of Eric's quote which, paraphrased, says that teachers may not realize they need to change when they attend supplementary training. Their work is teaching children, and to learn you need to change and adapt. It is strange to me that they do not apply this to their own learning.

PERSONAL THOUGHTS

When I started this study, I did not know what answers I was seeking. I think I was hoping for a simple answer: take this course and learn how to unlock your inner superhero. Turns out, reality is complicated. Each teacher has their own teaching style. I learned from Dora that there are no right answers here, and that what works for one teacher might not work at all for another. In my job teaching adults mathematics at the gymnasium level I am heavily dependent on the text book. I do not like this, and want change my behavior. My belief is that I have learnt a few tricks from doing this study, such as thinking about the important points of the lesson before giving it, and the use of open-ended

exercises. I will of course also try to make at least one module of Matematiklyftet, preferably the one about problem solving.

My supervisor says that students that undergo studies to become a math teacher in Gothenburg University often are told not to depend on the text book when teaching math. In addition to doing practical things, they learn this by using a text book and during theoretical lectures. That is, they are told to do certain things with their students when they become teachers, like group work, or seminars, or create exercises that can be solved in multiple ways, or using computer programs like GeoGebra, but seldom get to try it out in their own education. She says that perhaps things are different in my education at Learning and leadership, since it includes an engineering degree, which may be more hands-on.

One of the points of the text about the history of the Swedish school system was that differentiation was a big problem in the 1960s, and that this issue was solved using the system of special teaching, where children with special needs were separated from other students. I was put in a corrective spelling class in elementary school myself. However, this report is about the gymnasium level, and my data shows that differentiation is still a problem today. In both the survey and the interviews, the teachers are asking for ways to help students with special needs. In an interview Charles states that he also wants to help motivate the high-achieving children. Some comments to survey questions are also saying that results from the international assessments show that children are getting more differentiated in regards to grades, suggesting elementary school teachers are not supporting the children that needs the most help.

From a personal viewpoint, I believe my teaching, aside from currently being mostly text book based as mentioned above, is instead too focused on the students that have trouble reaching the teaching goals, and not enough of my time is spent helping the students that perform well. I think this is an attitude problem; it seems to me that if I spend time explaining some more advanced concepts to some students, that this might be seen as an insult to the students struggling with the basic concepts. This is not to say that I have not done this type of teaching, because I have. I am just very conscious about it. Thus, I want to find the middle road: to keep the high performing children interested, while closing the gap by helping the low performing children to learn, and thus reach higher grades. I realize that this is the dream, but you should aim high, and push yourself past your own limitations. And I think the best way to achieve this is to talk to a lot of teachers, understand their methods, learn what they did that worked and what did not work. Teaching is of course also based on experience, and you get better at it the longer you teach, provided you keep wanting to learn. This study has helped me achieve just that: I got to talk to five teachers about their methods of education. As long as I keep finding ways to find new teachers to talk to, and remain open to new ideas and methods, I will keep developing as a teacher. Because I am never done learning.

5.3 RECOMMENDATIONS

Three conclusions have been drawn from this report, based on the survey and interviews: that more projects like Matematiklyftet should be implemented as soon as possible, that teachers do not like the official supplementary training provided by their schools, and that a sort of supplementary training should be developed that teaches how to teach without a text book.

A CONTINUATION OF MATEMATIKLYFTET

After the failures of the Delta project, MALM was initiated about five years later, but even though it was better in terms of implementation, it still failed to educate many teachers. This may indicate that quite some time needs to pass before new major changes can take place in the educational system. Since Matematiklyftet was just completed, I believe new totally different projects should not be initiated until the teachers are ready for that. However, in my opinion projects that are slight variations of Matematiklyftet *should* be implemented as soon as possible, since both my study and Skolverkets official assessment report shows that teachers have high regards for this type of supplementary training. For example, many of the teachers like it because it allows them to meet other math teachers and discuss actual problems. Aniara says in her interview that she was impressed with the scope; that it is not just an intensive one-week education, but instead spread out over an entire semester. However, some of the teachers also express negative views, saying that the material is not relevant to their teaching. This needs to change. Teachers should not be forced to go out of their way to implement some teaching tool that they think will be detrimental to their education. Supplementary training, like all learning, needs to be a good thing. Unless the person wants a change to happen, it is very hard for this to occur. And if nothing changes after having participated in supplementary training, time and resources were wasted. Thus, both make the material voluntary, and motivate the teachers better to make them understand how the new tools can be used to good effect in their classroom.

Skolverkets assessment report agrees with me that similar projects should be initiated. It also says that it is hard to adjust the modules to work on the gymnasium level, just as my data shows. Furthermore, it says that teachers are more enlightened about their teaching, also in accordance to my data. This is good news, as it shows that my data lead to the same conclusions as a major state funded enterprise.

