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Difficulties in mathematics among students with Swedish as a second language

Teachers‘ views on difficulties, causes, and measures in mathematics in Swedish lower secondary school, with a focus on students with Swedish as their second language

Master’s thesis in Learning and Leadership

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Preface

This master thesis was written by Daniella Hanoun Santana and Johanna Törnqvist during the final semester, spring of 2022, at the program Learning and Leadership at Chalmers University of Technology. The master's program includes 120 hp, of which this study includes 30 hp. The master's education leads to a double degree: Master of Science in engineering and teacher certification in mathematics and technology.

First and foremost, we would like to put our gratitude to our supervisor, Mona Arfs, who has been a great support and sounding board during this project. Mona has provided clear and keen input and insights, which have contributed much value to this thesis.

We would also like to express our gratitude to our respondents who gave us valuable information to analyze. The respondents' identity is anonymized in this report, but you know who you are - thank you!

It was an exciting battle against the clock when one of us was expecting a baby in the middle of the term. Special thanks to Nicholas who gave us a stick and carrot to stay productive, and patiently waited a couple of extra days to present himself to the world.

Daniella Hanoun Santana & Johanna Törnqvist, May 2022

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Abstract

In the media, news has highlighted that Sweden has performed worse in PISA (Programme for International Student Assessment) over the years compared to other countries. Statistics of Sweden's results of mathematics in PISA and National Tests show that students with a language other than Swedish as their mother tongue generally perform with a lower result compared to the students with Swedish as their mother tongue. The study aims to investigate the understanding of mathematics among students with Swedish as a second language who study mathematics with Swedish as the language of instruction.

The chosen method for this study is qualitative interviews, including seven respondents teaching mathematics at five Swedish lower secondary schools. Via the insight of the teachers' perspective, this study answers the following questions;

- What specific difficulties do students with Swedish as a second language encounter in mathematics teaching?
- What factors contribute to the difficulties in mathematics learning that students with Swedish as a second language encounter?
- How do mathematics teachers in lower secondary schools work to make it easier for students with Swedish as a second language who have difficulties?

The study is based on the sociocultural perspective which implies that students learn through interaction with each other so that learning takes place in social contexts. This study shows that students with Swedish as a second language (SVA) encounter difficulties connected to language comprehension; problem-solving tasks, mathematical concepts, reasoning, and communication. The causes of these difficulties according to the respondents are language comprehension, cultural differences, prior knowledge, and poor study technique. Common measures to facilitate the SVA students' learning in mathematics are interaction, support in the mother tongue, image support, paying attention to the student's culture, and increasing reading comprehension. These results are relevant for mathematics teachers who teach SVA students. By understanding the basic problem of the difficulties, teachers can take the right action and thus provide an equivalent education.

Keywords: Swedish as a second language, difficulties in mathematics, mathematical language, support in mother tongue, problem-solving

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Terminology

SVA student - *student with Swedish as a second language*

Knowledge survey (Kartläggning) - *a survey to declare the student's language skill, previous schooling, knowledge, and what conditions the student needs for learning.*

Saturation (Mättnad) - *the point at which further data collection does not add any new knowledge*

PISA - *Programme for International Student Assessment, evaluates the knowledge of 15-year-old students in nations all over the world via tests*

OECD - *The Organisation for Economic Co-operation & Development, runs the PISA project*

Compulsory school ordinance (Skolförordningen) - *ordinances are additional provisions in school matters from the government*

The Swedish National Agency for Education (Skolverket) - *the central administrative authority for the public school system, publicly organized preschooling, school-age childcare and for adult education*

The Swedish Education Act (Skollagen) - *regulates the rights and obligations of children, students and guardians*

Swedish Schools Inspectorate (Skolinspektionen) - *scrutinizes schools and assesses applications to run an independent school*

Compulsory school (Grundskolan) - *school year 0–9*

Lower secondary school (Högstadiet) - *school year 7–9, compulsory, non-selective*

Upper secondary school (Gymnasiet) - *school year 10-12, voluntary, programs*

1. Introduction

Mathematics is one of the school subjects that is considered important. It is also a core subject in the Swedish school, meaning that students must at least pass in order to be able to study further in upper secondary school (Norén, 2010a).

Research shows that language skills play an essential role in learning mathematics. Language can be seen as a tool for developing thinking. Difficulties in mathematics among second language students are often related to the student's language comprehension (Rönnberg & Rönnberg, 2001).

Sweden is a multilingual country and over the years, the Swedish schools have become more multicultural and the classrooms hold more students with Swedish as a second language (Svenska som andraspråk, SVA) than they did a few years ago. Just over 20% of the students in Sweden are SVA students. Research has shown that it can create problems for students to communicate mathematics when the language of instruction is their second language. Research has also shown that problem-solving tasks are particularly difficult for SVA students as they involve a lot of words (Norén & Caligari, 2020).

As mathematics in the higher school years includes more text-based exercises, in the form of problem-solving tasks, many students with Swedish as a second language experience difficulties in understanding these tasks (Myndigheten för skolutveckling, 2008). If students with Swedish as a second language do not get the stimulation and guidance they need, it will be unfair compared to the students who do not have the language as an obstacle. It is thus an ethical and societal aspect of this study. However, there is no connection to the ecological aspect.

Mathematics uses a universal symbolic language, which leads to mathematics being seen as a subject in which students who do not master the language of instruction could participate. The effect of this has led to many students with poor language skills in Swedish being placed in regular teaching of mathematics. This shows that the importance of language and culture for mathematics learning is not taken into account (Rönnberg & Rönnberg, 2001).

An obstacle arises for students when the teaching is practiced in a second language that the students do not fully master. There is both a linguistic obstacle to understanding the content of the teaching and an obstacle to communication. This means that second language students who do not master the Swedish language completely need to learn two new languages at the same time: the mathematical language and the language of instruction. This usually happens without the possibility of translating into the student's mother tongue. The mathematical language lacks the redundancy and paraphrasing that natural languages have which makes it harder to understand in comparison to other languages (Rönnberg & Rönnberg, 2001).

1.1 Research problem and research questions

The study aims to investigate the understanding of mathematics among students with Swedish as a second language who study mathematics with Swedish as the language of instruction. The study will examine what difficulties a number of mathematics teachers at Swedish lower secondary schools can identify and their causes, as well as what the teacher can do to facilitate learning.

The study will answer three research questions:

1. *What specific difficulties do students with Swedish as a second language encounter in mathematics teaching?*
2. *What factors contribute to the difficulties in mathematics learning that students with Swedish as a second language encounter?*
3. *How do mathematics teachers in lower secondary schools work to make it easier for students with Swedish as a second language who have difficulties?*

1.2 Delimitations

The study takes into account the mathematics teachers' perspective on the issues and not the students' since the teachers often have more experience and more understanding of what the problems are and why they arise compared to students. These mathematics teachers are the respondents of the interviews, and they work in lower secondary schools in the Gothenburg region (or a maximal one-hour drive from the Gothenburg region) and teach second language students. The geographical area was chosen as a delimitation to increase the possibility of physical interviews rather than digital interviews. A limited number of respondents were involved in the study, with the hope of reaching saturation within the chosen limit. The lower secondary schools were chosen as a delimitation as all students at that level read the same syllabus for mathematics. When it comes to upper secondary schools, the syllabus may differ somewhat depending on which specialization you study.

2. Background

In The Swedish Education Act, the right to equivalent education to stimulate each student's learning is laid down by law. The school is obliged to provide for all students' needs to be able to improve their mathematical skills to reach their full potential (SFS 2010:800).

2.1 Students with Swedish as a second language

According to the Swedish compulsory school ordinance (SFS 2011:185), students should be provided teaching in the course *Swedish as a second language* (SVA) if needed. Criteria for students to join the course:

- has a language other than Swedish as their mother tongue
- has Swedish as their mother tongue but have immigrated to Sweden from a school in a foreign country
- are immigrated students who uses Swedish as the main colloquial language with a caregiver
- has been accepted to continue the SVA course as an alternative to the ordinary course in Swedish

In this report students who meet the criteria to join the course *Swedish as a second language* are referred to as SVA students.

2.2 Support in mother tongue

Preparatory class

The Swedish Education Act includes how newly immigrated students should be introduced to education in Sweden. Initially, the students may attend some of the education in a preparatory class. When the student is considered to have sufficient knowledge in Swedish to comprehend the teaching in Swedish in a subject on their level, the student should transfer from the preparatory class to the regular teaching class in that subject. As the students' knowledge increases the students are gradually transferred to the regular teaching class in every subject. This transfer should be completely implemented within two years. Teaching in preparatory classes shall, as far as possible, be conducted in close connection with the ordinary teaching classes (Skolverket, 2022a; SFS 2015:578).

Mother tongue education

Students with a mother tongue other than Swedish can apply for mother tongue education (SFS 2010:800). It is an opportunity for students to read their mother tongue as a subject in school. This education is offered to students who:

- one or both guardians have a language other than Swedish as their mother tongue

- the language is the main colloquial language in the student's home
- have basic knowledge of the language.

According to The National Agency for Education, teaching in the mother tongue is not only important to improve the knowledge in the language itself, but it is also of great importance for the student's communication, development in their identity and personality, as well as development of their thinking process. A well-developed mother tongue will benefit the student as it sets good conditions for learning Swedish and other subjects (Skolverket, 2020). SVA students benefit from using both their mother tongue and Swedish when learning mathematics, as the students have a greater opportunity to attach their knowledge to several reference points (Hansson, 2011).

Study supervisor in mother tongue

The National Agency for Education (2022a) comments that good support via a study supervisor in the student's mother tongue, or in another language that the student master, can facilitate the student's transfer to a regular teaching class. According to the Swedish Education Act (SFS 2010:800) the purpose of the study supervisor in the student's mother tongue, or another language that the student masters, is to help the student meet the grading criteria of a passing grade. All students, year 0-12, who require study guidance in their mother tongue are entitled to this support. The students shall be provided support from the study supervisor as long as the students need it, there is no time limit (SFS 2010:800).

2.3 Curriculum

Compulsory schooling in Sweden includes four phases. The students start in preschool, also called year 0, at 6 years of age. After one year at preschool, the students transfer into three phases of three years each. First called "lågstadiet", year 1-3, the second is called "mellanstadiet", year 4-6, and the last one is called "högstadiet", year 7-9. Most students turn 16 years old the year they graduate in year 9 (Skolverket, 2022b). In this report, "högstadiet" is translated into lower secondary school.

The curriculum by the Swedish National Agency for Education (2018, p. 56) states what the teaching in the compulsory school shall include. Generally in mathematics, the students should be provided the opportunity to develop their ability to:

- formulate and solve problems using mathematics and also assess selected strategies and methods,
- use and analyse mathematical concepts and their interrelationships,
- choose and use appropriate mathematical methods to perform calculations and solve routine tasks,
- apply and follow mathematical reasoning, and
- use mathematical forms of expression to discuss, reason and give an account of questions, calculations and conclusions

According to the curriculum by the Swedish National Agency for Education (2018, pp. 59-60), the core content for year 7-9 include:

- understanding and use of numbers
- algebra
- geometry
- probability and statistics
- relationships and change
- problem solving

2.4 National assessment in mathematics

The teacher assesses the students' knowledge and abilities when setting grades. The foundation of the students' grades should include all available information on the students' knowledge. The student's level of ability to master the core content is tested in tests, such as National Tests or exit tickets in class. Students' knowledge may also be shown orally in class (Skolverket, 2018).

According to the Swedish Agency for School Development (2008), SVA students have significantly lower results in the National Tests in mathematics than students with Swedish as their mother tongue. Results from PISA (Programme for International Student Assessment) also show that SVA students in Swedish mathematics classrooms underachieve (Skolverket, 2019a).

Knowledge survey

According to The Swedish Education Act, students should be provided the guidance and support needed to develop as far as possible in line with the goals of the education. This means that the education may need to be adapted to support the students' individual conditions and needs. Reasons for adaptation may be students who need more stimulation to develop in class or students who need more support (SFS 2010:800; SFS 2010:800). Teachers can note the need for adaptation by observing the student in the classroom or using assessment materials to identify the student's need for support (Specialpedagogiska skolmyndigheten, 2020).

When including new immigrants in the Swedish school system, a survey is done to declare the student's language skills, previous schooling, knowledge, and what conditions the student needs for learning. This survey must be done within two months after a student arrives at the compulsory school (SFS 2015:246). The information that emerges from the survey will help to set a plan for the student's education and the possible need for support (Skolverket, 2022c).

The National Agency for Education provides materials used as support for teachers when doing a survey and assessment of the student's prior knowledge of mathematics and their conditions for better learning. The outcome of the survey will indicate what kind of support, if

any, the student needs to be able to meet their educational potential and goals (Skolverket, 2022c). The survey includes an assessment of literacy and numeracy. The literacy survey assesses how the student used the language in different contexts. It tests their reading comprehension and writing skills, as well as their ability to express themself orally via activities such as reading aloud and discussing the content of texts. Numeracy surveys examine the student's mathematical thinking by letting the student solve problems, argue, and reason for their solutions (Skolverket, 2022d; 2022e).

National Tests (NT)

The curriculum for year 0-9 is divided into three phases. During the last year of every three-year period, the core content in several courses is tested in National Tests (NT), for example, the core content of mathematics for year 6-9 is tested in NT in year 9. The NT is a test provided by the Swedish National Agency for Education and constructed in collaboration with several universities. The test aim is to cover as much of the curriculum as possible. All students in Sweden who are in year 3, 6, or 9 take the same NT for their respective level at the same period of time. The purpose of the National Tests is to provide an equal and fair basis to support the grading of the student's knowledge (Skolverket, 2021).

Statistics of National Tests results in math 2018/19 show that foreign-born students receive lower scores on average and run a bigger risk of a failing grade. Students who immigrated and have been registered in Sweden after the start of the compulsory school run a bigger risk of a lower or a failing grade than students who immigrated and have been registered in Sweden before the start of compulsory school. Students who immigrated within the last four years, run statistically more than double the risk of a failing score compared to the statistical score of all students who took that test (Skolverket, 2019b).

Table 1 shows four different categories of immigrant students who have Swedish as a second language. However, these four categories do not include all students with Swedish as a second language. For example, students who were born in Sweden to foreign-born parents are not included in this divided statistics but are still counted in the total (Skolverket, 2019b).

Table 1. Statistics of National Tests score 2018/2019 in mathematics year 9 (Skolverket, 2019b).

	Proportion of students' grades (%)						Average score (0-20)*
	F	E	D	C	B	A	
Total of all students who took the test 2018/2019	17,4	32,8	21,2	14,5	8,7	5,4	10,7
Immigrated before school start	24,5	32,5	19,3	12,6	6,7	4,3	9,6

Immigrated after school start in year 0	37,2	34,0	14,7	8,1	3,9	2,1	7,6
Immigrated within the last four years	39,7	32,9	14,6	7,7	3,6	1,6	7,2
Total of all students, excluding students immigrated within the last four years and students not registered in Sweden	16,4	32,8	21,5	14,8	9,0	5,6	10,9

*The average score shows the students' average score converted to points, the highest possible test score is 20 points and the lowest is 0 points. Grade F converts to 0 points, E converts to 10 points, D converts to 12.5, C converts to 15, B converts to 17.5 and A converts to 20 points.

Programme for International Student Assessment (PISA)

The Organisation for Economic Co-operation & Development (OECD) is running the project Programme for International Student Assessment (PISA) which evaluates the knowledge of 15-year-old students in nations all over the world. The students' knowledge is measured via tests in three categories: reading comprehension, mathematics, and science (Skolverket, 2019a).

The purpose of PISA is to evaluate to what degree each nation's education contributes to knowledge that prepares students for their future. PISA does not take the nations' curriculum into account, but an international framework by PISA's international experts (Skolverket, 2019a).

