# How adult migrant students learn maths.

## Adult students understanding and engaging with maths.

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Key words: abstraction, adult learning, biographical learning, decimal numbers, difficulties in mathematics, educational research, general maths problems, language comprehension, maths anxiety, motivation, second language students and maths.

# Abstract

The aim of this study is to explore the adult immigrant students' experience of maths in Sweden. I will present an understanding rather than an explanation on how second language adult students learn maths. It can be argued that people who study maths as adults in a new homeland and in a foreign language face particular challenges. At the same time research reports that people sometimes approach the subject in a more fruitful way as adults compared to their childhood experiences. I want to contribute to the general knowledge of the subject and furthermore provide improved understanding of how mathematics teachers can guide their students towards their goals.

I have performed semi-structured qualitative research interviews. My informants are my own maths students on the basic level with incomplete grades in maths from secondary school, or they have failed in their maths studies in upper secondary school due to a low level of knowledge. They are over 20 years of age and they are all immigrants and have arrived in Sweden as adults. I have used my students statements, written as narratives as the material which is to be interpreted and understood. Because of my use of my own students in the interview, I will not take into account their statements about the teacher's role in my conclusion.

I find that:

1. The difficult experience of being forced to leave the home country, together with a wish to take revenge on the failures from their youth, can lead to a kind of struggle for decompensation that can be reflected in the participants' positive evaluation of their maths studies.
2. Having a family is a great motivational help for studying regardless of the time it takes to take care of the same.
3. The memories of previous failures with the incomprehensible, abstract mathematics characterise the students' inception of the subject.
4. It seems possible that adult students can understand themselves in a new way and redefine their relationship with maths and their own ability to study the subject.

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# 1 Introduction

## 1.1 Mathematics and adult learners

Mathematics is a multidimensional subject and a unique human conceptual construction. Despite its high degree of abstraction, the subject has a deep and vital relationship with the world around us, both in simple everyday phenomena and in advanced scientific matters. It is a basic science but also a powerful tool for many other sciences such as physics, engineering, economics and social sciences (Gustavsson & Mouwitz, 2002). It can be seen as a communication topic and as an art science in which language and images are processed (Adler, 2007).

Mathematics education in elementary school should provide a good basis for further study, work and lifelong learning, which is not always the case. Some students in upper secondary school state that although they have a passing grade from secondary school, they feel that their skills are insufficient for further studies (National Agency for Education, 2003). Sometimes school mathematics blocks the students´ informal mathematical knowledge; they perform worse after their education than before (Gustavsson & Mouwitz, 2002). According to the National Agency for Education (2012) the number of students that fail has increased during the 2000s and as a result many adults have poor knowledge of mathematics and need to supplement it if they want to continue their education.

In the county of Stockholm, the number of examinations for ADHD and autism spectrum disorders has increased by over 50 % in two years. One explanation is that the knowledge of different diagnoses has increased. Another reason is that the chances of being tested for disorders have increased. A third explanation is that the education has changed and makes new kinds of demands on students. This means that even children with mild learning difficulties are likely to develop symptoms. (http://skolvarlden.se/artiklar/diagnoshysterin-dubbelt-s%C3%A5-m%C3%A5nga-utredningar-g%C3%B6rs)

It is difficult to survive in modern society if you cannot count. A large amount of the daily information that reaches us through the media and in our workplaces needs to be interpreted mathematically. The mathematical choices and decisions are many and they must also be made relatively quickly (Ljungblad 2006). If not, the opportunities to get or keep a job weaken and a series of educational pathways will be closed. A destroyed self-esteem can have a spill- over effect and affect other domains, such as reading or writing. It seems likely that there is a correlation between numeracy and later success in life in terms of pay and job satisfaction (Lundberg & Sterner, 2002).

The world economy is undergoing rapid change. The relationship between education and work is changing in a global perspective as countries become increasingly interdependent. The Swedish society is changing from producing traditional jobs to a knowledge-based service culture. Information and communication technology, knowledge production and globalisation alter the structure and content of work. There is a gap between the knowledge produced through formal education and skills needed in the workplace. In order to remain competitive in the production sector continuous, lifelong learning has become important, for individuals as well as organisations (Hager, Holland and Becket, 2002).

> Lifelong learning is defined as "**all learning activity undertaken throughout life, with the aim of improving knowledge, skills and competence, within a personal, civic, social and/or employment-related perspective.**" ("Making a European Area of Lifelong Learning a Reality", November 2001, p.10 referred to from http://lll-portal.eadtu.eu/key-considerations/defining-lifelong-learning).

Learning is not confined to adolescence and some restricted periods of working life; rapid social change and knowledge mass growth and change means that much of the knowledge that a person needs in his/her life has not yet been developed when he/she goes to school (Gustavsson & Mouwitz, 2002). From the public point of view, our common democratic and humanistic values are continually challenged and technology constantly presents new demands on critical evaluation and knowledgeable handling of information flows.