Per my interviews, the projects that should start needs to have a base in the discussion between teachers, and need not have a practical aspect such as a specific thing that must be implemented and tested in a classroom. However, the discussions should be focused, and the teachers need to be prepared. Again, this is in accordance to their assessment report.

As a start, I thus recommend that Matematiklyftet should continue to be sponsored by the state, but with the following modifications. First, the principals need not be involved. Second, no new material need to be developed; as can be seen in Table 3, most teachers have only used two of the seven available modules. Third, only the first 2 steps of the 4 steps involved in each of the 8 parts of each module should be taken by the teachers. These steps are to study the material and discuss it with other teachers. They can still talk about creating a lesson based on the study material. However, the third and fourth steps, namely the implementation of the lesson resulting from step two and the discussion thereof, should be left for the teacher's own discretion. Because of this reduction in temporal investment, the money granted the teachers should be reduced to match.

As a second action, I recommend that the state should reflect on the experiences made on the Matematiklyftet project, and develop a new project more focused on discussion and less on implementation. As an example, I discussed using video from the teacher's classrooms as a basis for discussion earlier in this chapter. It is also mentioned in chapter 5.4 Further studies.

OFFICIAL SUPPLEMENTARY TRAINING IS NOT APPRECIATED

Table 4 shows some great results from teachers having had some top quality official supplementary training. Despite this, the results from Table 2 cannot be ignored: only 12 % of the teachers put official supplementary training in the top three. Something needs to be done about this type of supplementary training. It is simply not enough to give teachers money that allows them to go to a cheap lecture where they get to listen to a generic speech. Better uses of the money is needed, and better motivation of the teachers, too. Perhaps a better management of supplementary training resources would be an uneven distribution, per Aniara, to make sure at least a few teachers gets supplementary training.

SUPPLEMENTARY TRAINING IN HOW TO TEACH MATH WITHOUT USING A TEXT BOOK

All but one teacher in the interviews touches on this: Eric says he tries to not use the text book, Aniara and Charles mentions wanting to teach without a text book, and Dora and Charles talks about exercises solvable using multiple approaches, implying not using a text book.

They feel that a text book limits them in what they can do during their lessons, and that it is easy to just follow the path the book puts them on, and that once you do that, it is hard to deviate from that path and do something else. Also, they do not like the exercises with a single correct answer the children can just look up in the back of the text book. In short, these teachers want to get in control of the lesson themselves. In this way, they can give the children exercises that in turn put them in charge of their own learning: for example, they must think about their answers and understand whether it is reasonable, and discuss them with other children.

I think a supplementary training course teaching this approach would be great. Perhaps this can be combined with Aniara's mentioning of the folders used in Japan where exercises are kept and used by all teachers, to save teacher's time having to come up with nice, open exercises by themselves.

5.4 FURTHER STUDIES

Several ideas for continuing to study supplementary training have come up during my work.

- Matematiklyftet taught school principals as well as the teachers. What effect has this had on the work they do in for example developing the pedagogy of the school?
- The fourth step of each part of each of the modules of Matematiklyftet involves discussions about the implemented teaching tools. A direct study of these talks and of the effects on the participating teacher's teaching might be interesting. This would involve listening to these talks and interviewing the teachers both before and after the talks.
- I feel that auscultations can be enhanced. There are several problems with them, including that the teachers feel exposed, and, at the same time, not enough information is presented to the auscultator to understand the teaching style of the examined teacher. After all, only one lesson is being evaluated. Perhaps teachers should film their lessons, being careful of not filming the children unnecessarily. Then, instead of one auscultator viewing a whole lesson, perhaps the teacher can show key parts of his lessons, and this film be used as discussion

material for a few teachers? In Chapter 2.5, I mentioned the study made by Burko et al, which involves teachers using video recordings to spark discussions.

- Study the work of the Matematiklyftet supervisors. How did that role affect their everyday job? Perhaps study Lead Teachers⁵⁸ in the same way?
- Is the geographical location affecting the quality of the teaching? Do children learn better near a University, because of easy access to it, and the supplementary training it allows for teachers through seminars and such?

⁵⁸ "Förstelärare" in Swedish. This is a promotional opportunity for teachers.

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APPENDIX 1: THE SURVEY

APPENDIX 1:1 INTRODUCTION TO THE SURVEY

The following pages demonstrates how the survey could have looked if it was reproduced in a form suited for reading on paper. The original survey used as material to create this report was created on a web site, and the teachers used computers to submit answers. Since this is not possible here, the survey was somewhat structurally redone in order to provide a way for you, the reader, to be able to get access to the questions and answers of the survey.

One difficulty here is that this appendix is language dependent. The survey was submitted in Swedish, and this report is written in English. The participants could all understand Swedish, but perhaps you, the reader of this report, cannot. The following pages may not be of much use to you then, since the survey is provided in Swedish only.

For an analysis based on some of the questions and answer options, see the Discussion chapter.