The PISA tests also measure how the students can use their knowledge in a context. The students interpret texts, identify processes, search, obtain and assess information. In the result of PISA, each nation's students' abilities are summarized with the concept of literacy in each category. A high score in literacy shows a high ability to analyze, reason, and present concepts and ideas in a constructive way. Which, according to PISA, are valuable abilities to function in modern society and sets a base for lifelong learning. Another purpose of PISA is to understand the causes and consequences of how different nations' school systems can affect the students' knowledge (Skolverket, 2019a).

The assessment in PISA is based on several levels of knowledge, also called performance levels, from level 1 to 6. Level 2 is defined as a basic level of knowledge, level 5 and above is defined as a very good level of knowledge. These performance levels are set by OECD and do not necessarily correspond to grades according to the Swedish curriculum. (Skolverket, 2016; 2019a)

In Table 2-4 the Swedish PISA results are presented as performance level points and the share of students in each level. The results refer to reading comprehension, mathematics, and science in 2015 and 2018.

Table 2. PISA results in reading comprehension in 2015-2018 (Skolverket, 2016; 2019a).

Country	Year	Average score	Share of students below level 2	Share of students on level 2-4	Share of students on level 5-6
Sweden	2018	506 p	18 %	69 %	13 %
	2015	500 p	18 %	72 %	10 %

Table 2 shows that the share of students performing on level 5 and above has improved slightly between the years. In 2018 Sweden's average score in reading comprehension was 506 points, which is slightly higher than the score in 2015. However, both years' results show that 18 % of the students perform lower than level 2, which is the level OECD defines as a basic level of reading comprehension.

Table 3. PISA results in mathematics in 2015-2018 (Skolverket, 2016; 2019a).

Country	Year	Average score	Share of students below level 2	Share of students on level 2-4	Share of students on level 5-6
Sweden	2018	502 p	19 %	68 %	13 %
	2015	494 p	21 %	69 %	10 %

According to Table 3, the average score in mathematics in 2018 was 502 points, which is slightly higher than the score in 2015. The share of students performing on level 5 and above has improved slightly between the years. However, both years' results show that a fifth of the students perform lower than level 2.

Table 4. PISA results in science year 2015-2018 (Skolverket, 2016; 2019a).

Country	Year	Average score	Share of students below level 2	Share of students on level 2-4	Share of students on level 5-6
Sweden	2018	499 p	19 %	73 %	8 %
	2015	493 p	22 %	70 %	9 %

Table 4 shows that the average score of Swedish science students was 499 points in 2018, which is slightly higher than the score in 2015 of 493 points. However, the share of students performing lower than level 2 is one-fifth of the students.

In Table 5-6 the PISA results of students with foreign backgrounds are compared to the results of the students with a native background.

Table 5. Average PISA results 2018 in Swedish students with foreigen background and students with native background (Skolverket, 2019a).

	Reading comprehension	Mathematics	Science
Students with native background (1)	525 p	519 p	517 p
Students born in Sweden with a foreign background (2)	471 p	467 p	457 p
Students born abroad with a foreign background (3)	410 p	429 p	422 p
Difference (2) - (1)	- 54 p	- 52 p	- 61 p
Difference (3) - (1)	- 115 p	- 89 p	- 95 p

The 2018 PISA results in Table 5 show that students with a foreign background perform lower on an average level compared to students with a native background, in all three subjects. Further, students born abroad with a foreign background perform lower on an average level compared to students born in Sweden with a foreign background. In the results of reading comprehension for example, the average score for students born in Sweden with a foreign background and students with a native background differs by 54 points, and the average score of students born abroad with a foreign background and students with a native background differs by 115 points.

Table 6. PISA results in reading comprehension 2018 (Skolverket, 2019a).

Student group	Average score	Share of students below level 2	Share of students on level 2-4	Share of students on level 5-6
Students with native background	525 p	12 %	72 %	16 %
Students born in Sweden with a foreign background	471 p	27 %	66 %	7 %
Students born abroad with a foreign background	422 p	51 %	46 %	3 %

Table 6 shows that the share of students performing below level 2 in reading comprehension 2018 was 12 % for students with a native background and 51 % for students born abroad with a foreign background. The percentage of students performing on level 5-6 in reading comprehension was 16 % for students with a native background and 3 % for students born abroad with a foreign background (Skolverket, 2019a).

3. Previous research

This chapter presents previous research on difficulties in mathematics for second language students, causes, and measures to support the students. In addition to previous research, a synopsis of various researches on the subject is used as sources for this chapter, as well as the Swedish Schools Inspectorate's results (2010) from quality review reports.

3.1 Research on difficulties in mathematics for SVA students

Knowledge of several languages may have many benefits, however, linguistics in mathematics, with its different terms, expressions, and grammar, is different from the everyday language that the student uses (Löwing & Kilborn, 2008a). The mathematical language has its own register and differs from the everyday language which can cause problems for students in general. The difficulty of managing the register is greater for second language students considering that the students need to learn two languages at the same time; the language of instruction and the language of mathematics (Löwing & Kilborn, 2010). Many students learning in their second language have difficulties with mathematics, indicating that mathematics has a linguistic dimension that teachers must be aware of and consider in their teaching (Myndigheten för skolutveckling, 2008).

In year 4 to 6, the level of language used in mathematics gradually becomes more advanced. Students that in earlier years have done well in the subject face a big challenge to keep pace in the subject due to the new advanced language. Studying in a language you do not fully master makes the student put more energy into decoding the instructions and the text of a problem-solving task than a student learning the subject in their mother tongue. The process of decoding and solving a math problem must be done with care, expressions and concepts are of high importance. This means that reading becomes a very time-consuming task for SVA students (Myndigheten för skolutveckling, 2008).

Mathematics is often seen as a universal language, with its number and symbols, which is often used as an argument to introduce newly immigrated and SVA students to the math class sooner than to other subjects. The same students may have been advised not to join the ordinary teaching in orienteering subjects such as science and social studies due to poor language skills. In the math classroom, however, much of the communication is beyond the numbers and symbols, in verbal and text communication (Rönnberg & Rönnberg, 2001).

3.2 Research on causes to difficulties in mathematics for SVA students

A common mistake in the decoding process is that the student misses implicit information in their attempt to interpret the text. The obstacles in the decoding process cost mental energy that the student could have put into solving the mathematical problem instead. They may also

be tricked by misleading information, putting their mindset in the wrong direction. They may face new words, terms, or expressions, which are unknown to the student (Myndigheten för skolutveckling, 2008).

When a new concept is introduced the SVA student must work with both the language and the concept. This dual-task makes the learning process more complex. The ability to communicate teacher to student, between students and student to teacher becomes more difficult when you do not master the language, which will affect the ability to understand instructions, reason with friends, and the ability to ask for help. The consequences of only being taught in a second language are poorer development both in the school subject and in the students' cognitive development. This makes it difficult for SVA students to catch up with peers who have the language of instruction as their mother tongue (Rönnberg & Rönnberg, 2001).

The student's reference framework is different depending on culture and previous experiences. The framework may differ between SVA students and students with Swedish as their mother tongue. What is familiar to one student may be unfamiliar to another one, depending on one's experience (Löwing & Kilborn, 2008a). Lack of knowledge in a specific environment can make a math problem more difficult. If a student for example has never been skiing or seen anyone skiing a math problem in a context of a biathlon competition may be hard to understand. Such a text may include several terms and words that the student has never been in contact with before (Myndigheten för skolutveckling, 2008).

A review made by the Swedish Schools Inspectorate (2010) shows that many teachers lack knowledge and competence in beneficial methods for successful knowledge development when working with SVA students. In order to adapt the teaching, the teachers need an understanding of the students' interests and previous experience in the subject, as well as their linguistic and cognitive level in mathematics. According to the report, this understanding is something that many teachers are missing (Skolinspektionen, 2010).

3.3 Research on measures to support SVA student

According to the Swedish Agency for School Development (2008), mathematics teachers should devote more time to reading comprehension in mathematics. Eckerholm (2018) agrees with the Swedish Agency for School Development and shows in her study that difficulties with reading comprehension in Swedish also affect the students' ability to learn mathematics. According to Eckerholm, good reading skill is important in mathematics. Möllehed (2001) writes in his dissertation that one of the biggest reasons why students respond incorrectly to problem-solving is that they do not understand the content of the texts and that they misunderstand details or the question in the text.

Both SVA students and students with Swedish as a mother tongue need help in conquering the mathematical language as well as learning both the everyday and mathematical meaning of words. The more the students hear the mathematical meaning of the words, the more they

get stuck in the active vocabulary. By letting students discuss, write and read mathematics, reading comprehension increases. Another way for students to improve and deepen their reading comprehension is by including reading strategies in mathematics teaching (Myndigheten för skolutveckling, 2008).

It is crucial to have a good vocabulary to be able to understand what you are reading. Teachers should promote students encountering new words and expressions as this allows students to expand their vocabulary and develop their language skills. Teachers tend to simplify the language when they notice that students have a limited vocabulary or insufficient knowledge of Swedish. At first, teachers explain many difficult words, but eventually, they begin to use fewer difficult words, which leads to students' ability to develop the language decreasing in the long run. Both textbook authors and teachers scale down the text in the assignments by compressing the content and avoiding small words to make the text easier to read and easier for students to understand. The risk with this is that it makes it difficult for students to understand reading if the information is removed. There is no connection between the number of words and reading comprehension, which means that a longer text does not necessarily have to be more difficult for students, it can rather be the opposite. When it comes to testing situations, it is inappropriate to introduce new and unfamiliar words if these words are not already well established in the students' vocabulary (Myndigheten för skolutveckling, 2008).

If a mathematics task follows a mental structure such as a logical sequence, a time sequence, or some other type of order, it is easier for students to understand the task. Most mathematics tasks are structured as a holistic situation in which students themselves must find the task inside the situation. This contributes to two ways of designing a task, through a clear logical sequence or by the students themselves finding the right logic in a complex situation. It can be a challenge for teachers to succeed in creating a clear task based on a holistic situation without simplifying the actual mathematics in the task (Myndigheten för skolutveckling, 2008).

The student's understanding of the context may be helped by an image or explanation of the concept. Which also will expand the student's vocabulary (Löwing & Kilborn, 2008a). A Dutch study conducted by Hoogland, Koning, Bakker, Pepin, and Gravemeijer (2018), shows that students performed better when they solved mathematical text problems where the text in the problem was decreased and at the same time depicted with pictures and photographs of real objects in real events.

Regardless of whether the mathematics teaching takes place in the student's mother tongue or a second language, great demands are made on language comprehension. It is extra demanding for students to solve text tasks without illustrations when it is required that the students use the language in cognitively demanding, situation-independent, and often context-reduced communication. If the students are provided with a visual image that explains the text task, it is easier to understand. The visual image acts as a tool that clarifies the content of the

text, but it might also have the opposite effect if the image is unclear and contradicts the text (Myndigheten för skolutveckling, 2008; Rönnberg & Rönnberg, 2006).

Teachers should strive to construct tasks that challenge both students' language ability and mathematical thinking. It is required that the teacher is sensitive, can support the student, and can introduce new words and expressions at the right time. Supporting the students does not mean that one should simplify and avoid difficulties, but that it is about the teacher creating a language-developing environment for the students. This can be done through small group work and discussions that promote language development and at the same time give students the conditions to maintain their interest in mathematics (Myndigheten för skolutveckling, 2008).

According to the Swedish Agency for School Development (2008, p. 43), when designing mathematics tasks, teachers should think about: being confident in the student, understanding new mathematical concepts, and everyday words that take on a different meaning when used in a mathematical context. And to rather fill in a text than scale it down. Teachers should also keep in mind that students understand all the information in the task before they try to solve the task and create opportunities for students to reflect both orally and in writing on different ways of solving mathematical problems. The teacher should make use of issues that promote communication about mathematics and contribute to students having the opportunity to work in pairs and groups as this contributes to improved language development (Myndigheten för skolutveckling, 2008).

Research shows that students need to feel safe in the classroom to communicate mathematics. Therefore, the teacher must contribute to a safe classroom environment. In multicultural classrooms where SVA students do not fully master the language of instruction, it is extra challenging for them to feel safe in the classroom. These students can avoid expressing themselves as they are afraid of being corrected linguistically and risk being misunderstood. The teacher should allow students to reflect and communicate mathematics in the classroom. This can be done by working in small groups or for example in pairs. When students have the opportunity to reflect with their classmates, it helps to increase their understanding as they think through what to do and why. This creates relationships between ideas, facts, and procedures. If the students only get lesson time in watching when the mathematics teacher demonstrates methods for solving different problems, they will probably be good at imitating these to solve similar problems. And if students are only encouraged to practice prescribed procedures, it leads them to perceive mathematics as following instructions to move around symbols as quickly as possible. For this reason, most of the lesson time must be devoted to students working together and reflecting and discussing as they develop their understanding of mathematics (Rönnberg & Rönnberg, 2001).

The ability to communicate and solve problems increases when students have the opportunity to work together in small groups. In comparison with students who have Swedish as their mother tongue, SVA students have less experience in verbalizing academic content in the

language of instruction. This means that SVA students need to have opportunities to process concepts orally and in writing so that the learning process does not stop. This is possible when working with small groups when the students dare to use new words, ideas, and concepts. They become more linguistically risk-taking, which increases self-confidence. The advantage of working in small groups is that there are not as high demands on a formal language compared to in a large group. Another advantage is that the students are not affected by the teacher's authority as the teacher does not control the small groups. Research shows that SVA students develop their mathematical understanding and language development more by working in small groups than in traditional teaching as individual work. For students who have not come far in their language development in the second language, it is an advantage to group the students based on their mother tongue. In this way, these SVA students can get help from peers with the same mother tongue who can help each other explain and translate. If the mother tongue teacher has the opportunity to participate in the teaching, the working method will be even more efficient (Rönnberg & Rönnberg, 2001).

3.4 Research on mathematics support in mother tongue

Research has shown that SVA students' knowledge development in mathematics benefits from a multilingual classroom, where both students' mother tongue and Swedish are used. This is an effective way of working which also gives SVA students a greater opportunity to attach their knowledge as they have the opportunity to use both their languages (Hansson, 2011; Norén, 2010a; Rönnberg & Rönnberg, 2001). According to Löwing and Kilborn (2010), SVA students show good results in the development of knowledge in mathematics if they acquire good knowledge in the language of instruction and their mother tongue. Hansson (2011) states in her dissertation that students with well-developed skills in both their mother tongue and Swedish benefit from this in their knowledge development in mathematics. This is because students with two languages can do internal translations and consolidate their knowledge at several reference points, which also leads to an increased understanding and knowledge development in mathematics.

Developing the mother tongue and Swedish to a level that traditional textbook-based teaching requires is something that SVA students find difficult. Most SVA students do not receive enough teaching hours in their mother tongue to develop written language in comparison with students with Swedish as a mother tongue who have significantly more lessons in their mother tongue (Rönnberg & Rönnberg, 2006). Professor Pauline Gibbons (2018) argues that for second language students to develop the second language to the same level as their classmates take a longer time. For second language students, it takes about two years to develop their second language to a level that works in everyday situations. On the other hand, it takes at least five years for second language students to develop the language used in the school's various subjects, that is the knowledge-related language (Gibbons, 2018).

According to the Swedish Schools Inspectorate (2010), language has a significant role in the development of knowledge. It is complicated for students who do not master the language of

instruction to develop knowledge. As long as SVA students do not master the language of instruction, they will have worse conditions than students with Swedish as their mother tongue. To give SVA students the opportunity to achieve the national goals, the schools need to offer study guidance in the students' mother tongue to a greater extent for those who need it (Skolinspektionen, 2010).

There is a discussion going on regarding the impact of the use of the mother tongue for second language learning. Researchers agree that investments in the mother tongue have a positive and crucial significance for SVA students' school success and development. Although researchers agree that the effects are positive, there are different opinions on how mother tongue and second language teaching should best be organized and implemented in practice (Skolinspektionen, 2010).