The survey was submitted in parts. The participant had to complete each part in full to get access to the next part. Questions containing a red asterisk (*) were mandatory. Questions not containing this asterisk could be skipped. Some questions, usually ones where there are many answer options but only one answer option could be chosen, used drop down menus instead of lists. Many questions contained a box where an answer of any length could be given.

The question structure is as follows. The questions are written as normal. Clarifying text is written with a single indent. Answer options are written with several indents. An example is now given so as to illustrate this.

Question 1

Clarification 1

Answer option 1

Answer option 2

Clarification 2

Question 2

The first question is special. If it is answered in the negative, the survey is completed. This is because this would indicate that the participant did not have the experience needed to help answer the research question.

The second question of the part “Vidareutbildning, del 2” is also special. The answers given here shape much of the rest of the survey. If the participant selects the answer “Vidareutbildning har inte påverkat min roll som matematiklärare.” then the parts of the survey containing questions about specific types of supplementary training are skipped. If the participant selects one, two, or three answer options connected to different types of supplementary training, then the parts of the survey pertaining to these types will be provided.

All the questions in the part “Vidareutbildning, sista delen” is also dependent on the answer given on the question mentioned above.

Before presenting the survey, the participants got this text:

Hej! Robin Wilsson heter jag och studerar på masterprogrammet Lärande och Ledarskap vid Chalmers. Jag hoppas att du vill hjälpa mig genom att fylla i en enkät som syftar till att samla in och analysera åsikter om och erfarenheter av vidareutbildning. Enkäten går ut till samtliga knappt 250 matematiklärare på gymnasier i Göteborgs Stad, samt de drygt 350 matematiklärare på olika gymnasier i Hallands och Västra Götalands län kopplade till Matematiklyftet. Enkäten ligger till grund för mitt examensarbete. Jag uppskattar att du tar dig tid att besvara min enkät!

På grund av att enkäten följs upp av frivilliga intervjuer så behöver jag veta vem som svarade vad. Jag garanterar att ingen annan kommer att få ta del av informationen du ger mig. Ditt frivilliga deltagande hjälper till att visa om vidareutbildning används på rätt sätt. Genom ditt deltagande samtycker du till att uppgifterna du lämnar, samt din mailadress, får användas i forskningssyfte och lagras i databas i upp till tre månader. Endast jag, Robin Wilsson, kommer att ha tillgång till dessa data. Om du har frågor angående enkäten eller om mitt examensarbete i övrigt, är du välkommen att kontakta mig via min mailadress: wilsson@student.chalmers.se. Tack för den hjälp du kan ge mig!

APPENDIX 1:2 A TEXT VERSION OF THE SURVEY

Introduktion, del 1

* Har du arbetat som matematiklärare för gymnasieelever under totalt minst tre år, oavsett omfattning, under de senaste fem åren?

Välj ett av följande svar: *Flervalsfråga (ett svar)*

- Ja
- Nej

Om du svarar "Nej" så tillhör du tyvärr inte målgruppen för den här enkäten!

Introduktion, del 2

* Hur gammal är du?

Välj ett av följande svar: *Rullningslist*

- 19 år eller yngre
- 20-24 år
- 25-29 år
- 30-34 år
- 35-39 år
- 40-44 år
- 45-49 år
- 50-54 år
- 55-59 år
- 60 år eller äldre

* Ange ditt kön

Välj ett av följande svar: *Rullningslist*

- Man
- Kvinna
- Annat
- Vill ej svara

* Ange din högsta avslutade utbildningsnivå

Välj ett av följande svar: *Flervalsfråga (ett svar)*

- Grundskola
- Gymnasium
- Universitet/Högskola
- Har licentiatexamen
- Har doktorerat
- Annat

Skriv din kommentar här: *Fritextsvar*

* Hur många högskolepoäng matematik har du läst?

Välj ett av följande svar:

- Färre än 30 hp
- 30-59 hp
- 60-89 hp
- 90-119 hp
- 120hp eller mer
- Vet ej

Endast avslutade kurser räknas. En termins heltidsstudier motsvarar 30 högskolepoäng.

Introduktion, del 3

- * Har du lärarlegitimation (eller behörighet att undervisa) inom matematik på gymnasienivå?

Välj ett av följande svar: *Flervalsfråga (ett svar)*

- Ja
- Nej

- * Hur länge (i hela år) har du totalt sett arbetat som matematiklärare på gymnasienivå?

Fritextsvar (endast siffror tillåtna)

Det spelar ingen roll om du arbetat deltid eller heltid, eller hur stor del av din arbetstid du spenderat på matematikundervisning.

- * Vilket/vilka program undervisar du på?

Fritextsvar

Om du bytt program, ange de du jobbat med under längst tid, eller kommentera.

- * Vilka ämnen undervisar du i?

Fritextsvar

Ange ett ämne per rad, tack!

- * Är matematik ett av dina huvudämnen?

Välj ett av följande svar

- Ja
- Nej

- * Hur många lärare arbetar på din skola?

Fritextsvar

- * Hur många matematiklärare (oavsett nivå) har du regelbunden kontakt med?

Fritextsvar

- * I vilken utsträckning instämmer du i följande påståenden?

	Instämmer helt	Instämmer delvis	Håller delvis med	Håller inte med alls	Vet ej
Jag trivs på min skola.	<input type="radio"/>				
Jag har god kontakt med mina lärarkollegor på min skola.	<input type="radio"/>				
Jag reflekterar kontinuerligt över hur min matematikundervisning kan förbättras.	<input type="radio"/>				
Jag diskuterar vanligtvis problem och möjligheter i matematikundervisningen när möjligheten uppstår i samtal med andra.	<input type="radio"/>				
Rektorn har god kunskap om matematikundervisningens kvalitet på min skola.	<input type="radio"/>				

Frivilliga kommentarer till ovanstående fråga. *Fritextsvar.*

Vidareutbildning, del 1

* Vad tänker du på när du hör ordet "vidareutbildning"? *Fritextsvar.*

Vidareutbildning, del 2

* Har du deltagit i följande sorters vidareutbildning **under de senaste fem åren?**

	Ja	Nej	Vet inte
Regelbundna seminarier/möten inom samma ämne	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Avslutad/pågående kurs, till exempel via Komvux eller högskolan (oavsett ämne)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Auskultering, terminsvis eller oftare (Auskultering betyder att du varit med under andra lärares arbete i klassrummet via lektionslånga besök, utan att deltaga i undervisningen, och kanske givit feedback)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Officiell vidareutbildning arrangerad av skolan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inofficiell "vidareutbildning" (samtal som utvecklats dig som lärare, till exempel med kollegor eller vänner)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Självstudier (kväll/helg/övrig ledig tid)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Matematiklyftet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Läraryftet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Annan sorts vidareutbildning (specificera i en senare fråga)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* Vilka sorters vidareutbildningar, som du genomfört, anser du har haft störst påverkan för din roll som matematiklärare?

Markera upp till tre (3) alternativ, **eller** markera rutan "Vidareutbildning har inte påverkat min roll som matematiklärare".

Välj mellan 1 och 3 svar

- Regelbundna seminarier/möten inom samma ämne
- Avslutad/pågående kurs, till exempel via Komvux eller högskolan (oavsett ämne)
- Auskultering
- Officiell vidareutbildning arrangerad av skolan
- Inofficiell "vidareutbildning" (samtal som utvecklats dig som lärare, till exempel med kollegor eller vänner)
- Självstudier (kväll/helg/övrig ledig tid)
- Matematiklyftet
- Läraryftet
- Annan sorts vidareutbildning (specificera senare)
- Vidareutbildning har inte påverkat min roll som matematiklärare.

Vidareutbildning: seminarier

* Vem tog initiativet till seminarierna?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Hur genomfördes det?

Välj ett av följande svar

- På arbetstid med vikarie/motsvarade som övertog ordinarie lektioner
- På arbetstid utöver mina ordinarie lektioner
- På arbetstid avsatt för vidareutbildning
- På min fritid
- Annat sätt (specificera längst ner på sidan)

* Hur många seminarier har du deltagit vid?

Välj ett av följande svar

- 1-3
- 4-6
- 7-9
- 10 eller fler
- Vet inte
- Spelar ingen roll, antalet är inte relevant

* Hur finansierades seminarierna?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Har seminarierna gett någon (varaktig) effekt på din matematikundervisning?

	Ja	Nej
Ökat engagemang	<input type="radio"/>	<input type="radio"/>
Ökat självförtroende	<input type="radio"/>	<input type="radio"/>
Fler undervisningsmetoder	<input type="radio"/>	<input type="radio"/>
Ny insikt i hur undervisning kan bedrivas	<input type="radio"/>	<input type="radio"/>
Ökad förmåga att individanpassa undervisningen	<input type="radio"/>	<input type="radio"/>
Annat (specificera i nästa fråga)	<input type="radio"/>	<input type="radio"/>

Har du något övrigt att säga om denna sorts vidareutbildning? *Fritextsvar*

Vidareutbildning: kurser

* Vem tog initiativet till kursen/kurserna?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Hur genomfördes det?

Välj ett av följande svar

- På arbetstid med vikarie/motsvarade som övertog ordinarie lektioner
- På arbetstid utöver mina ordinarie lektioner
- På arbetstid avsatt för vidareutbildning
- På min fritid
- Annat sätt (specificera längst ner på sidan)

* Hur många kurser har du genomfört?