The opportunities for schools to invest in SVA students' mother tongues are limited due to schools not having sufficient resources (Norén, 2010a: Rönnberg & Rönnberg, 2001). Schools find it more difficult to organize bilingual education for students whose mother tongue is spoken by a few students at the school. On the other hand, research shows that it is more profitable to invest in mother tongue teaching and study guidance for SVA students than to extend the education period for SVA students who do not reach upper secondary school eligibility during the nine-year compulsory school (Rönnberg & Rönnberg, 2001). When students do not master the language of instruction, large parts of the teaching are lost, which in turn affects the student's learning. For that reason, teaching in the student's mother tongue is required (Löwing & Kilborn, 2008a).

The problems that arise for SVA students do not disappear by just letting them learn the Swedish language and different concepts in the subject of mathematics. Löwing and Killborn (2008b) believe that SVA students should instead be recommended to continue to develop their mother tongue, as this also contributes to them developing their mathematical thinking. One way to make this possible is to let students who speak the same mother tongue discuss and communicate with each other even though the teacher does not master the students' mother tongue. Interaction in their mother tongue promotes mathematical thinking development (Norén, 2010a). This working method becomes even more efficient if the mother tongue teacher participates in the teaching (Rönnberg & Rönnberg, 2001).

Since many teachers are aware that a major reason why SVA students perform worse in mathematics compared to students with Swedish as a mother tongue is due to their language comprehension, some SVA students receive help with the language in mathematics from their mother tongue teachers or study supervisor speaking their language. But some teachers are skeptical and do not have enough confidence that mother-tongue teachers can teach their students mathematics (Rönnberg & Rönnberg, 2001). These teachers believe that there is a risk that the mother tongue will harm the learning of the Swedish language. They are concerned that SVA students' development in Swedish is disadvantaged if two languages are used in mathematics teaching (Norén, 2010b). According to Rönnberg & Rönnberg (2001),

many teachers neglect students' mother tongues and actively try to prevent students from using their language. Most often, the teachers' reason is that everyone should understand what is said in the classroom and that students should use the opportunity to speak and develop the Swedish language instead (Rönnberg & Rönnberg, 2001).

3.5 Research on words, digits and culture in mathematics

Some Swedish words can confuse students in general as the words have different meanings depending on whether they are used in mathematics or everyday life (Löwing & Kilborn, 2010; Myndigheten för skolutveckling, 2008; Rönnberg & Rönnberg, 2001). The Swedish Agency for School Development (Myndigheten för skolutveckling, 2008, p.16) has created a list of Swedish words that cause confusion considering that they have different meanings depending on whether they are used in mathematics or everyday life:

Table 7. List of Swedish words with two meanings.

Ord i matematiskt språk (Words in mathematical language)	**Vardaglig betydelse (Everyday meaning)**
Rymmer (holds)	Flyr (escapes)
Skillnad (difference)	Olikhet (inequality)
Volym (volume)	Ljudvolym, hårvolym (sound volume, hair volume)
Teckna (uttrycket) (Compose the expression)	Rita (draw)
Axel (axis)	Kroppsdel axel (body part shoulder)
Udda (odd)	Konstig (strange)
Värde (value)	Något värdefullt (something valuable)
Minst (två förslag) (at least two proposals)	Tre betydelser: motsatsen till längst, högst eller äldst (Three meanings: the opposite of the longest, highest or oldest)
Bestäm (arean) (determine the area)	Besluta (decide)
(Triangelns) bas (The base of a triangle)	Grund i ord som baslivsmedel, basläger (Basic in words like base food, base camp)
Term (term)	Ord (word)
Rot (root)	Rot på en växt (Root of a plant)

When students are given a problem-solving task, it is common for them to read through the task quickly and only focus on so-called *signal words.* These words signal which calculation method should be used. When it comes to addition, it can be words like *more, longer, wins, heavier, increases,* and *earns.* Words that lead to the thought that subtraction should be used are *dropped, younger, smaller, cheaper,* and *shorter.* But sometimes these signal words cause students to miss what is really being requested. For example, Peter is 8 years and 4 years *older* than Gustav. How old is Gustav? Some students focus on the word older which signals that addition should be used and therefore assumes that Gustav is 12 years old (Myndigheten för skolutveckling, 2008).

According to international research, the reader needs to know at least 95% of the words to be able to understand the content (Nation, 2013). This may be an explanation for why second language students can have a hard time understanding what the task requires. Researchers Inger Lindberg and Sofie Johansson Kokkinakis (2007) claim that it is not always the unusual words that are most problematic for second language students as these words are usually explained by teachers or in the text itself. Words that can create problems for second language students are words that many teachers take for granted that students recognize and therefore do not provide an explanation of what they mean. These words do not belong to the low-frequency or the high-frequency words that cause the most problems and are Swedish words such as *ersätta* (replace), *redovisa* (present), *uttrycka* (express), and *fastställa* (determine) (Lindberg & Johansson Kokkinakis, 2007).

An important prerequisite for being able to think with numbers is that you should be able to name them correctly depending on the language. Otherwise, it can be complicated to constantly have to translate the name of the number between the language of instruction and the mother tongue (Löwing & Kilborn, 2010). Problems may arise for SVA students when it comes to double-digit numbers. Different languages have different structures when it comes to naming double-digit numbers, which can create confusion for multilingual students (Löwing & Kilborn, 2008a; Rönnberg & Rönnberg, 2001).

Some countries have a more logical structure of naming numbers in comparison with Sweden. The Swedish numbers after 10 are “elva” (11) and “tolv” (12), which can be perceived as uninterpretable for students who do not know the connection to Gothic or Old Norse. After “tolv” the numbers follow “tretton”, “fjorton” up to “nitton” (19), the word “ton” creates an irregularity (Löwing & Kilborn, 2010; 2008a). The Swedish numbers 13 to 19 are named with ones before the tens. Where the tens are now referred to as “ton”, for instance, “tre-ton” (13). The numbers 20 to 29 do not follow the same logical structure as the numbers 30 to 99. These numbers are called, for example, "femtio" (50) which means “five tens’’ and "åttiotvå" (82) which means “eight-ten and two”. These numbers start with the tens and then with the ones (Löwing & Kilborn, 2010; 2008a). The spoken Swedish language when it comes to the tens provides poor support in understanding what the word describes. 30 is written trettio but often pronounced “tretti”, fyrtio is pronounced “förti”, femtio is pronounced “femti” etc. (Rönnberg & Rönnberg, 2001).

The name of double-digit numbers varies depending on the structure of the country's language. The name of the numbers has a great impact on how children develop an understanding of the place value of numbers in the positioning system and of multi-digit addition and subtraction (Rönnberg & Rönnberg, 2001). For students who originate, for example, from Vietnam or a country with a Slavic language, the numbers after 10 are named ten-one, ten-two, ten-three, and so on. This means that the numbers are pronounced in the same way as they are written and this leads to the calculation 10 + 4 = 14 (ten-four) being supported by the language. In Germany, the numbers 13, 14, 15 up to 19 are pronounced as three-ten, four-ten five-ten, etc. This means that students with a German background can mistake the Swedish numbers 30 (trettio), 40 (fyrtio), and 50 (femtio) with 13, 14, 15 (Löwing & Kilborn, 2010; 2008a).

The Arabic numbers are structured in the same way as in the German language. A problem that can arise when it comes to the Arabic language compared to Swedish is the reading orientation. In Arabic, text and some words are written from right to left but Arabic numbers are written from left to right. This means that the calculation 14 - 9 is written as 9 - 14 (with Arabic numbers). The numbers between 20 and 100 are treated in the same way for both German and Arabic. For example, the number 52 is read as two and fifty and the number 352 is read as three hundred two and fifty (Löwing & Kilborn, 2010; 2008a).

In Somalia, the number 12 can be pronounced both as "ten and two" and "two and ten" in addition, 32 can be called both "thirty and two" and "two and thirty". This can create problems between the Somali numbers and the Swedish ones when it comes to the numbers 13 (tretton) and 30 (trettio) (Löwing & Kilborn, 2010; 2008a).

In addition to differences when it comes to words and digits, cultural differences can also affect students' learning. It can be difficult for SVA students to understand problem-solving tasks if they are written from a Swedish perspective. Tasks that are linked to contexts that SVA students may find unfamiliar are, for example, weekly allowances, train travel, ski trips, and mushroom picking (Myndigheten för skolutveckling, 2008; Rönnberg & Rönnberg, 2006). If students perceive the context as foreign, it can result in them losing interest in the tasks. This does not mean that the teacher should always avoid new contexts for SVA students, nor should the teacher always choose contexts from SVA students' experiences. The teacher needs to keep in mind that some phenomena are not familiar to all students. In some cases, the context may provide support in the understanding of a task, while in other cases, the context of the task may obscure the students' understanding (Myndigheten för skolutveckling, 2008).

According to Norén and Caligari (2020), students often relate to their own cultural experiences and home culture when solving problem-solving tasks. It is easier for students to relate to contexts that they find familiar. By linking tasks to students' everyday lives or students' ethnic culture, tasks are linked to students' cultural context. This gives students a confirmation that culture is valuable, which can lead to students' self-image and motivation

being strengthened and thus simplifying learning in mathematics (Myndigheten för skolutveckling, 2008; Rönnberg & Rönnberg, 2006).

Paying attention to students' different cultures can be done in other ways than just connecting tasks with SVA students' cultural contexts, for example, by paying attention to different cultures' notions of mathematics, such as different symbols, number systems, and calculation methods. In some parts of the world, such as Asia and Africa, there are finger counting systems. SVA students who come from these continents may be used to using these systems. Some SVA students with a different cultural background than Africa and Asia may be used to counting on the finger joints instead of on the fingers. When it comes to the subtraction and division algorithms, they generally follow the same pattern even though the algorithm can be written in different ways. In Sweden, short divisions are used, while in other countries, long divisions are more common. It is beneficial if students with different cultural backgrounds can demonstrate how the different types of algorithms are performed. In this way, students see that there are more ways to solve a task (Rönnberg & Rönnberg, 2006).

The working method and the teaching situation may differ for students who have immigrated to Sweden. The majority of immigrant students are accustomed to a school culture with a strong framework that contains firm and stated rules. When students from these cultures come to the Swedish school, they are faced with a weak framework with vague rules. Which complicates the learning situation (Löwing & Kilborn, 2008a). In the Swedish classroom, the teacher encourages students to discuss and participate in the teaching. While other countries consider that students should listen and be quiet in the classroom as this is considered respectful. This can create a culture clash when students are used to this type of school culture (Löwing & Kilborn, 2008b).

4. Theoretical framework

This chapter introduces the theoretical frame of reference of the study. For this study, the theory of the sociocultural perspective is in focus with related concepts such as *The Zone of Proximal Development* and *scaffolding.*

4.1 Sociocultural perspective

Russian psychologist Lev Vygotsky developed the sociocultural perspective during the 1960s. The sociocultural perspective means that we humans learn through interaction with each other, which means that learning takes place in social contexts. It can happen through linguistic communication with each other but also through thinking. With the help of the sociocultural perspective, we can use the insights and reasoning of others to make it our own. From a learning perspective, this is about both talking and listening to each other. The cognitive language skills, such as the ability to comprehend and analyze, and the metacognitive ability, which is the ability to handle all information, are developed through the sociocultural perspective. This is because we can draw conclusions, analyze and have access to each other's thoughts (Säljö, 2014).

A language is a tool for being able to convey and absorb knowledge. Within the school, dialogue can thus be used as a tool for students to learn, and for that reason, dialogues need to be implemented more naturally in teaching. Mathematics consists of a special culture where the subject is communicated by structuring and categorizing the mathematical content, which teachers need to be aware of to meet all students' needs. If the didactic work in the school develops, so does the development of the learning environment for students (Säljö, 2022; 2014). Language should not only be seen as a tool for learning, but language is a starting point for thinking and learning to take place. To contribute to good teaching, teachers need to have a good knowledge of students' different cultures and the languages they use. The social environment contributes to students learning new concepts, which means conversations and discussions with teachers and students and between students (Säljö, 2014).

From the sociocultural perspective, concepts are a tool for teaching us things. But before we can use these concepts, we need to create an understanding of them. Vygotsky argued that when students are in school, they become familiar with both abstract and scientific concepts. In mathematics, it can be about concepts such as subtraction and addition. Teachers can also use concrete objects as a kind of support material for all students to keep up with, especially SVA students. These concrete objects can be money, bricks, deciliter measures, etc. Through the opportunity to develop knowledge of different concepts, students can connect to their experiences and their everyday lives (Eriksson, 2003).

4.1.1 The Zone of Proximal Development

An important concept in the sociocultural perspective is *The Zone of Proximal Development* (ZPD) (Gibbons, 2018). According to Vygotsky, humans are constantly evolving and he used the ZPD to explain knowledge. Vygotsky described the ZPD as the distance between what a human being can do on his own and what a human being can do with the help of a more experienced person. ZPD consists of three different zones, the first zone is the very beginning of the development of knowledge, which is things that you can not do on your own. The second zone is learned by the learner with the help of support from someone knowledgeable. In a student context, it can be, for example, the teacher or another student. During the second zone, appropriation becomes useful. Appropriation means that you take part of others' knowledge and then use this knowledge yourself (see Figure 1). This is done, for example, through social interaction as a dialogue between teachers and students or the students in between. The teacher should help the students to absorb and develop their knowledge. This can be done through some didactic questions such as What?, How? And why? The teacher should also keep in mind that all students learn differently and for that reason create different activities where all students have the opportunity to develop their ability to communicate. It can be oral, written, or visual communication. That is, through discussions, describe in words or draw pictures. A prerequisite for this to be possible is that the students feel safe in the classroom and dare to argue, discuss and express their thoughts. A good conversational climate is therefore required. Based on these conditions, the student must achieve the third and final zone, which is the very goal of ZPD. The third zone means that the student has developed his/her knowledge and ability to now manage on his/her own (Phillips & Soltis, 2014; Säljö, 2022; 2014).

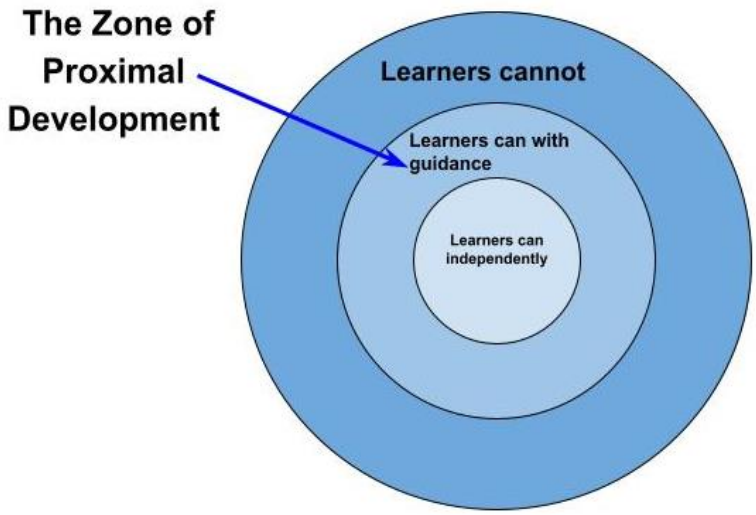

Figure 1. The Zone of Proximal Development (ZPD).

Vygotsky describes the concept as a distance between what a learner can do independently and what he or she can do with the guidance of a person with more knowledge (van de Pol, Mercer & Volman, 2019; Säljö, 2014).

4.1.2 Scaffolding

For students to be able to develop according to ZPD, they need guidance and support, which can be done through *scaffolding.* The term scaffolding is used in the sociocultural perspective and can be described as support in the form of cognitive support that, for example, the teacher uses to guide students in problem-solving situations. Learning is often guided by others who have more knowledge, such as a teacher in a school environment. Scaffolding is connected to ZPD as scaffolding is used at the transitions between the zones. From the student needing assistance and support to the zone where students have learned enough to manage on their own. According to scaffolding, the support must be reduced when the student has developed and become more independent, which can be equated with the second zone in ZPD (van de Pol et al. 2019; Säljö, 2022; 2014). This means that scaffolding is temporary and gradually decreases when the structure is fostered and becomes more solid and more reliable (Norén & Caligari, 2020).