Välj ett av följande svar

- 1
- 2
- 3
- 4
- 5
- Vet inte

Frivilligt: skriv namnet på den eller de kurser du anser har haft störst effekt på din matematikundervisning. *Fritextsvar*

* Hur finansierades kursen/kurserna?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Kurserna har finansierats på olika sätt
- Mina kollegor

Annat:

Ange det vanligaste sättet om finansieringen varierat mellan kurserna, eller välj "Kurserna har finansierats på olika sätt".

* Gav kursen/kurserna någon (varaktig) effekt på din matematikundervisning?

Ja Nej

Ökat engagemang	<input type="radio"/>	<input type="radio"/>
Ökat självförtroende	<input type="radio"/>	<input type="radio"/>
Fler undervisningsmetoder	<input type="radio"/>	<input type="radio"/>
Ny insikt i hur undervisning kan bedrivas	<input type="radio"/>	<input type="radio"/>
Ökad förmåga att individanpassa undervisningen	<input type="radio"/>	<input type="radio"/>
Annat (specificera i nästa fråga)	<input type="radio"/>	<input type="radio"/>

Har du något övrigt att säga om denna sorts vidareutbildning? *Fritextsvar*

Vidareutbildning: auskultering

* Vem tog initiativet till auskulteringen?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Hur genomfördes det?

Välj ett av följande svar

- På arbetstid med vikarie/motsvarade som övertog ordinarie lektioner
- På arbetstid utöver mina ordinarie lektioner
- På arbetstid avsatt för vidareutbildning
- På min fritid
- Annat sätt (specificera längst ner på sidan)

* Hur många auskulteringar brukar du genomföra varje termin?

Välj ett av följande svar

- 1-3
- 4-6
- 7-9
- 10 eller fler
- Vet inte

* Hur finansierades auskulteringen?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Fick det någon (varaktig) effekt på din matematikundervisning?

	Ja	Nej
Ökat engagemang	<input type="radio"/>	<input type="radio"/>
Ökat självförtroende	<input type="radio"/>	<input type="radio"/>
Fler undervisningsmetoder	<input type="radio"/>	<input type="radio"/>
Ny insikt i hur undervisning kan bedrivas	<input type="radio"/>	<input type="radio"/>
Ökad förmåga att individanpassa undervisningen	<input type="radio"/>	<input type="radio"/>
Annat (specificera i nästa fråga)	<input type="radio"/>	<input type="radio"/>

Har du något övrigt att säga om denna sorts vidareutbildning? *Fritextsvar*

Vidareutbildning: officiell

* Vem tog initiativet till den senaste officiella vidareutbildningen du genomfört?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

Beskriv gärna kort denna officiella vidareutbildning *Fritextsvar*

* Hur genomfördes det?

Välj ett av följande svar

- På arbetstid med vikarie/motsvarade som övertog ordinarie lektioner
- På arbetstid utöver mina ordinarie lektioner
- På arbetstid avsatt för vidareutbildning
- På min fritid
- Annat sätt (specificera längst ner på sidan)

* Hur många tillfällen har du genomfört?

Välj ett av följande svar

- 1-3
- 4-6
- 7-9
- 10 eller fler
- Vet inte

* Hur finansierades den senaste officiella vidareutbildningen?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Gav den någon (varaktig) effekt på din matematikundervisning?

	Ja	Nej
Ökat engagemang	<input type="radio"/>	<input type="radio"/>
Ökat självförtroende	<input type="radio"/>	<input type="radio"/>
Fler undervisningsmetoder	<input type="radio"/>	<input type="radio"/>
Ny insikt i hur undervisning kan bedrivas	<input type="radio"/>	<input type="radio"/>
Ökad förmåga att individanpassa undervisningen	<input type="radio"/>	<input type="radio"/>
Annat (specificera i nästa fråga)	<input type="radio"/>	<input type="radio"/>

Har du något övrigt att säga om denna sorts vidareutbildning? *Fritextsvar*

Vidareutbildning: inofficiell

Frivilligt: beskriv hur det gick till när du började med denna sorts "vidareutbildning".

Fritextsvar

* Genomförs denna "vidareutbildning" mestadels under din fritid?

Välj ett av följande svar

- Ja
- Nej

* Hur ofta sker denna sorts "vidareutbildning"?

Välj ett av följande svar

- Cirka en gång per vecka
- Någon gång per månad
- Cirka en gång per månad
- Cirka en gång i kvartalet
- Cirka en gång i halvåret
- Mer sällan än en gång i halvåret
- Vet inte

Frivilligt: hur finansierades denna inofficiella "vidareutbildning"? *Fritextsvar*

* Fick det någon (varaktig) effekt på din matematikundervisning?