According to Norén and Caligari (2020, p. 63):

> Scaffolding in multilingual mathematics classrooms means:
>
> – making the mathematical content understandable by putting it in contexts that the students can relate to,
>
> – promoting students' active language use both orally and in writing in the mathematics classroom,
>
> – offering varied and long-term linguistic support.

An analysis made by Norén and Caligari (2020) shows what kind of different strategies teachers use when scaffolding their SVA students. Sometimes teachers' scaffolding was planned in ways of building on earlier lessons, results of diagnostic tests, or text material that was going to be used. In other circumstances, the scaffolding occurred spontaneously while teaching, for example, during interaction in the classroom as well as students' questions and students' answers to teachers' questions. Other strategies that were being used by the teachers are, for example, encouraging SVA students to actively use Swedish orally and in writing but also at the same time promoting the SVA students to use their mother tongue. The teachers also encourage the SVA students to ask questions when problems are presented and to highlight "keywords" in a problem-solving task.

5. Method

In this chapter, the selection of the method and the selection of respondents are presented. The method chapter also describes the study's implementation as well as how the outcomes were processed and how the ethical principles have been met.

5.1 Selection of method

According to Esaiasson, Gilljam, Oscarsson, and Wängnerud (2017), there are three ways to collect information in the social sciences; ask people, observe people or search for previous literature.

The chosen method for this study is qualitative interviews. An interview is like an everyday conversation with the purpose of getting specific information. In fact, it's a professional conversation where the researcher asks questions and listens to what people say, with the purpose to understand the world from the subject's point of view and develop a sense from their experience (Kvale & Brinkmann, 2014).

Interviews, in comparison with a quantitative approach with questionnaire responses, provide an opportunity to reduce the degree of interpretation by asking follow-up questions, which can lead to deeper conversations (Esaiasson et al., 2017).

The qualitative approach increases the opportunity to study a phenomenon from a wider perspective (Jacobsson & Skansholm, 2019). In terms of qualitative studies, variations of open interviews are preferable methods in comparison to structured interviews, observation templates with selected categories as well as surveys (Stukát, 2011). A structured interview follows an interview guide with predetermined questions. A semi-structured interview is neither an open everyday conversation nor a closed questionnaire. It follows an interview guide that focuses on certain topics with suggestions for questions and gives the interviewer room to add fill-in questions to get a fuller picture of the respondent's view of the topic (Kvale & Brinkmann, 2014).

An open conversation may give a lot of interesting insights however it will impact the comparability between the respondents' answers and make it more difficult to interpret the result. A structured interview will have better comparability but the lack of fill-in questions can make the interview less in-depth. The semi-structured interview provides a combination between a free conversation and a strict interview, which allows a deeper understanding of the respondents' point of view. The answers can lead to exciting and unexpected material if the respondent is given more space and freedom to answer questions (Stukát, 2011). Thus, the chosen method for this qualitative study is a semi-structured interview.

The respondents are interviewed individually to prevent the negative effects that can arise from group interviews such as the respondents feeling uncomfortable giving truthful answers

or the group influencing each other. The consequences of this can lead to a form of the majority opinion that is in fact not covered by any of the respondents (Stukát, 2011).

Seven respondents have been interviewed in order to reach saturation. Jacobsson and Skansholm (2019) refer to saturation as the point at which further data collection does not add any new knowledge. A pattern of the respondents' answers started to appear after 7 interviews were conducted and consequently the remaining time was spent on analyzing the given answers rather than interviewing more people. According to Stúkat (2011), it is difficult to state how many respondents should be included in a qualitative interview study. Too many respondents risk that the analysis becomes too superficial due to lack of time. Time for interviews, transcription, and analysis should be set to the scope of the study to reduce the risk of superficial interview answers.

Another reason for the choice of seven respondents was the fact that all the interviews needed to be transcribed and this study has a time limit of 20 weeks. Transcribing is time-consuming, a one-hour long interview takes anywhere from three to five hours to transcribe (Stukát, 2011). Each interview was about one hour long.

Each interview consisted of two interviewers and one respondent. One lead interviewer asked the questions and the other one took notes and recorded the interviews as well as filled in with supplementary questions if needed. It is easier for two to identify different aspects during an interview than it is for one interviewer. This allows the interviewers to have different focus areas (Stukát, 2011).

5.2 Selection of respondents

Qualitative studies often contain targeted selection, meaning that one consciously chooses individuals, documents, organizations, etc. that are best suited for the study's research questions (Jacobsson & Skansholm, 2019).

Consequently, the selection of respondents for this study is limited to qualified mathematics teachers at lower secondary schools who teach students with Swedish as a second language in mathematics. The respondents were found by contacting the headmasters of 45 schools by email. They were informed by a missive letter (see Appendix 1 for Swedish and Appendix 2 for English). Some headmasters responded that they did not have the possibility to participate at this time. Eventually, seven teachers from five different schools responded that they were interested in participating in an interview.

Interviews have been used for an empirical study to provide insight into teachers' everyday lives. As the teachers are close to the students with difficulties, interviews with them provided relevant insights into what the difficulties are, their causes and the teachers' supporting measures.

A description of each respondent is presented in Table 8. R1 refers to “respondent number one”, R2 refers to “respondents number two” etc. up to R7, “respondent number 7”. The background questions of the study (see Appendix 3 for Swedish and Appendix 4 for English) were used to provide information about each respondent.

Table 8 consists of six columns that describe which respondent it is, how many years he/she has worked as a teacher, which year they teach, what percentage of their students are SVA students, if other languages than Swedish are used as a language of instruction and if SVA students receive support in mathematics in their mother tongue.

Table 8. Information about the selection of respondents.

Respondent	**Work experience (years)**	**Year(s)**	**SVA students (%)**	**Other languages in the classroom**	**Support in mother tongue**
R1	5.5	8	90%	Yes	No
R2	10	7	45%	No	Yes
R3	7	7–9	25%	No	Yes
R4	15	7–9	80%	No	Yes
R5	40	8 and 9	5%	No	Yes
R6	22	7–9	50%	Yes	Yes
R7	20	7 and 9	95%	Yes	Yes

5.3 Implementation

The Swedish Research Council (Vetenskapsrådet, 2002) has published ethics issues that must be taken into account when it comes to the implementation of humanities-social science research. The four main requirements are: *The information requirement, the consent requirement, the requirement of confidentiality,* and *the utilization requirement.* The information requirement implies that the researcher is obliged to provide information about the purpose of the research to those who are involved. The consent requirement means that those who participate must be able to decide whether they want to participate as well as whether they want to suspend their participation. The requirement of confidentiality means that the researcher must make it possible for the participants to be anonymous. The last requirement, the utilization requirement, implies that the collected material should only be used for research purposes (Vetenskapsrådet, 2002).

In connection with the Swedish Research Council’s (Vetenskapsrådet, 2002) four main requirements, the headmasters were sent a missive letter (see Appendix 1 for Swedish and

Appendix 2 for English). The missive letter contained information about; the purpose of the study, participation is voluntary and participants can choose to cancel their participation during the survey, personal information is anonymized and collected material is only used for the master's thesis. A reminder was to the headmasters who had not responded. According to Esaiasson et al. (2017), an important part of getting respondents is to send out a reminder.

The interviews are organized according to a semi-structured interview guide. When it comes to interviews, it is important that the questions are formulated in a way that is easy to understand and answer by the respondent. The questions must also be relevant to the study, that is to contribute with useful answers (Stúkat, 2011).

With the respondent's approval, the interview was recorded and saved until it had been transcribed. The transcription is limited to the content that directly contributes to the research questions. After the interviews, the answers are analyzed and thematized.

The first interview is done as a pilot, which gives an indication of how long the interview is and the outcome of the interview guide. Future respondents want to know how much time the interview is expected to take. Further, analyzing the pilot's outcome gives input on how to improve the interview guide. Are there questions missing or questions that may need to be rephrased or removed? Tape recording is a common tool in the interview process and by recording the pilot interview, the interviewer can focus on the ongoing conversation with the respondents. This can increase the interviewer's self-awareness for upcoming interviews (Jacobsson & Skansholm, 2019).

The interviews were conducted once the pilot interview had been tested. Each interview was in Swedish and began with a few background questions to get the respondent comfortable and create a favorable atmosphere (Jacobsson & Skansholm, 2019). Another factor that affects how comfortable a respondent is the chosen setting for the interview. It is essential that both parties (the respondent and the interviewer) are in an environment in which they feel comfortable (Stukát, 2011). The respondents were given the opportunity to choose the setting. Each interview was recorded and notes were kept. One interviewer was responsible for asking questions while the other kept notes and recorded the interview.

The relationship between the interviewer and the respondent is critical for the interview's outcome, which depends on how open the conversation is. To open up requires a safe space. An environment where the respondent feels safe enough to talk about private events that will be documented for public use. The interviewer's ability to create and obtain this safe environment is based on a balance between the interviewer's interest in gaining valuable knowledge and respect for the respondents' integrity. If the respondent does not feel safe, the respondent might withhold information, object to questions, or interrupt the interview. Therefore it is important to emphasize an interview environment surrounding consensus and empathy (Kvale & Brinkmann, 2014). The place of the interview should be calm and can favorably be decided by the respondent. To create a safe space it is appropriate to start with

some background questions. These kinds of questions are easy to answer, which usually makes the respondent relax (Jacobsson & Skansholm, 2019).

5.4 Processing the outcomes

After the interview, the recorded material is transcribed and analyzed (Kvale & Brinkmann, 2014). The recordings were listened to a few times and carefully analyzed along with the notes to see if anything important had been missed. The respondents' answers were divided into different themes in order to see a certain pattern in each respondent's answer. The themes are presented in the Result chapter. The interview results were compared with previous research and theoretical frame of reference to see differences and similarities.

5.5 Validity, reliability and generalizability

The quality of qualitative research is affected by the degree of validity and reliability, which makes its mark on the entire study from implementation and method of data collection to the analysis process. The validity and the reliability of a study are linked to what is researched and how the research is done to get to the study's result (Jacobsson & Skansholm, 2019).

The degree of validity of a study indicates to what extent the research matches with what the researcher claims that the study will show. By carefully describing what is included in the study and how it will be conducted, as well as explaining the theoretical concepts used in the study, the validity is increased (Kvale & Brinkmann, 2014). Another way to add validity is to let the respondents read and give views on the projected result and analysis (Jacobsson & Skansholm, 2019).

The degree of reliability indicates the quality of the measuring instrument - if a result can be reproduced by other researchers at another time. In an interview, with the interviewer as the measuring instrument, the reliability will show in whether the respondents will give different answers to different interviewers. External disturbances or misinterpretation of questions and answers may play a role in the reliability (Stukát, 2011). The questions must be clearly formulated. As well as *what* is asked in the interview, it's also significant *how* it is asked (Jacobsson & Skansholm, 2019). The interviewer, as a measuring instrument, holds a responsibility to avoid leading questions as well as stay objective in the transcript and analyzing process. Interpretation of collected data and the conclusions must correctly reflect what has been studied (Kvale & Brinkmann, 2014; Yin, 2013).

The study's generalizability provides the possibility of making conclusions from a smaller group to a larger population. Qualitative studies allow studying a phenomenon on a deeper level, but the results are difficult to generalize for a larger population (Jacobsson & Skansholm, 2019). The result of an interview study with a small group of respondents can probably be generalized in some topics, but it may only be true for the examined group - but it cannot be applied to a larger population (Stukát, 2011).

This study's validity is strengthened by this report's description of what is included in the study and how it is conducted. Previous research and theoretical framework are declared, as well as the chosen research questions. The research questions are at focus in the interview guide, which amplifies both validity and reliability. Reliability is also amplified by recording and transcription of the interviews, which reduces the risk of interpretation. Generally, an interview study can't show generalizability for a larger population bigger than the group of respondents itself, likewise in this study.

6. Results

The result chapter is presented in three different parts. The first part constitutes the interview questions one to four and deals with mathematical difficulties. The second part consists of the interview questions five to eight and deals with the causes of the mathematical difficulties. The last part is the interview questions nine to thirteen. The last part is about strategies to minimize the measures for mathematical difficulties. The respondents' answers are presented with summaries and quotes. Each part ends with a brief summary. The interviews were conducted in Swedish and the respondents' quotes are presented in Swedish with an English translation made by the authors.

6.1 Specific difficulties that students with Swedish as a second language encounter in mathematics teaching

1. What learning goals and abilities in the mathematics subject do you experience that your students with Swedish as a second language have the most difficulty in achieving?

Respondents 1 to 6 answered that SVA students have the most difficulty in achieving problem-solving ability. Respondent 7 was the only one who did not mention the problem-solving ability. R7 replied that SVA students have the most difficulty in achieving reasoning and communication ability. R4 also answered in addition to the problem-solving ability that reasoning and communication was a problem among SVA students. R3 and R5 also replied that SVA students have difficulty with reasoning ability.

> R1: "Problemlösning, ett skrivet problem som du ska översätta till matematik."
>
> Author's translation: Problem solving, a written problem that you have to translate into mathematics.

> R2: "Det är så mycket språk i de uppgifterna. Även om man skalar ner det är det svårt för eleverna att tolka vad texten är ute efter."
>
> Author's translation: There is so much language in those tasks. Even if you scale it down, it is difficult for students to interpret what the text is for.

> R3: "Problemlösningsförmågan är den absolut svåraste."
>
> Author's translation: Problem-solving ability is by far the most difficult.

R3: “Föra resonemang med ord, förklara hur man tänker är jättesvårt för eleverna.”

Author’s translation: Reasoning with words, explaining how to think is very difficult for students.

R4: “Resonemang, problemlösning och kommunikation.”

Author’s translation: Reasoning, problem-solving and communication.

2. What type of math difficulties do you experience that your students with Swedish as a second language often encounter?

The respondents answered that SVA students often encounter difficulties in mathematical concepts and words, for instance, words that can mean two different things. SVA students also experience difficulties in understanding and solving a task if the text contains words that they do not understand.

R2: “Ordet en halv kan vara jobbigt för SVA elever. De tror att det betyder en och en halv.”

Author’s translation: The word one half can be difficult for SVA students. They think it means one and a half.

R5: “Vi har i svenskan vissa ord som kan betyda två olika saker och har de bara lärt sig det ena så fattar de inte när det plötsligt kommer i en mening där det har en annan betydelse och då får de inte ut någonting av den här kontexten.”

Author’s translation: We have in Swedish certain words that can mean two different things and if they have only learned one thing, they do not understand when it suddenly comes in a sentence where it has a different meaning and then they do not get anything out of the context.

R7: “Begreppen är svåra, fyrhörning, de har aldrig använt det ordet. Man säger kanske istället fyrkant.”

Author’s translation: The concepts are difficult, quadrangle, they have never used that word. They might say square instead.

According to R4, students have difficulty interpreting the text. They get caught up on particular words, find it difficult to ignore these particular words, and lose focus when looking for the "clues" given in the text.

> R4: “Det som är problem när det gäller problemlösning det är att många saker är ju ord de inte känner till [...] Till exempel: en ljuvlig sommar, vad är ljuvlig? De har svårt för att kunna bortse från dessa ord och se ledtrådarna i texten.”
>
> Author’s translation: The problem with problem solving is that many things are words they do not know [...] For example: a lovely summer, what is lovely? They get caught up in small words. They find it difficult to ignore these words and see the clues in the text.

In addition to difficulties with mathematical words and concepts, the respondents also mentioned that SVA students’ language deficiencies, cultural differences, and prior knowledge in mathematics. R1, R3, and R4 mentioned that SVA students encounter difficulties in mathematics due to cultural differences and insufficient prior knowledge.

> R1: “Dels är det svårigheter med det svenska språket men är det också den svenska kulturen.”
>
> Author’s translation: On one hand, it’s the difficulties with the Swedish language, but it’s also the Swedish culture.

> R3: “Att lära sig nya saker som de inte har med sig sedan tidigare.”
>
> Author’s translation: To learn new things that they don’t have with them beforehand.

> R4: “Halvdana metoder, har ej bra förkunskaper. De blandar ihop metoder.”
>
> Author’s translation: Half-baked methods, no good prior knowledge. They mix methods.