	Ja	Nej
Ökat engagemang	<input type="radio"/>	<input type="radio"/>
Ökat självförtroende	<input type="radio"/>	<input type="radio"/>
Fler undervisningsmetoder	<input type="radio"/>	<input type="radio"/>
Ny insikt i hur undervisning kan bedrivas	<input type="radio"/>	<input type="radio"/>
Ökad förmåga att individanpassa undervisningen	<input type="radio"/>	<input type="radio"/>
Annat (specificera i nästa fråga)	<input type="radio"/>	<input type="radio"/>

Har du något övrigt att säga om denna sorts vidareutbildning? *Fritextsvar*

Vidareutbildning: självstudier

* Vem tog initiativet till självstudierna?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Hur genomfördes det?

Välj ett av följande svar

- På arbetstid med vikarie/motsvarade som övertog ordinarie lektioner
- På arbetstid utöver mina ordinarie lektioner
- På arbetstid avsatt för vidareutbildning
- På min fritid
- Annat sätt (specificera längst ner på sidan)

* Hur många olika sorters självstudier har du slutfört under de senaste fem åren?

Välj ett av följande svar

- 1-3
- 4-6
- 7-9
- 10 eller fler
- Vet inte

* Hur finansierades dessa självstudier?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Fick det någon (varaktig) effekt på din matematikundervisning?

	Ja	Nej
Ökat engagemang	<input type="radio"/>	<input type="radio"/>
Ökat självförtroende	<input type="radio"/>	<input type="radio"/>
Fler undervisningsmetoder	<input type="radio"/>	<input type="radio"/>
Ny insikt i hur undervisning kan bedrivas	<input type="radio"/>	<input type="radio"/>
Ökad förmåga att individanpassa undervisningen	<input type="radio"/>	<input type="radio"/>
Annat (specificera i nästa fråga)	<input type="radio"/>	<input type="radio"/>

Har du något övrigt att säga om denna sorts vidareutbildning? *Fritextsvar*

Vidareutbildning: Matematiklyftet

* Vem tog initiativet till att du genomförde Matematiklyftet?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor
- Centralt beslut

Annat:

Om initiativtagandet varierat mellan modulerna, ange vem som var initiativtagare till den senast genomförda modulen.

* Hur genomfördes det?

Välj ett av följande svar

- På arbetstid med vikarie/motsvarande som övertog ordinarie lektioner
- På arbetstid utöver mina ordinarie lektioner
- På arbetstid avsatt för vidareutbildning
- På min fritid
- Annat sätt (specificera längst ner på sidan)

* Vilka moduler har du genomfört? *Fritextsvar*

* Hur finansierades Matematiklyftet för dig?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor
- Centralt beslut

Annat:

Om finansieringen varierat, ange hur senaste modulen finansierades.

* Fick det någon (varaktig) effekt på din matematikundervisning?

	Ja	Nej
Ökat engagemang	<input type="radio"/>	<input type="radio"/>
Ökat självförtroende	<input type="radio"/>	<input type="radio"/>
Fler undervisningsmetoder	<input type="radio"/>	<input type="radio"/>
Ny insikt i hur undervisning kan bedrivas	<input type="radio"/>	<input type="radio"/>
Ökad förmåga att individanpassa undervisningen	<input type="radio"/>	<input type="radio"/>
Annat (specificera i nästa fråga)	<input type="radio"/>	<input type="radio"/>

Har du något övrigt att säga om denna sorts vidareutbildning? *Fritextsvar*

Vidareutbildning: lärarlyftet

* Vem tog initiativet till att du genomförde Lärarlyftet?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Hur genomfördes det?

Välj ett av följande svar

- På arbetstid med vikarie/motsvarade som övertog ordinarie lektioner
- På arbetstid utöver mina ordinarie lektioner
- På arbetstid avsatt för vidareutbildning
- På min fritid
- Annat sätt (specificera längst ner på sidan)

* Hur många tillfällen har du genomfört?

Välj ett av följande svar

- 1-3
- 4-6
- 7-9
- 10 eller fler
- Vet inte

* Hur finansierades Lärarlyftet för dig?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Fick det någon (varaktig) effekt på din matematikundervisning?

	Ja	Nej
Ökat engagemang	<input type="radio"/>	<input type="radio"/>
Ökat självförtroende	<input type="radio"/>	<input type="radio"/>
Fler undervisningsmetoder	<input type="radio"/>	<input type="radio"/>
Ny insikt i hur undervisning kan bedrivas	<input type="radio"/>	<input type="radio"/>
Ökad förmåga att individanpassa undervisningen	<input type="radio"/>	<input type="radio"/>
Annat (specificera i nästa fråga)	<input type="radio"/>	<input type="radio"/>

Har du något övrigt att säga om denna sorts vidareutbildning? *Fritextsvar*

Vidareutbildning: annan

* Vilken typ av vidareutbildning syftade du tidigare på när du markerade rutan "annan vidareutbildning"? *Fritextsvar*

* Vem tog initiativet till att du genomförde denna sorts vidareutbildning?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Hur genomfördes det?