R6 gives an example of how a student from Somalia does not recognize himself in the cultural context, gets stuck in details, and does not get on with the task itself.

> R6: "Ett bord är dukat för ett visst antal personer. Hur man ska duka om man plötslig blir fler personer, hur många gafflar och knivar behöver man då?"

Author's translation: A table is set for a certain number of people. How to set the table if you suddenly become more people, how many forks and knives do you then need?

The student's response is: "Why is the knife on that side? We do not eat with a knife and fork that way. How to set the table?" R6 reflects on the fact that an illustration could have helped the student understand the task.

3. Which parts of the mathematics subject are particularly difficult to understand for students with Swedish as a second language?

The answers to the third question vary from each respondent. They replied that algebra, percentage calculation, statistics, number perception, relationships, and change are particularly difficult to understand for SVA students. In contrast, respondent R6 sees a trend that SVA students have an easier time with algebra, as they may have had it in earlier school years in their home country.

R3: "Procenträkning och statisk där det i huvudsak är text i matteböckerna."

Author's translation: Percentage counting and static where there is mainly text in the math books.

R7: "Taluppfattning är ett område de är svaga på. Skriv talet fyrtiotusentjugo, bland elevsvaren skrivs 4020 och 4000020."

Author's translation: Number perception is an area they are weak in. Write the number forty thousand twenty, among the student answers are 4020 and 4000020 written."

4. What methods do you use to discover what is especially difficult for students with Swedish as a second language?

Four out of seven respondents answered that they use diagnostic tests to be able to discover what is especially difficult for SVA students when it comes to mathematics.

R4: "Diagnos två gånger per läsår. Då ser man om tydligt vad för arbetsområden som eleven har svårt för."

Author's translation: Diagnosis twice per academic year. Then you can clearly see what work areas the student has difficulty with.

R1 usually creates their own tests for each mathematical chapter and tests the students after each completed area. The first test is an E-level test. Those who pass the test may take a C-A level test during the next lesson, while those who failed may take a retest at E-level. Through this method, R1 claims that this method makes it easier to discover the students' individual difficulties.

R2 goes through the wrong answers every time the students start with a new area. R2's students work a lot in groups with open tasks. According to R2, the method helps students not to make mistakes as often. They first work with the wrong answers before they show the correct answers.

R3 aims at walking around the classroom every lesson and talking to each student.

> R3: "Man får en känsla av var eleven befinner och vad de behöver hjälp med."
>
> Author's translation: You get a sense of where the student is and what they need help with.

6.1.1 Summary of mathematical difficulties that SVA students encounter according to the respondents

- Problem solving
- Reasoning
- Communication
- Mathematical concepts

6.2 Factors that contribute to the difficulties in mathematics learning that students with Swedish as a second language encounter

5. What factors do you experience that can cause difficulties in mathematics for students with Swedish as a second language?

Five respondents considered that language comprehension is a factor that can cause difficulties in mathematics for SVA students. The remaining answers were factors such as newly arrived students with a short school background, lack of prior knowledge, motivation, and cultural differences. R4, R6, and R7 talked about an "anti-study" culture that has been formed in some students and that these students do not think it is cool to study math.

R1: “Svårigheter med språket och den svenska kulturen. De fastnar på språket när matten är fokuset.”

Author’s translation: Difficulties with the language and Swedish culture. They get caught up in the language when math is the focus.

R3: “Det är mycket språk i matte och det finns små ord som gör att eleverna fastnar. Man behöver behärska svenska ganska väl för att förstå resonemangen.”

Author’s translation: There is a lot of language in math and there are small words that make the students get stuck. You need to master Swedish quite well to understand the reasoning.

R2: “En del har inte läst så mycket matte i hemlandet. Exempelvis flyktingbarn som inte haft en riktig skolgång”

Author’s translation: Some have not read that much math in their home country. For example, refugee children who have not had a proper schooling

R3: “De allra flesta nyanlända elever har en kortare skolbakgrund och de kan inte ta del av undervisningen och undervisningen behöver anpassas mycket mer. Det kan bli väldigt svårt att lära sig nya saker för nyanlända elever.”

Author’s translation: The vast majority of newly arrived students have a shorter school background and they cannot take part in the teaching and the teaching needs to be adapted much more. It can be very difficult to learn new things for newly arrived students.

R4: “Eleverna saknar grundkunskaper och det blir svårt för dem att utvecklas utan en stadig bas.”

Author’s translation: The students lack basic knowledge and it becomes difficult for them to develop without a solid base.

R5: “Språket, exempelvis ord de inte kan eller har dubbel mening. Förkunskaper och motivation.”

Author’s translation: Language, such as words they do not know or have a double meaning. Previous knowledge and motivation.

R4: “Motivation och attityder till skolan har förändrats när det gäller den senaste generationen.”

Author’s translation: Motivation and attitudes towards school have changed when it comes to the latest generation.

R6: “När man kommer till ett nytt land så blir det plötsligt väldigt fritt kanske i förhållande till hur man har haft det förut [...] Man klarar inte av friheten för man är van vid en annan form av undervisning.

Author’s translation: When you come to a new country, it suddenly becomes very free, perhaps in relation to how you have had it before [...] You can not cope with the freedom because you are used to another form of teaching.

R4 did not consider SVA students to have difficulty with math because Swedish is their second language. Instead, R4 replied that one factor is that many students do not read books which makes them think that the language is difficult. It is therefore the students’ literacy that is crucial.

R4: “Det handlar inte om vad man har för modersmål egentligen. Jag brukar säga att: just att du har ett extra språk bör ju berika din värld och inte vara ett hinder”

Author’s translation: It’s not about what mother tongue you really have. I usually say that: the fact that you have an extra language should enrich your world and not be an obstacle.”

6. How can you determine if the math difficulties have to do with deficiencies in language comprehension or have other causes?

Four respondents had some difficulty in determining if the math difficulties have to do with deficiencies in language comprehension or have other causes. The rest answered that they either usually discovered the difficulties by walking around in the classroom and talking to each student. Another way of discovering difficulties is by comparing how the student is doing in other subjects. R6 mentioned that in the case of newly immigrated students, the difficulties and prior knowledge can be seen in the result of the knowledge survey.

R2: “Det är först när du är med eleven på egen hand, det är då du vet.”

Author’s translation: It is when you are with the student on your own, that is when you know.

R3: “Om det går dåligt i alla andra ämnen så kanske det inte beror på språket.”

Author’s translation: If it goes badly in all other subjects then maybe it does not depend on the language.

R4: “Jag kollar först om eleven kan metoden. Om metoden inte fastnar efter en halv termin så misstänker jag att det rör sig om någon annan svårighet än språket.”

Author’s translation: I first check if the student knows the method. If the method does not stick after half a semester, I suspect that it is a problem other than language.

7. Do you feel that there is anything other than language comprehension that students with Swedish as a second language have problems with mathematics teaching? If so, what?

In summary, the respondents answered that other than language comprehension, SVA students have problems with their motivation and attitude towards math. However, the respondents think that this is a generational problem and that this does not specifically apply to SVA students only. In addition, certain cultural differences can cause problems such as different calculation methods.

R4: “Tidigare generation hade mer motivation och driv. Just nu känner eleverna att de inte behöver jobba. De har en inställning om att de inte behöver kämpa i skolan. Motivationen och attityden till skolan har förändrats.”

Author’s translation: The previous generation had more motivation and drive. Right now, students feel they do not have to work. They have an attitude that they should not have to struggle. The motivation and attitude towards school has changed.

R3: “Vissa saker är kulturbundna, elever förstår inte vad det är. Exempelvis vissa namn som elever inte förstår att det är ett namn. De har inte hört de namnen tidigare och förstår inte uppgiften för de förstår inte att det är en person.”

Author’s translation: Some things are culturally bound, students do not understand what it is. For example, some names that students do not understand is a name. They have not heard those names before and do not understand the task because they do not understand that it is a person.

R1 said that the students do not want to fail and for that reason they choose not to do anything.

> R1: “Elevernas inställning: Om man inte försöker så har man inte misslyckats.”
>
> Author’s translation: Students’ attitude: If you do not try, you have not failed.

R3 thinks that it is a strength that students come from a culture that uses a different method of calculation. R3 mentions, for example, that many countries use long division while Sweden uses short division. It can cause uncertainty and confusion among students who are not used to the Swedish calculation method, but R3 sees it as an advantage as the students get to learn more ways to solve a problem. R5 also mentions that some SVA students use long division instead of short division. R5 also answered that equation solutions can look different in different ways depending on which country the students come from. Some countries focus only on the correct answer, while in Sweden it is important to be able to explain your solution. R3 and R6 answer that names and contexts that are linked to Swedish culture can cause problems for SVA students.

R6 mentioned prior knowledge as a major factor, for example, students from Somalia who had hardly any mathematical experience at all. They have worked as shepherds and have not met mathematics more than counting their sheep. While working with these students, one difficulty that R6 has met is finding exercises that are basal level and aimed at adults. Most exercises at that level are aimed at children. The students R6 refer to are almost adults, they do not want any task for toddlers, they want exercises that relate to their everyday life.

R3 also mentioned that mathematics is considered to be a universal language, but R3 does not think that is true.

> R3: “Man pratar om matte som ett universellt språk men så är det inte, det är något som vi har hittat på”.
>
> Author’s translation: People talk about math as a universal language, but that is not the case, it is something we have invented.

8. Do you think that support in the student’s mother tongue is a help or an obstacle in mathematics teaching? Why? Why not?

In R1’s experience, the study supervisors often are bad at math. R1 commented that it seems to be difficult to find someone who simultaneously has good knowledge of the student’s

mother tongue, Swedish, and mathematics, and who can explain to the student pedagogically. However, R1 also has experienced some cases when study supervisors have been a great help for the student.

> R1: “Det beror helt och hållet på den som de får stöd av. Jag har upplevt både och [bra och dåligt] men oftast är de stödpersonerna så dåliga på matte, de kan inte förklara [...] Alla saker är svåra att förklara om man inte kan de själv”
>
> Author’s translation: It depends on the person they get support from. I have experienced both [good and bad], but most of the study supervisors are bad at math, they can not explain [...] All things are difficult to explain if you do not know them yourself.

> R1: “Men det har funnits undantag också, jätteduktiga [studiehandledare] som verkligen har hjälpt och pushat eleverna så de har klarat godkänt.”
>
> Author’s translation: But there have been exceptions as well, very talented [study supervisors] who have really helped and pushed the students so they have passed.

R2 agrees with R1 in the case of variation in the study supervisor’s math ability, but in general, R2 has good experience with the study supervisors at the school and thinks it is great that the students can get help in their mother tongue. R2 thinks that the study supervisors contribute to an improvement in the students’ performance and wish that they could get more time together.

> R2: “Jag tycker bara det är synd att man inte har fler timmar, det hade behövts”
>
> Author’s translation: I feel sorry that they do not have more hours, it would have been needed.

R3 and R4 are skeptical if support in their mother tongue helps the students but lets the students help each other in their mother tongue in class. R4 commented that students miss the chance to get involved in discussions if students have to leave the classroom to study separately with the study supervisor. R4 thinks that the students can follow the lessons and learn methods even if they are not fluent in Swedish. R3 points out that a study supervisor is a cost for the school. New arrivals obviously need the support, but when it comes to SVA students who have lived in Sweden for some years it is not as easy to decide if they really need that kind of support.

R3: “Jag har förstått att det är ett stöd men helt ärligt har jag inte sett på vilket sätt det skulle vara ett stöd [...] Men jag har inte sett motsatsen heller, jag skulle aldrig hindra det”.

Author’s translation: I have understood that it is a support, but quite honestly I have not seen in what way it would be a support […] But I have not seen the opposite either, I would never prevent it.

R4: “Jag ser det som ett hinder för om man inte pratar och hör svenska blir det svårt att kunna koppla ihop olika sammanhang [...] Man kan lära sig metoder utan att behöva språket”

Author’s translation: I see it as an obstacle because if you do not speak and hear Swedish, it will be difficult to be able to connect different contexts [...] You can learn methods without having the language.

R5, R6, and R7 have seen the positive effect of having study supervisors for SVA students. In R5’s classroom the study supervisor sat down with the SVA students in the classroom, they talked and translated during R5’s instruction at the board. The SVA students appreciated the support, it helped them to stay motivated to learn. R5 meant that because the students were so positive and grateful to learn, there was no obstacle.

R6 has a study supervisor attending most of her classes. The supervisor helps translate both ways, from teacher to student and from student to teacher, as well as helps the student interpret math exercises. R6 likes to engage the students by asking "what is this called in your language?" If there are students with different mother tongues, they can compare concepts or methods they used in their home country and discuss differences and similarities. Show interest in the students’ home country culture and their earlier experiences make them feel appreciated. R6 means that these kinds of discussions create engagement among the students.

In R7’s experience, the support works well, the study supervisor at the school has good knowledge of mathematics, and is good support for the student’s understanding of mathematics. They help the student to understand, not only the mathematics itself but also processes in school, for example, when a student who has failed a test is upset for not being able to prove themself in the subject. In communication with the teacher after the test, some students think that they must cross the passing grade immediately but via the study supervisor, the teacher can explain that it can take time to get to a passing level and that is okay. The study supervisor helps to calm down the situation so that the student understands the Swedish school system.

R6 commented that SVA students usually have parents with limited Swedish skills, therefore the school has translators involved in parents’ meetings too. When you do not know the

language it is common to feel left out, both in society and at school. By providing translator support at school meetings with the students' parents they hopefully reduce the feeling of exclusion.

> R5: "Jag tror inte det kan vara ett hinder överhuvudtaget mer än om dem tycker det är känsligt att det är en annan som kommer med dem och sätter sig bredvid dem"
>
> Author's translation: I do not think it can be an obstacle at all, more than if they are uncomfortable that someone joins the class and sits next to them.

6.2.1 Summary of causes of mathematical difficulties for SVA students according to the respondents

- Language comprehension
- Prior knowledge and study technique
- Cultural differences

6.3 Measures to make mathematics easier for students with Swedish as a second language

9. Which working methods and methods do you think work best for your students with Swedish as a second language to keep up with? Do you make any adjustments in your teaching?

R7 describes a structure of the lesson that has been successful in his class. It starts with a review on the board where R7 can take time to illustrate how to communicate mathematically. The students take notes and are free to ask questions. Later the class gets some time to work on their own. While the teacher helps students separately, he can pick up what the students have difficulty understanding. R7 ends the lesson with a summary of the content of the lesson and repeats parts that the students may struggle with.

R4 does adjustments by thoroughly going through how to look at text assignments and mathematically interpret them. R4 emphasizes the importance of involving all students in the classroom discussion. Another support by R4 is the concept maps that are placed in the classroom.

When the students work separately, R1 hands out exercises for the students to solve. When following up on the students during the class R1 gets a good idea of how it is going and what they need help with. R1 thinks that it is important to connect with the students and to create a good relationship with the students which makes them dare to ask for help.

R6 makes adjustments to the class by creating image support. R6 means that every image you can find, related to the text, is an important support for the students to understand a mathematical concept or problem.

> R1: “Jag ger uppgifter och ser hur det går. Vi är två stycken [lärare] och har 20 elever så vi hinner se var alla är någonstans [...] Det viktigaste är att man skapar en relation till eleverna så att de vågar fråga.”
>
> Author’s translation: I provide exercises and see how it goes. We are two [teachers] and 20 students, so we have time to see where they are [...] The most important thing is to create a relationship with the students so that they dare to ask questions.

> R6: ”Bildstöd för allting [...] alla ord som jag kunde hitta”
>
> Author’s translation: Image support for everything [...] for all the words I could find.

> R7: “Det som jag tycker fungerar är att man har genomgång på tavlan och de skriver av, jag kan peka på att ‘såhär ska ni skriva’[...] de kan ställa frågor om lite allt möjligt.”
>
> Author’s translation: What I think works is to have a review on the board and they take notes, I can point out ‘this is how you should write’ […] they can ask questions about anything.

When working in couples R2 lets the SVA students work together if they want to. R2 thinks this will give them comfort as they can ask and discuss with each other in their mother tongue if they need to.

Neither R3 or R5 makes any adjustments when teaching a class with SVA students. However, R3 emphasizes that being structured is beneficial for all students, not only SVA students, and R5 emphasizes the importance of making adjustments for weak students by providing material on a more basal level.

R5 does not have experience with SVA students with weak mathematical skills, on the contrary, they have been motivated to study and can often solve math problems behind the text when they know the meaning of the words. Some of R5’s SVA students had bought math books in their mother tongue to use as a supplement to the Swedish math book. R5 took help from a colleague who knows the language to navigate and choose the right level from the math book. R5 thinks this extra supplement was a winning concept for the SVA student to get a good understanding of mathematics.

10. Does your teaching method differ for students with Swedish as a second language and students with Swedish as a mother tongue? How?

R1 and R7 answered no. R2, R3, R4, and R5 answered that they do not make adjustments in their reviews on the board but when helping students separately they think about what words they use and if necessary, try to explain them in other ways. R5 remarks that this is not significant for SVA students, but something they do with all students. However, language barriers may have a bigger impact when helping SVA students.

When trying to explain in a different way R3 uses different words, other methods, or uses body language. Further R3 has noticed that SVA students often ask for help directly after a review, the teacher explains exactly the same thing again but separately. However, R3 thinks that when explaining individually, the students have a better focus which helps them to understand.

R4 remarks that it would give them false hope for their future if they expect ease and exception, they need to understand that in the real world outside the school this will not work.

> R5: “Inte på en genomgång men när man sitter med dem [...] men det gäller alla elever för de kan alla uppfatta saker och ting på olika sätt, då får man försöka vrida och vända på allting [tills de förstår]”
>
> Author’s translation: Not in a review but when you sit with them [...] but it applies to all students because they can all perceive things in different ways, then you have to try to twist and turn things [until they understand].

> R3: “Nu förstår man att man är till stor del en språklärare”.
>
> Author’s translation: Now you understand that you are for the most part a language teacher.

> R2: “Man kanske pratar på ett annat sätt när man förklarar för dem, när man går fram till en elev och förklarar […] Man använder enklare uttryck, enklare exempel, mindre siffror, allt för att nå fram så att eleven förstår”
>
> Author’s translation: "You may speak differently when you explain to them, when approaching a student to explain […] You use simpler expressions, simplified examples, less numbers, anything to make the student understand"

R4: “Jag ser det som en falsk värld om jag gör skillnad”

Author’s translation: I see it as a fake world if I make a difference.

R6 is the only respondent who makes adjustments in her review in the form of image support. R6 thinks this kind of support is helpful for most SVA students but is not necessary to the same extent as students who have Swedish as their mother tongue. R6 also expresses that language knowledge has an impact on the level of problem-solving.

R6: “När man jobbar med problemlösning [med elever med svenska som modersmål] jobbar man med en högre nivå för att man kan det på grund av språket”

Author’s translation: When you work with problem solving [with students with Swedish as their mother tongue] you work on a higher level because you can due to the language.

11. In what way do students interact with each other in mathematics teaching?

All respondents create study groups or couples where the students can solve problems together or explain them to each other. R1 creates small study groups where they can discuss exercises with each other or let them correct each other’s tests and compare results, methods used, and how they communicate their mathematical reasoning. R2 often lets the students work with open exercises in study groups of four. The group solves a task together and presents an answer to the teacher. At the end of the exercise, the teacher writes all answers on the board and starts a discussion in the class on what their reasoning looked like. R2 thinks that by discussing why a wrong answer is wrong, and the reasoning behind it, the student’s understanding of the method used and reasoning for problem-solving improves.

R2: “Jag är intresserad av det felaktiga svaret inte det rätta”

Author’s translation: I’m interested in the wrong answer, not the right one.

R2: “Ju färre man är i en grupp desto mer tid får man, desto mer vågar man ställa frågor [...] Många elever sitter med massa frågor men vågar aldrig säga något.”

Author’s translation: When you are in a smaller group you get more time, and you dare to ask questions [...] Many students have a lot of questions but never dare to say anything.

When working in couples R2 usually lets SVA students work together. R2 has realized that it gives them comfort to be able to discuss or ask each other in their mother tongue. R4 and R5 let the students work in couples most lessons and R5 describes that students can share and benefit from each other's knowledge by helping each other, simultaneously unburdening the teacher. Both R4 and R5 allow students to help each other in their mother tongue, but R4 also emphasizes the importance of pushing the students to train their Swedish. In R4's classroom, the students who are newly immigrated or who do not know Swedish very well, are allowed to use their mother tongue, but if they can speak Swedish well they are expected to use the right mathematical words in Swedish to a greater extent.

R6 lets the students interact through exercises where they explain to each other. For example, one student looks at a picture with some geometrical figures, the other students have a pen and a blank piece of paper. The student with the picture orally tries to explain what the picture looks like by telling its shapes and sizes and how the geometrical figures relate to each other. Meanwhile, the students with the pen and paper try to reproduce the image as described. R6 means that in this kind of exercise, the students practice both listening and explaining. Primarily, R6 lets the student explain in Swedish, if they do not know the words they can try in English or get help from the teacher, and then they must say it again in Swedish. R6 means that it is a disservice to let the students work a lot in English or their mother tongue, they may later have a hard time letting go of that comfort zone. They must be forced to use Swedish to learn Swedish.

R7 does quizzes with the class. The students write down their reasoning and answer, then the students sit in pairs to correct and comment on each other's answers. Another version of this kind of exercise is to let one student present their answer on the board, the teacher then asks for comments från the classmates. They go through the wrong and the right answers as well as different methods and preferred ways to communicate mathematical answers. The teacher helps keep the conversation on track but it is the students' words that describe the exercise and the solution going forward. R7's impression is that this type of exercise contributes to increased engagement as the students get to contribute and be involved in the search for the answer.

> R7: "De bidrar till någonting. Det visar värdet i att de är aktiva på lektionen, du lär dig själv, du bidrar till att andra blir med aktiva och vi får igång ett resonemang."
>
> Author's translation: They contribute to something. It shows the value in that they are active in the lesson: you teach yourself, you contribute to others becoming active and we get a reasoning started.

R7 commented that another common way to let the students interact with each other is by letting them work together with mathematical problems in small groups. The students discuss

the mathematical problems of the tasks and then the students can reason together. R7 describes some factors that will affect the success of small group discussions. To reach its full potential, all students need to get involved in the discussions. By considering the students' mathematical ability, and ability to collaborate, when arranging the groups the exercise can be selected suitable for the students' level. In some cases, this is a great success but sometimes it is difficult to maintain a good study environment in the classroom if the freedom of working in groups leads to the students talking about irrelevant matters.

> R7: "De kan sitta i öar och lösa problem tillsammans […] alla ska kunna komma till tals och alla ska bidra till diskussion för att man ska få ut något av det."
>
> Author's translation: They can sit in small groups and solve problems together […] everyone should be able to speak and everyone should contribute to the discussion in order to get something out of it.

> R7: "När det blir mycket prat om annat […] finns risk för totalt kaos i klassrummet."
>
> Author's translation: When there is a lot of talk about other things […], there is a risk of total chaos in the classroom.

12. How do you organize your mathematics teaching when working with, for example, problem-solving in a class with students with Swedish as a second language?

All respondents' answers involve reviewing problems together on the board. First, they break up the text into sections, then reflect on how the text can be converted into mathematics, and finally, they discuss different methods that can be used.

R6 uses exercises with simplified language and complementary image support. R1 has also come across simplified exercises, meant for SVA students, that consist of very little text and simplified language. But R1 does not see the benefit of using simplified material as it will be too easy and the students will not take the next step in their mathematical development. R1 emphasizes the importance of letting the students practice their ability to pick out the relevant information. On the other hand, R1 admits that if there is too much text the students will not read it.

R2 works with problem-solving by the think-pair-share method. First, the students try to solve the problem themselves, then two and two, and then the whole class together. In the last step, the teacher highlights the essentials, and what to start with. Then the students present different solutions and examples. R2 has noticed that SVA students give up more easily because they

do not know how to tackle a problem, and have trouble picking out the essentials in the text. R2 believes that due to poor language comprehension and prior knowledge the threshold gets too high.

When constructing problems for the students to work with, R3 tries to find a context that the students can recognize by referring to things from the students' everyday life. When they recognize themselves in the context this usually motivates them to engage a bit more.

R3 shows how to structure a problem based on a text, learn different problem-solving strategies and thoroughly go through problems together, and does not skip intermediate steps or take shortcuts.

R5 and R6 complement the text with image support and are prepared with paper and pencil to draw additional images in order to explain to the students when working individually or in groups.

13. How do you think the school can use the work team and the school's resources to meet students with Swedish as a second language even better at their individual level of knowledge?

According to R2, students do not dare to discuss or ask enough in a large classroom. Weak students need more time to work in smaller groups together with a teacher but schools do not have enough resources to provide small study groups. R2 also points out that the study supervisors should have good knowledge of both mathematics and the language in the students' mother tongue to secure the quality of SVA students' education.

> R2 "Det bästa hade varit om man kunde plocka några elever och sitta med dem."
>
> Author's translation: The best would be to be able to pick some students and sit with them.

> R2: "Det är så olika hur mycket matten den lärare [studiehandledaren] kan."
>
> Author's translation: It's so different how much math that teacher [study supervisor] knows.

In R4's perception, the lack of language comprehension of all students, in general, has increased over time. R4 thinks the major reason for lack of language comprehension is the lack of reading. R4's school has recently started up reading groups to increase the students' reading comprehension.

R5 thinks the school team has worked well as there are both SVA teachers and special educators at the school who can help, and if the students are up for it, they can sit in smaller groups and get extra support and resources. At the school where R6 works, there are few SVA students, but R6 is considering collaborating with other schools by sharing material used in teaching SVA students.

R7 commented that the teachers work quite closely with each other as they sit in the same workroom, leading to informal discussions between colleagues and collegial cooperation. However, R7 proposes an extended collaboration between subjects. For example, between the subjects Home and consumer studies and Mathematics, where different units can be calculated, or between sports and mathematics, where scales can be calculated. R7 thinks that by helping the students see connections to other subjects, and thereby increasing the recognition factor, the students find it easier to understand.

R3 wants to have better knowledge of the students' difficulties with the language beforehand if they have problems or not. R3 finds the knowledge surveys time-consuming, yet not thoroughly done, and rarely leads to actually understanding what difficulties the students have. R3 describes the feeling of not always having the time or sufficient resources and skills to help the SVA students in the classroom.

6.3.1 Summary of measures to support SVA students with mathematical difficulties according to the respondents

- Interaction
- Support in mother tongue
- Image support
- Paying attention to the student's culture
- Increasing reading comprehension

7. Analysis and discussion

The information for this study has been obtained via problem analysis of previous research literature and through interviews. After compiling problem analysis and interviews, an analysis was made of the collected material to thematize the answers, the research questions are answered and the material is discussed and compared to the background information, previous research and theory.

7.1 Mathematical difficulties that SVA students encounter

The most frequent mathematical difficulties that SVA students encounter are, according to the respondents, connected to language comprehension; problem-solving, reasoning and communication, and mathematical words and concepts.

Problem-solving

According to 6 out of 7 respondents, students with Swedish as a second language have the most difficulty in achieving problem-solving ability. R2 was one of the respondents who claimed that problem-solving tasks are difficult for SVA students as these tasks contain a lot of language, which makes it difficult for SVA students to interpret what the text is looking for. Research also underlines this statement, according to Norén and Caligari (2020) problem-solving tasks are particularly difficult for SVA students as they involve words. The Swedish Agency for School Development (2008) also states that many students with Swedish as a second language experience difficulties in understanding problem-solving tasks, especially in the higher school years when they include more text-based exercises.

Given that problem-solving tasks contain a lot of text, this means that SVA students need to focus and understand two languages at the same time, the mathematical language and the language of instruction. R1 answered that a problem-solving task is a written problem that you have to translate into mathematics. Löwing and Kilborn (2010) as well as Rönnberg and Rönnberg (2001), consider that the difficulty of managing the register is greater for second language students considering that the students need to learn two languages.

In addition to the problem-solving ability, the respondents answered that SVA students have difficulty with reasoning and communication ability as well as mathematical words and concepts.

Mathematical reasoning and communication

The respondents mentioned that SVA students find it more difficult to express themselves, both orally and in writing. Most respondents let the students help each other in their mother tongue. R6 encouraged the students to use Swedish as much as possible and helped them to translate from their mother tongue, or English, to Swedish. R4 said it is a disservice to let the students use their mother tongue, they need to be pushed out of their comfort zone in order to

get to use and learn Swedish. The first zone of ZPD-theory is described as the furthest one can get to knowledge. A student in this zone has a big gap between the task and what the student can do alone (Säljö, 2014). The safe zone that R4 was referring to can be seen as the first ZPD-zone. It may be a safe space to be in but does not lead to development as long as no further steps are taken. The students need to be guided by the teacher to develop their knowledge little by little. In ZPD-theory it can be translated to the guidance, the scaffolding, in the second zone of ZPD, which is the Zone of Proximal Development, and leads to knowledge the students own, in the third zone (Säljö, 2014).

Some respondents mention that the SVA student usually transfers from preparatory class to ordinary class earlier in mathematics than in other subjects, as it is assumed that the subject uses Swedish to a lower extent. If the transfer from preparatory class to ordinary class happens too fast, it may be a contributing factor to the difficulty of communication. Translated into the ZPD-theory this means that the ZPD-zone is challenging to reach if the scaffolding decreases too fast or too early.

Mathematical words and concepts

The respondents answered that SVA students have difficulties with words that have two meanings depending on whether they are used in everyday language or mathematics. It creates problems when students only know what these words mean in one of the contexts. Löwing and Kilborn (2010), The Swedish Agency for School Development (2008) as well as Rönnberg and Rönnberg (2001) also underline this statement. The Swedish Agency for School Development (2008) has also created a list) of words that have two meanings depending on context (see Chapter 3.5 Table 7).

7.2 Causes of mathematical difficulties for SVA students

The most frequent causes of mathematical difficulties for SVA students are, according to the respondents, language comprehension, cultural differences, insufficient prior knowledge, and poor study technique.

Language comprehension

The majority of the respondents considered that language comprehension is a factor that causes the most difficulties in mathematics for SVA students. It is thus the language comprehension itself that is the reason why SVA students have difficulties with problem-solving tasks. According to the Swedish Schools Inspectorate (2010), it is complicated for students who do not master the language of instruction to develop sufficient knowledge. As long as SVA students do not master the language of instruction, they will have worse conditions to learn than students with Swedish as their mother tongue. It can be concluded that language comprehension affects students' understanding of mathematics.

On the other hand, one respondent, R4, did not consider that SVA students' difficulty with mathematics is due to Swedish being their second language. R4 believes that one factor is that many students do have difficulty with mathematics because students do not read books which means that their reading comprehension is weak. According to the Swedish Agency for School Development (2008), mathematics teachers should devote more time to reading comprehension in mathematics. Furthermore, the Swedish Schools Inspectorate (2010) points out that it is crucial to have a good vocabulary to be able to understand what you are reading. Reading comprehension increases when students discuss, write, and read. Reading becomes a very time-consuming task for SVA students if they do not fully master the language of instruction. It makes it more difficult for SVA students to decode the instructions and the text of math problems in comparison with a student with Swedish as their mother tongue.

In order for SVA students to be given the opportunity to develop their language skills and expand their vocabulary, teachers should allow students to encounter new words and expressions. The Swedish Agency for School Development (2008) states that teachers tend to simplify the language when they notice that students have a limited vocabulary or insufficient knowledge of Swedish, which makes it more difficult for SVA students to develop their language comprehension. Some of the respondents answered that they sometimes speak differently when explaining to SVA students. They use simpler expressions, simplified examples, anything to make the student understand. In the long run, this leads to a decreasing opportunity for the student to develop the language. The Swedish Agency for School Development (2008) also writes that it is inappropriate to introduce new and unfamiliar words when it comes to testing situations. Especially if these words are not already well established in the students.