Välj ett av följande svar

- På arbetstid med vikarie/motsvarade som övertog ordinarie lektioner
- På arbetstid utöver mina ordinarie lektioner
- På arbetstid avsatt för vidareutbildning
- På min fritid
- Annat sätt (specificera längst ner på sidan)

* Hur många tillfällen har du genomfört?

Välj ett av följande svar

- 1-3
- 4-6
- 7-9
- 10 eller fler
- Vet inte
- Inte relevant

* Hur finansierades denna sorts vidareutbildning?

Vänligen välj ett svar

- Jag själv
- Rektorn/motsvarande på min skola
- Mina anhöriga
- En statlig myndighet
- Ett privat företag
- Mina kollegor

Annat:

* Fick det någon (varaktig) effekt på din matematikundervisning?

	Ja	Nej
Ökat engagemang	<input type="radio"/>	<input type="radio"/>
Ökat självförtroende	<input type="radio"/>	<input type="radio"/>
Fler undervisningsmetoder	<input type="radio"/>	<input type="radio"/>
Ny insikt i hur undervisning kan bedrivas	<input type="radio"/>	<input type="radio"/>
Ökad förmåga att individanpassa undervisningen	<input type="radio"/>	<input type="radio"/>
Annat (specificera i nästa fråga)	<input type="radio"/>	<input type="radio"/>

Har du något övrigt att säga om denna sorts vidareutbildning? *Fritextsvar*

Vidareutbildning, sista delen

- * Hur många timmar per månad spenderar du på någon form av vidareutbildning?

(Förekommer såvida inte svaret "Vidareutbildning har inte påverkat min roll som matematiklärare." är markerat på frågan "Vilka sorters vidareutbildningar, som du genomfört, anser du har haft störst påverkan för din roll som matematiklärare?")

Välj ett av följande svar

- 0 timmar
- 1-5 timmar
- 6-10 timmar
- 11-15 timmar
- 16-20 timmar
- Mer än 20 timmar

- * Varför har du inte genomfört någon vidareutbildning?

(Förekommer om svaret "Vidareutbildning har inte påverkat min roll som matematiklärare." är markerat på frågan "Vilka sorters vidareutbildningar, som du genomfört, anser du har haft störst påverkan för din roll som matematiklärare?")

Fritextsvar

- * Skulle du vilja delta i vidareutbildning i framtiden?

(Förekommer om svaret "Vidareutbildning har inte påverkat min roll som matematiklärare." är markerat på frågan "Vilka sorters vidareutbildningar, som du genomfört, anser du har haft störst påverkan för din roll som matematiklärare?")

Välj ett av följande svar

- Ja
- Nej

- * Vilka hinder ser du för att du ska kunna utföra vidareutbildning på din skola?

(Förekommer om svaret "Vidareutbildning har inte påverkat min roll som matematiklärare." är markerat på frågan "Vilka sorters vidareutbildningar, som du genomfört, anser du har haft störst påverkan för din roll som matematiklärare?")

Fritextsvar

Avslutning

- * Anser du att vidareutbildning behövs för att utvecklas som lärare?

Välj ett av följande svar

- Ja
- Nej
- Vet ej

- * Inom vilka områden känner du ett behov av vidareutbildning?

Välj de alternativ som stämmer

- IT
- Formativ bedömning
- Betygsättning
- Undervisning i matematik för nyanlända
- Elever med särskilda behov

Annat:

- * Anser du att behovet av vidareutbildning är tillgodosett på din skola?

Välj ett av följande svar

- Ja
- Nej
- Vet inte

Om du svarade "Nej" eller "Vet inte" på ovanstående fråga, vad kan göras för att möjliggöra mer vidareutbildning?

Välj de alternativ som stämmer

- Skolan behöver avsätta mer tid/resurser för vidareutbildning
- Jag saknar motivation för att vidareutbilda mig
- Skolans ledning behöver ändra sin attityd jämt mot vidareutbildning
- Bättre finansiella möjligheter behövs, då skolan inte har råd att betala för vidareutbildning

Annat:

* Hur mycket känner du att du varit delaktig i utformningen av din egen vidareutbildning?

Välj ett av följande svar

- Väldigt delaktig
- Något delaktig
- Mestadels odelaktig
- Inte alls delaktig

Skriv din kommentar här: *Fritextsvar*

Vilken typ av vidareutbildning tror du skulle kunna leda till att eleverna presterar bättre i kommande internationella undersökningar? *Fritextsvar*

* Anser du att din skola ger dig det stöd du behöver för att utvecklas som matematiklärare?

Välj ett av följande svar

- Ja
- Mestadels
- Oftast inte
- Nej

Skriv din kommentar här: *Fritextsvar*

* Får jag kontakta dig för en uppföljningsintervju?

Välj ett av följande svar

- Ja
- Nej

Har du synpunkter om enkäten och dess utformning är du välkommen att skriva dem här! *Fritextsvar*

APPENDIX 1:3 MESSAGES PERTAINING TO THE SURVEY

Meddelande om inbjudan till enkäten:**Titelrad:** Enkät om vidareutbildning!

Hej matematiklärare!

Robin heter jag och jag går på Chalmers lärarutbildning och skriver nu mitt examensarbete inom didaktik. Syftet med arbetet är att undersöka hur vidareutbildning genomförs av matematiklärare på gymnasienivå. Det är till stor hjälp för mig om du besvarar min enkät!

Undersökningen heter "{SURVEYNAME}" och tar cirka 10 - 15 minuter av din tid i anspråk beroende på hur du svarar.

För att delta, var snäll att klicka på länken nedan.

Med vänlig hälsning,

Klicka här för att delta i undersökningen:

{SURVEYURL}

Om du inte vill delta i denna enkät och inte heller vill ha vidare inbjudan, klicka på följande länk:

{OPTOUTURL}

Om du tidigare valt att inte delta i enkäten (opt-out) men har ändrat dig och vill delta igen, klicka på följande länk:

{OPTINURL}

Meddelande om påminnelse om enkäten:**Titelrad:** Påminnelse: enkät om vidareutbildning!

Hej igen matematiklärare! Det är Robin igen, som ber dig delta i min enkät.

Jag går som sagt på Chalmers lärarutbildning och skriver nu mitt examensarbete inom didaktik. Syftet med arbetet är att undersöka hur vidareutbildning genomförs av matematiklärare på gymnasienivå. Det är till stor hjälp för mig om du besvarar min enkät!

Undersökningen heter "{SURVEYNAME}" och tar cirka 10 - 15 minuter av din tid i anspråk beroende på hur du svarar.

För att delta, klicka på länken nedan.

För frågor, kontakta mig via wilsson@student.chalmers.se

Med vänlig hälsning,

Robin,

Klicka här för att komma till enkäten:

{SURVEYURL}

Om du inte vill delta i denna enkät och inte heller vill ha vidare inbjudan, klicka på följande länk:

{OPTOUTURL}

Meddelande som tackar för deltagande i enkäten**Titelrad:** Bekräftelse av ditt deltagande i vår undersökning

Hej matematiklärare!

Stort tack för ditt deltagande i min enkät {SURVEYNAME}! Ditt svar har registrerats och är viktigt för min undersökning.

Om du har frågor, kontakta mig via wilsson@student.chalmers.se.

Med vänlig hälsning,

Robin Wilsson, snart lärare.

APPENDIX 2: THE INTERVIEW

APPENDIX 2.1: THE UNTRANSLATED INTERVIEW QUESTIONS

- 1: Beskriv hur du genomför din matematikundervisning. Vilka undervisningsmetoder har du. Med undervisningsmetoder menar jag till exempel traditionell katederundervisning, grupparbeten, formativ bedömning, problembaserat lärande, IKT, utomhusundervisning, flipped classroom, eller liknande. Ge exempel.
- 2: Tror du att din undervisning skiljer sig från andra matematiklärares. I så fall hur.
- 3: Hur vanligt förekommande tror du det är att mattelärare i huvudsak baserar sin undervisning på kursboken?
- 4: Har dina undervisningsmetoder förändrats de senaste åren? På vilket sätt, och vad beror det på?
- 5: Beskriv den vidareutbildning som du genomfört under de senaste åren som du tycker har påverkat din undervisningskvalitet mest. Med undervisningskvalitet menar jag inte bara resultatet hos eleverna, utan även stämningen, pedagogisk skicklighet, bättre arbete mot mobbing, och så vidare. Vad lärde du dig?
- 6: Om du tänker på all den vidareutbildning du genomfört de senaste åren, på vilket sätt anser du att din undervisningskvalitet rent konkret har påverkats. Har du anpassat din undervisning baserat på vidareutbildning, ge exempel.
- 7: Vilken sorts vidareutbildning skulle du helst vilja genomföra?
- 8: Vilka hinder ser du för att kunna utföra vidareutbildning på din skola?
- 9: Är du stressad i ditt arbete som lärare? Hur påverkar det din undervisning?
- 10: Är din rektor eller skolledare positiv till att du och dina kollegor vidareutbildar er?
- 11: Känner du att du har möjlighet att testa nya undervisningsmetoder i klassrummet? Gör du det?
- 12: Betrakta följande scenario: en nyexaminerad matematiklärare spenderar några år med att hitta ett bekvämt sätt att undervisa i klassrummet, och efter detta påverkas dennes arbetsmetoder endast marginellt av vidareutbildning. Hur realistiskt anser du att detta scenario är?
- 13: Träffar du andra lärare eller pedagoger regelbundet för att diskutera hur undervisning genomförs?
- 14: Hur borde undervisningen i matematik förändras så att Sverige presterar bättre på internationella undersökningar som TIMSS och PISA? Hur kan man genomföra den här förändringen?
- 15: Har du några övriga tankar om vidareutbildning?