The respondents also believe that one reason why SVA has difficulty with mathematics is that they get stuck on words so that they do not understand what the task requires. According to Nation (2013), the reader needs to know at least 95% of the words in a text to be able to understand the content. This can be an explanation for why SVA students can have a hard time understanding what the task requires. According to researchers Lindberg and Johansson Kokkinakis (2007) words that many teachers take for granted that students recognize can create problems for SVA students. Respondent R4 mentioned an example that SVA students had difficulty understanding the word "lovely", which led them to not complete the task because they got stuck on the word.

R3 also mentioned that mathematics is considered to be a universal language, but R3 does not think that is the case and says that mathematics is something we humans have invented. Rönnberg and Rönnberg (2001), underline this statement by writing that mathematics is often seen as a universal language, and due to this fact newly immigrated and SVA students are often placed in regular teaching of mathematics sooner than other subjects. This creates difficulties for these students as they do not master the language of instruction.

Cultural differences

In addition to difficulties due to deficiencies in language comprehension, respondents answered that another reason is cultural differences. SVA students have a different culture than the Swedish culture, which can create problems for these students. For example, it may be that SVA students are not familiar with certain parts of the Swedish culture that are used in a problem-solving task, which makes them unable to understand the task. Some respondents answered that names and contexts that are linked to Swedish culture can cause problems for SVA students when solving a problem. The Swedish Agency for School Development (2008) as well as Rönnberg and Rönnberg (2006) state that cultural differences can affect students' learning. They provide examples of contexts that SVA students may find unfamiliar, for example, weekly allowances, train travel, ski trips, and mushroom picking. Respondent R5 gave an example of students from Somalia who had problems understanding a task that was different from the students' culture. The task was about different ways of setting the table with a fork, knife, and spoon. This created a distortion for the Somali students as they do not use cutlery in Somalia.

Another cultural difference that can cause problems for SVA students is that different countries have different methods for solving mathematical tasks. An example of a solution method that is different both within Sweden and in most cultures is the solution method of division. According to Rönnberg and Rönnberg (2006), Sweden uses short divisions while in other countries, long divisions are more common. Both R3 and R5 replied that they have discovered that some SVA students use long division instead of short division because they are used to that method. R3 believes that it is an advantage if students can solve a task through several different methods which Rönnberg and Rönnberg (2006) also emphasize.

The school culture itself differs from country to country. In Swedish school culture, teachers encourage social learning in the form of students participating in discussions. Swedish schools are characterized by Vygotsky's sociocultural perspective, which means learning takes place through interaction with each other, which means that learning takes place in social contexts (Säljö, 2014). In other countries, students should instead sit quietly and listen to teachers as it is considered respectful. Students who come from such a culture may have difficulty reasoning and discussing as they have not done so before in school.

Newly immigrated students can be accustomed to a school culture with clear rules and a strong framework. This differs from the Swedish school which according to Löwing and Kilborn (2008a) has more vague rules and a weak framework. This can create a cultural clash and complicates the learning situation for these students. R6 emphasizes this statement by mentioning that some newly immigrated students are not able to cope with the "freedom" in the Swedish school because they are used to another form of teaching. This leads to these students becoming unfocused in school.

According to Löwing and Kilborn (2010), an important prerequisite for being able to think with numbers is that you should be able to name them correctly depending on the language.

R7 answered that SVA students have difficulty with number perception and gave an example of when students were given a task where they would write the number forty thousand twenty. The SVA students wrote 4020 and 4 000 020. This may be because different languages have different structures when it comes to naming numbers. Löwing and Kilborn (2008a) as well as Rönnberg and Rönnberg (2001) state that this can create confusion for multilingual students.

Insufficient prior knowledge and poor study technique

Five of seven respondents answered that SVA students face difficulties in mathematics due to insufficient prior knowledge. Some respondents answered that this may be since some newly immigrated students have had a short or no school background in their home countries. The fact that they have had a short or no school background leads to a lack of study technique.

According to Vygotsky's Zone of Proximal Development, the students who have insufficient prior knowledge and poor study technique are still in the first zone while their native classmates might be in the third. The first zone is the zone where you can not understand things on your own, the third zone is where the student can do things on their own (Säljö, 2014).

7.3 Measures to support SVA students with mathematical difficulties

According to the respondents, the most useful strategies to support SVA students with mathematical difficulties are; interaction, support in their mother tongue, paying attention to the student's culture, image support, and increasing reading comprehension.

Interaction

All the respondents answered that they let the students interact with each other by working in groups or in pairs where they can solve tasks together or explain and discuss how to solve a task. When working in pairs, the students may mix Swedish and their mother tongue. Rönnberg and Rönnberg (2001) consider that it helps to increase students' understanding when they are allowed to reflect and communicate mathematics with their classmates. According to the Swedish Agency for School Development (2008), a language development environment can be promoted by the teacher allowing students to work in groups and have discussions with each other. Säljö (2014) also sees the benefits of a social environment. The social environment contributes to students learning new concepts which takes place through discussions. This applies to both discussions with teachers and students and between students. Through social interaction, you can take part in others' knowledge and then use this knowledge yourself, which is called appropriation. This also leads to scaffolding considering students who have more knowledge can guide and assist other students with less knowledge. Säljö (2022; 2014) thinks that the teacher should help the students to absorb and develop their knowledge and let students have the opportunity to develop their ability to communicate, which can be done through oral, written, or visual communication.

Although letting students work in groups or pairs has many advantages, some disadvantages can sometimes arise. According to R7, sometimes it is difficult to maintain a good study environment in the classroom if the freedom of working in groups leads to the students talking about irrelevant matters.

Interaction is important both between students when working in a group and between students and teachers when working individually. Creating a relationship is important to make the students comfortable to ask questions and help each other. Students need to feel safe in their environment in order to dare to express themselves. This means that a good conversational climate is required. As the students get more comfortable they dare to speak up and ask more. Being able to listen to others' reasoning and express themself in small groups becomes a safe space for the students. It seems to be easier to ask a question as a group or couple rather than with one alone voice in the class. To be able to help each other out probably acts as a confidence boost. According to Rönnberg and Rönnberg (2001), working in small groups can increase students' self-confidence as they become more linguistically risk-taking. In comparison with working in larger groups, there is not as high demand for a formal language compared to in a small group. Students take more risks by, for example, daring to use new words, ideas, and concepts. It can feel extra challenging for SVA students to express themselves orally as they are afraid of being misunderstood or they are afraid of being corrected linguistically, especially if the SVA students do not fully master the language of instruction. Rönnberg and Rönnberg (2001) argue that students need to feel safe in the classroom to communicate mathematics. For this reason, it is important that the teacher contributes to a safe classroom environment.

Support in mother tongue

When SVA students do not fully master the language of instruction, it can be advantageous to let them use their mother tongue in group and pair discussions if the other students speak the same mother tongue. According to Rönnberg and Rönnberg (2001), SVA students can get help from classmates with the same mother tongue who can help each other explain and translate. This contributes to SVA students becoming more comfortable and it promotes their learning. R2 usually lets SVA students work together and says that it gives them comfort to be able to discuss or ask each other in their mother tongue. R3 and R4 also let SVA students help each other in their mother tongue but they are at the same time a bit skeptical if support in their mother tongue helps the students in the long run. R4 sees it as an obstacle if SVA students do not practice Swedish as much as possible and if the students use their mother tongue too often during lesson time. R4 believes that it will be more difficult for SVA students to develop their language if they do not speak and hear Swedish. R3 is aware that researchers say that it is good for SVA students to use their mother tongue, but has not seen in what way it would be a support. But R3 has not seen the opposite either and hence allows students to use their mother tongue. Hansson (2011) writes in her dissertation that students with well-developed skills in both their mother tongue and Swedish can benefit from this in their knowledge development in mathematics. According to Norén and Caligari (2020), one

way of scaffolding in multilingual mathematics classrooms is when teachers promote students' active language use, both orally and in writing in the mathematics classroom. This means promoting SVA students to actively use Swedish and also promoting the SVA students to use their mother tongue.

In addition to the students receiving help from each other in their mother tongue, they can also get help in their mother tongue from a study supervisor. Norén and Caligari (2020), state that offering varied and long-term linguistic support to the students is considered scaffolding. The respondents have mixed opinions about whether the support that the study supervisor contributes is effective or not. According to Rönnberg and Rönnberg (2001), some teachers are skeptical that study supervisors can teach their students mathematics. The quality of the support the student receives through the study supervisors depends on their knowledge of the subject and their ability to explain it in a pedagogical way. R1 has a bad experience when it comes to studying supervisors. R1 believes that they are usually bad at explaining mathematics to students because it is difficult to find a study supervisor who simultaneously has a good knowledge of the student's mother tongue, Swedish, and mathematics, and can explain to the student pedagogically. R2 agrees with R1 to a certain extent. However, in most cases, R2 has a good experience with the study supervisors and wishes that the SVA students could get more hours with the study supervisor. R3 points out that the resource of a study supervisor for students is a cost for the school.

According to Rönnberg and Rönnberg (2006) as well as The Swedish Schools Inspectorate (2010), most SVA students do not receive enough teaching hours in their mother tongue and the schools need to offer study guidance in students' mother tongue to a greater extent for those who need it. Norén (2010a) agrees with Rönnberg and Rönnberg (2001) that the opportunities for schools to invest in SVA students' mother tongues are limited due to schools not having sufficient resources. However, Rönnberg and Rönnberg (2001) point out that it is more profitable to invest in mother tongue teaching and study guidance for SVA students than that the actual education period is extended for SVA students who do not reach upper secondary school eligibility with the nine-year compulsory school.

Paying attention to the students' culture

It is important to take time to make the students familiar with the context and involve the students' culture and prior experiences in the learning exercises. According to the Swedish Agency for School Development (2008) as well as Rönnberg and Rönnberg (2006), students' self-image and motivation can be strengthened by linking tasks to students' cultural context which can be done by linking tasks to students' everyday lives or students' ethnic culture. This gives students a confirmation that their culture is valuable and this can simplify learning in mathematics. Säljö (2014) agrees with the Swedish Agency for School Development (2008) and Rönnberg and Rönnberg (2006). Säljö (2014) thinks that teachers need to have a good knowledge of students' different cultures and the languages they use to contribute to good teaching.

R3 tries to construct tasks from the students' perspective by picking things from the students' everyday life. When they recognize the context this usually motivates them to engage themselves a bit more. R6 encourages the students to use concepts or methods they used in their home country and compare them with each other to discuss differences and similarities. The students feel appreciated when the teacher shows interest in the students' home country's culture and their earlier experiences. R6 thinks that these kinds of discussions create engagement among the students. According to Norén and Caligari (2020), teachers scaffold the students by making the mathematical content understandable by putting it in contexts that the students can relate to.

Image support

Hoogland, Koning, Bakker, Pepin, and Gravemeijer (2018) and The Swedish Agency for School Development (2008) agree with Rönnberg and Rönnberg (2006) and state that visual image support simplifies the text task. The visual image acts as a tool that clarifies the content of the text. The opposite effect may also occur if the image is unclear and contradicts the text. Both R5 and R6 use images as a support for helping students understand the task. R6 states that every image you can find, related to the text, is an important support for the students to understand a mathematical concept or problem. According to R6, this kind of support is helpful for most SVA students but is not necessary to the same extent as students who have Swedish as their mother tongue. R5 and R6 are prepared with paper and pencil to draw additional images to explain to the students when working individually or in groups.

Increasing language comprehension

R4 was the only one out of the seven respondents that answered that students should increase their reading comprehension in order to understand mathematics better. According to R4, the major reason for lack of language comprehension is the lack of reading. R4 replied that many students do not read books which makes them think that the language is difficult. It is therefore the students' literacy that is crucial. R4's school has recently started up reading groups to increase the students' reading comprehension. According to the Swedish Agency for School Development (2008), mathematics teachers should devote more time to reading comprehension in mathematics. This applies to students in general and not just SVA students. Eckerholm (2018) noticed in her study that the consequence of students who have difficulties with reading comprehension in Swedish have difficulties in mathematics as well. That is, a good reading skill is important in mathematics.

8. Conclusion and reflection

This study aimed to investigate how language comprehension affects the students' understanding of mathematics, with a focus on students with Swedish as a second language who study mathematics with Swedish as the language of instruction. The purpose of the study has been achieved with the help of theory, previous research, and the respondents' answers.

This chapter presents the conclusion of results, a discussion of the method as well as proposals for future research.

8.1 Conclusion of results

The conclusion of the results is divided into three different parts according to the study's research questions; difficulties, causes, and measures.

1. What specific difficulties do students with Swedish as a second language encounter in mathematics teaching?

The most frequent mathematical difficulties that SVA students encounter are, according to the respondents, connected to language comprehension; problem-solving, reasoning and communication, and mathematical words and concepts.

Both research and the respondents' answers indicate that problem-solving tasks are particularly difficult for SVA students. Problem-solving tasks involve text, and the older the students become, the more complicated the text-based exercises become. Many SVA students have difficulty understanding a text, especially mathematical texts.

When solving a problem-solving task, it is important to be able to reason and communicate how you arrived at the answer, which is another difficulty for SVA students. This is something that students, in general, have a hard time with, regardless of whether they have Swedish as their mother tongue or a second language. But it becomes much more difficult to reason and communicate if you do not master the language of instruction. SVA students may understand the task but have difficulty describing how to proceed. This applies both orally and in writing.

2. What factors contribute to the difficulties in mathematics learning that students with Swedish as a second language encounter?

Difficulties in mathematics among second language students are often related to students' language comprehension. All students may have difficulty with language when it comes to math. However, it can be extra challenging for SVA students as they need to learn two languages at the same time, the mathematical language and the language of instruction. Sweden is a multilingual country and over the years, the Swedish schools have become more multicultural and the classrooms accommodate more SVA students than they did a few years

ago. This means it's important to pay attention to these difficulties and try to find different strategies to make it easier for these students. If not, the problem will only continue to grow. It is not always easy to define whether the SVA students have problems with the mathematical words, the Swedish language or if the student has missed the understanding of a concept. There are always language challenges in learning mathematics in a second language.

Mathematics contains a lot of language and it is difficult to avoid the language in mathematics. To understand and be good at mathematics, you also first need to be good at the language of instruction. Mathematics uses a universal symbolic language, which means that many believe that mathematics is a universal language. This leads to mathematics being seen as a subject in which students who do not master the language of instruction could participate in. The effect of this has led to many SVA students with poor language skills in Swedish being placed in regular mathematics teaching. SVA students must participate in regular teaching as soon as they are considered to know the language of instruction sufficiently to be able to understand the subject in Swedish. Unfortunately, this transition happens too fast, which affects these students' learning process, especially when it comes to mathematics.

The fact that the student must master the language of instruction affects many parts of the learning. When a new concept is introduced, the SVA student must work with both the language and the concept. This dual-task makes the learning process more complex. The ability to communicate becomes more difficult when one does not master the language, which will affect the ability to understand instructions, reason with classmates, and the ability to ask for help. Thus, obstacles arise for the students when the teaching is practiced in a second language that the students do not fully master. There is both a linguistic barrier to understanding the content of teaching and a barrier to communication.

It can be difficult for SVA students to understand problem-solving tasks if they are written from a Swedish perspective. Research shows that linking information to students' cultural contexts, such as students' everyday lives or students' ethnic culture, gives students a confirmation that their culture is valuable. Which can lead to the students' self-image and motivation being strengthened and thus simplify learning in mathematics.

Newly immigrated students can be used to a teaching method that is different from Sweden. In other countries, the focus may be on the correct answer, while Sweden focuses more on the reasoning that leads to the answer. This can cause difficulties for these students as they are not used to having to present their solutions. In the Swedish classroom, the teacher encourages students to discuss and participate in teaching. While other countries consider that students should listen and be quiet in the classroom as this is considered respectful. This may also be a reason why these newly immigrant students have difficulty reasoning and communicating.

3. How do mathematics teachers in lower secondary schools work to make it easier for students with Swedish as a second language who have difficulties?

According to the respondents, the most useful strategies to support SVA students with mathematical difficulties are; interaction, support in their mother tongue, paying attention to the student's culture, image support, and increasing reading comprehension.

A major reason why SVA students perform worse in mathematics than students with Swedish as their mother tongue is due to language comprehension. Despite this, only a few SVA students receive support in their mother tongue. Some teachers are skeptical and do not have enough confidence that the study supervisors can teach their students mathematics. This is also reflected in the respondents' answers. It can be difficult to find a person who both speaks the student's mother tongue and can communicate and explain mathematics. However, it is better than the SVA student gets some kind of help in their mother tongue than no one at all. Study supervisors can work as more than just a translator. Study supervisors can help in communication with the student's parents and in this way also explain the school system and culture that may be different compared to their home country. It can be a big change for both students and their parents who have recently immigrated to adapt to the Swedish school. The working method and the teaching situation can differ and this can complicate the learning situation. For that reason, it can be beneficial to have a study supervisor who helps to explain the Swedish school system.

Unlike other countries, the Swedish school is characterized by the social perspective, which means that learning takes place in social contexts. The sociocultural perspective is clearly anchored in our curriculum, but mathematics teaching mostly follows the traditional teaching method. Which is more of a one-way communication. If students only get lesson time in watching when the math teacher shows methods for solving different problems, they will probably be good at imitating these to solve similar problems. And if students are only encouraged to practice prescribed procedures, it leads them to perceive mathematics as following the instructions for moving symbols around as quickly as possible. For this reason, most of the lesson time must be devoted to the students working together and reflecting and discussing as they develop their understanding of mathematics. Research shows that the ability to communicate and solve problems increases when students have the opportunity to work together. There are many benefits to working in a team. Through discussions, students get the opportunity to develop their language and at the same time give students the conditions to maintain their interest in mathematics. To be able to communicate mathematics, students need to feel safe in the classroom. The students can also feel more comfortable working in groups and in this way dare to ask questions to the group and that the group asks questions to the teacher. It is easier to ask as a group than as an individual. The students can avoid expressing themselves as they are afraid of being corrected linguistically and risk being misunderstood. The advantage of working in groups is that there are not as high demands on a formal language. When students have the opportunity to reflect with their classmates, it helps

to increase their understanding when they think through what to do and why. Which creates relationships between ideas, facts, and procedures.

Research shows that many teachers lack knowledge and competence in which methods should be used for successful knowledge development for SVA students. Teachers need to have an understanding of the students' interests and previous experiences in the subject as well as their linguistic and cognitive level in mathematics in order to be able to adapt to the education. SVA students need tasks that challenge both language skills and their mathematical thinking. The teacher needs to be responsive and support the student. This can be done through group work and discussions that promote language development and at the same time give students the conditions to maintain their interest in mathematics.

It can be difficult for SVA students to understand problem-solving tasks if they are written from a Swedish perspective. If students perceive the context as foreign, it can result in them losing interest in the tasks. Research shows that students often relate to their own cultural experiences and home culture when solving problem-solving tasks. Which makes it easier for students to relate to contexts that they find familiar. By linking tasks to students' cultural context, students' self-image and motivation can be strengthened. This can also simplify learning in mathematics for the students. Another factor that can facilitate understanding is image support. The teacher should illustrate as much as possible to help students understand the context and reasoning of a mathematical text. In order for SVA students to understand the mathematical text, reading comprehension needs to be increased. The teachers could include students in reading groups and vary the way of describing and explaining in other words.

The most important result is that SVA students' understanding of how to proceed in problem-solving tasks increases when they receive support in their mother tongue and are encouraged to work with classmates by explaining and discussing in pairs or groups and they become familiar with the context.

8.2 Reflection of results

Regarding the difficulties and causes, the respondents had similar answers. A few had other opinions, such as R4, who did not consider SVA students to have difficulty with math because Swedish is their second language.

Sometimes we had an idea of what the questions would provide for answers. This is because we had read some previous research and theory regarding this issue. One example is that the majority of the respondents answered that problem-solving tasks are a difficulty for SVA students due to shortcomings in language comprehension, which is stated in previous research.

Some of the answers were not what we had thought of since it was not included in our prior knowledge of previous research or theory. From reading previous research, problem-solving was an expected answer, but limited time in school in their home country was not.

The respondents' schools seem to have different setups when it comes to if the SVA students sit with the study supervisor in the classroom or another room. In the cases where they leave the classroom, the respondents are skeptical about whether help via study supervisor is beneficial for the student. The respondents who have a study supervisor in the classroom are more positive. In answers related to the study supervisor we understand that the study supervisors are more than just translators for the students, they can help in communication with parents, explain the school system, and cultural issues that may be different compared to their home country.

As a whole, the results are rewarding for the study's research questions as the answers confirmed previous research and theory, but also because the answers provided new perspectives.

8.3 Discussion of method

The chosen method for this study was qualitative interviews. We concluded that interviews were the best method for obtaining the best possible result for our research questions. An interview is more personal and can capture more information and details than, for example, an online survey. We focused a lot on making the respondents feel as comfortable as possible in order for us to get genuine answers. The conducted interviews felt, in our opinion, like everyday conversations with a friend or colleague. After conducting all the interviews, we think that all the respondents felt relaxed when they responded. Our respondents were given the opportunity to choose the time and place for the interview. We also chose to interview each respondent individually to avoid dishonest responses due to peer pressure.

After the interview, the recorded material was transcribed and analyzed. The recordings were listened to a few times and carefully analyzed along with the notes to see if anything important had been missed. The respondents' answers were divided into different themes in order to see a certain pattern in each respondent's answer.

Succeeding in getting respondents was quite difficult. A missive letter was sent out in good time to 45 schools as well as a reminder to the schools that did not respond. This resulted in only five schools agreeing to be interviewed, which gave the study seven respondents. One disadvantage was that we only had access to the principals' email addresses. We believe that we would have received more answers from respondents if we had had access to the teachers' email addresses. There is no guarantee that all principals forwarded the email to the teachers.

We chose to expand our original geographical delimitation to get more respondents. An alternative would have been for the geographical delimitation to apply throughout Sweden. This means that you could, for example, have interviewed teachers from Stockholm. But that would lead to digital interviews, which we would rather avoid. It would have been rewarding to get a few more interviews, but transcribing the seven interviews was time-consuming. Given the length of the study, only a few more interviews could have been handled. On the other hand, saturation was reached with seven respondents. One alternative could have been

to mix interviews with, for example, surveys, to get more answers. However, we do not think that the time would have been enough and that the quality of the answers would have deteriorated.

8.4 Future research

For future research, it would be interesting to also include the students' perspectives on the research questions. Would there be similarities/differences between the students 'and teachers' responses? Sometimes the direct source, in this case, the SVA students, can give the best answers. On the other hand, the teachers have more experience and are trained to work with these kinds of questions. If there is enough time, we believe that a study that includes both teachers and SVA students is the alternative that would give an overall picture of the problem.

A follow-up study could include more methods such as surveys or to choose observation as a method. Then you have the opportunity to see on the spot what is happening rather than just hearing it from the respondents.

Another suggestion we have for future research is to test the effect of the measures to facilitate for SVA students that the respondents have mentioned. Is there any improvement? Why/Why not? It can be difficult to determine and see if a measure makes any difference for that reason, you must have time for such an examination. A suggestion is longitudinal studies in which intervention of different measures are assessed over a period of time.

Some respondents expressed concern that an anti-study culture has grown among students. They point out that this applies to this generation of students and not specifically just SVA students. The student's motivation and attitude have decreased over the years. One respondent expressed a feeling that some students did not think it was cool to study, and another that the students did not see the point of making an effort, or that it was the teacher's job to make the student pass. We have not found any additional research to confirm this hypothesis, furthermore, it was slightly out of the scope for our thesis as we focus on measures significant for SVA students, but we found these comments interesting and would gladly read a future thesis about this topic.

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Appendices

Appendix 1 Missive letter (Swedish)

Hej!
Vi är två studenter från Chalmers Tekniska Högskola som läser masterprogrammet Lärande och Ledarskap. Programmet är en unik utbildning som leder till både civilingenjörs- och ämneslärarexamen.

I vårt masterexamensarbete utför vi en studie där vi undersöker svårigheter i matematik hos elever med svenska som andraspråk. Studien kommer att besvara tre forskningsfrågor:

1. *Vilka specifika svårigheter möter elever med svenska som andraspråk i matematikundervisningen?*
2. *Vilka faktorer bidrar till att elever med svenska som andraspråk möter svårigheter i matematikundervisningen?*
3. *Hur arbetar matematiklärare på högstadiet för att underlätta för elever med svenska som andraspråk som har svårigheter?*

Vi kommer att söka svar på dessa frågor genom att studera tidigare forskning och genom att genomföra en kvalitativ intervjustudie med ett antal matematiklärare på högstadiet som undervisar elever med svenska som andraspråk.

Deltagandet är frivilligt och du kan när som helst avbryta. Din intervju kommer att spelas in, transkriberas och din identitet anonymiseras. Inspelningen kommer endast vara tillgänglig för oss och raderas när examensarbetet är färdigställt. Självklart kommer du att få ta del av resultatet av vår studie.

Vi är tacksamma om du vill bidra med din erfarenhet genom att deltaga i vår studie. Vi önskar boka in en tid med dig för intervju mellan 25:e februari - 25:e mars. Intervjun förväntas pågå under cirka 45-60 minuter.

Skulle det uppstå några frågor eller funderingar får du gärna kontakta oss för ytterligare information.

Med vänliga hälsningar,

Johanna Törnqvist: johtornq@student.chalmers.se

Daniella Hanoun Santana: hanoun@student.chalmers.se

Samtycke _____

Appendix 2 Missive letter (English)

Hi!

We are two students from Chalmers University of Technology who are studying the master's program Learning and Leadership. The program is a unique education that leads to both a master's degree in engineering and a subject teacher degree.

In our master's thesis, we carry out a study in which we investigate difficulties in mathematics in students with Swedish as a second language. The study will answer three research questions:

1. *What specific difficulties do students with Swedish as a second language encounter in mathematics teaching?*
2. *What factors contribute to the difficulties in mathematics learning that students with Swedish as a second language encounter?*
3. *How do mathematics teachers in lower secondary schools work to make it easier for students with Swedish as a second language who have difficulties?*

We will seek answers to these questions by studying previous research and by conducting a qualitative interview study with a number of mathematics teachers in lower secondary school who teach students with Swedish as a second language.

Participation is voluntary and you can cancel at any time. Your interview will be recorded, transcribed and your identity anonymized. The recording will only be available to us and deleted when the master thesis is completed. Of course, you are welcome to take part of our study.

We are grateful if you want to contribute your experience by participating in our study. We wish to book an appointment with you for an interview between February 25th - March 25th. The interview is expected to last about 45-60 minutes.

Should any questions or concerns arise, please feel free to contact us for further information.

Sincerely,

Johanna Törnqvist: johtornq@student.chalmers.se

Daniella Hanoun Santana: hanoun@student.chalmers.se

Consent _____

Appendix 3 Interview guide (Swedish)

Bakgrundsfrågor:

1. Vad har du för utbildning?
2. Hur länge har du arbetat som lärare?
3. I vilken/vilka årskurs/er arbetar du?
4. Hur länge har du undervisat i matematik?
5. Hur länge har du varit på din aktuella arbetsplats?
6. Hur många av dina elever i matematik har svenska som andraspråk?
7. Vilket eller vilka läromedel använder du i matematikundervisningen?
8. Sker matematikundervisningen i klassrummet endast på svenska?
9. Får elever med svenska som andraspråk stöd i matematik på sitt modersmål?

Intervjufrågor:

Forskningsfråga 1: *(Vilka specifika svårigheter möter elever med svenska som andraspråk i matematikundervisningen?)*

1. Vilka lärandemål och förmågor i matematikämnet upplever du att dina elever med svenska som andraspråk har svårast att uppnå?
2. Vilken typ av matematiksvårigheter upplever du att dina elever med svenska som andraspråk ofta stöter på?
3. Vilka moment i matematikämnet är särskilt svåra att förstå för elever med svenska som andraspråk?
4. Vilka metoder använder du för att upptäcka vad som är speciellt svårt för elever med svenska som andraspråk?

Forskningsfråga 2: (Vilka faktorer bidrar till att elever med svenska som andraspråk möter svårigheter i matematikundervisningen?)

5. Vilka faktorer upplever du kan orsaka svårigheter i matematik hos elever med svenska som andraspråk?
6. Hur kan du avgöra om matematiksvårigheterna har med brister i språkförståelsen att göra eller har andra orsaker?
7. Upplever du att det finns annat än språkförståelsen som elever med svenska som andraspråk har problem med i matematikundervisningen? Vad i så fall?
8. Tycker du att stöd på elevens modersmål är en hjälp eller ett hinder i matematikundervisningen? Varför? Varför inte?

Forskningsfråga 3: *(Hur arbetar matematiklärare på högstadiet för att underlätta för elever med svenska som andraspråk som har svårigheter?)*

9. Vilka arbetssätt och metoder tycker du fungerar bäst för att dina elever med svenska som andraspråk ska hänga med? Gör du några anpassningar i din undervisning?
10. Skiljer sig ditt undervisningssätt för elever med svenska som andraspråk och elever med svenska som modersmål? På vilket sätt?
11. På vilket sätt interagerar eleverna med varandra i matematikundervisningen?
12. Hur organiserar du din matematikundervisning vid arbetet med exempelvis problemlösning i en klass med elever med svenska som andraspråk?
13. Hur anser du att skolan kan använda arbetslaget och skolans resurser för att ännu bättre möta elever med svenska som andraspråk på deras individuella kunskapsnivå?

Appendix 4 Interview guide (English)

Background questions:

1. What is your education?
2. How long have you been working as a teacher?
3. In which/what year(s) do you work?
4. How long have you been teaching math?
5. How long have you been at your current workplace?
6. How many of your students in mathematics have Swedish as a second language?
7. Which teaching material or materials do you use in mathematics teaching?
8. Is the mathematics teaching in the classroom only in Swedish?
9. Do students with Swedish as a second language receive support in mathematics in their mother tongue?

Interview questions:

Research question 1: (What specific difficulties do students with Swedish as a second language encounter in mathematics teaching?)

1. What learning goals and abilities in the mathematics subject do you experience that your students with Swedish as a second language have the most difficulty in achieving?
2. What type of math difficulties do you experience that your students with Swedish as a second language often encounter?
3. Which parts of the mathematics subject are particularly difficult to understand for students with Swedish as a second language?
4. What methods do you use to discover what is especially difficult for students with Swedish as a second language?

Research question 2: (*What factors contribute to the difficulties in mathematics learning that students with Swedish as a second language encounter?)*

5. What factors do you experience that can cause difficulties in mathematics in students with Swedish as a second language?
6. How can you determine if the math difficulties have to do with deficiencies in language comprehension or have other causes?
7. Do you feel that there is anything other than language comprehension that students with Swedish as a second language have problems with mathematics teaching? If so, what?

8. Do you think that support in the student's mother tongue is a help or an obstacle in mathematics teaching? Why? Why not?

Research question 3: (*How do mathematics teachers in lower secondary schools work to make it easier for students with Swedish as a second language who have difficulties?)*

9. Which working methods and methods do you think work best for your students with Swedish as a second language to keep up with? Do you make any adjustments in your teaching?
10. Does your teaching method differ for students with Swedish as a second language and students with Swedish as a mother tongue? How?
11. In what way do students interact with each other in mathematics teaching?
12. How do you organize your mathematics teaching when working with, for example, problem-solving in a class with students with Swedish as a second language?
13. How do you think the school can use the work team and the school's resources to meet students with Swedish as a second language even better at their individual level of knowledge?

DEPARTMENT OF DEPARTMENT OF COMMUNICATION AND LEARNING IN SCIENCE
CHALMERS UNIVERSITY OF TECHNOLOGY
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