Sweden has more than one hundred years of experience building and working with adult education. The training started when industrialisation and economics changed the society; adults needed to be trained to meet the changes, not least in order to learn the new rules of democracy (Ahlberg, 2001). Since then there have been a lot of changes. Komvux was established in 1968 with the aim of providing basic adult education and upper secondary adult education with the purpose of giving adults knowledge suitable for their working life and/or prepare them for further study. The public adult education system today comprises, besides municipally run adult education (Komvux), adult education for the intellectually disabled (Lärvux) and Swedish for immigrants (SFI). There is also advanced vocational education (KY) as well as supplementary educational programmes (http://www.regeringen.se/content/1/c6/08/00/78/8c84638d.pdf). In the autumn of 2006 adult education was incorporated in the new Education Act and the new curricula for primary and secondary schools (www.lararnashistoria.se). The new Education Act (applied to adult education from 1 July 2012) strengthens the individual perspective; the starting point of education should be the

individual's needs and circumstances. Those who have received the least education should be prioritised.

According to the National Agency for Education (2012) three out of ten students in adult education failed their exams in the first two upper secondary courses in mathematics in 2010. In addition, many students dropped out of the course at an early stage. One explanation is that education is not sufficiently based on the student's needs. Students in adult education sometimes have weak prior knowledge and need more support than what is offered. The short time span for the courses is a factor that are likely to contribute to poor achievement. Gustavsson & Mouwitz (2002) comment that some groups of adults easily fall out of the educational system, e.g. men with a brief educational background, people with reading and writing disabilities, older adults, the unemployed and some people with immigrant backgrounds. According to Statistics Sweden (2013) there is a fairly large proportion of the Swedish population that shows a low level in various areas of knowledge. This group includes people with short training and also many foreign-born.

Most of the students at my workplace who study maths on a basic level are immigrants. Before studying maths they were studying Swedish for immigrants. The number of students in SFI (Swedish for Immigrants) has risen sharply in recent years. In 2010 compared with 2003, the number of students has almost doubled.
(http://www.scb.se/statistik/_publikationer/UF0524_2011A01_BR_12_UF01BR1101.pdf)

I work as a mathematics teacher for adult learners. Most of my students are second language learners with a background in another country. Earlier in life I have worked in elementary and secondary schools as a teacher of music and maths. Many researchers describe the complexity of learning. I want my students to consider on what and how they learn and I am curious to know if they are reflecting and if so how. I also have a great interest in getting to know why some of my students drop out; many adult learners fail to achieve their goals of completing the basic maths course. Perhaps in several cases a better understanding of the students' problems from the teacher's side could make their maths studies improve. This has made me wonder what my students' approach to maths is.

### 1.2 Aim and Research Questions

The aim of this study is to describe and understand how adult migrant students learn maths, or more precisely: how they understand and engage with maths. It can be argued that people who

study maths as adults in a new homeland and in a foreign language face particular challenges. At the same time research reports that people sometimes approach the subject in a more fruitful way as adults compared to their childhood experiences. I have read in the National Agency for Education ´National quality inspections 2001-2002´ *"Desire to learn - with a focus on mathematics" (2003)*:

> Many adult students seem to be more positive to maths now than before and they are inspired by the fact that they can see concrete results thanks to their efforts. Success in maths builds their confidence, the teachers say. The fact that the students are successful in maths at the adult education gives us reason to believe that earlier difficulties had nothing to do with difficulties in connection with maths but were caused by other circumstances. (p 36, translated from Swedish)

The quote suggests that previous negative feelings towards the subject sometimes is replaced by a much more positive and fruitful approach. However, there is probably a variety here, with respect to peoples learning strategies and the way in which they make sense of their studies, the challenges and opportunities they face and the social resources that enable and constrain their engagement.

Assuming that an individual's engagement with a particular subject or challenge depends on how (s)he makes sense of his/her situation, thus I would like to explore how adult students engage with maths. Doing this I want to contribute to the general knowledge of the subject. Also, built on this understanding, it is possible for me and other teachers to improve our teaching.

My research questions are:

1. How do adult migrant students in Sweden understand and engage with mathematics as adults compared to their recollection of their previous engagement with the subject as children in their native country?
2. What particular challenges do adult migrant students in Sweden face and how do they deal with them?
3. What current social conditions and resources affect adult migrants' engagement in mathematics-studies?
4. What significance does knowledge of the Swedish language have for the ability to study maths?

Knowledge of what maths competence an adult needs is limited. According to Gustavsson (2010) those who are active in adult education experience that adult learning is an almost forgotten activity in both education policy and education science. Research on adults' maths learning in Sweden has, according to Gustavsson & Mouwitz (2002), not been widespread. Hopefully the results of this study will add to the understanding of how adult students think when they learn mathematics as adults and furthermore provide improved understanding of how mathematics teachers can guide their students towards their goals.

### 1.3 Key concepts

*Abstraction comprehension (decimal numbers and problem solving tasks):* Examples of a higher level of abstraction are decimal numbers (integers followed by more digits after the decimal point). There are different types of problem-solving tasks: everyday problems, problems related to other topics as well as routine tasks and multi-step problems. The difficulty is finding problem tasks that are perceived as factual by all students. Many students give up and leave the problem if it cannot be solved within the next ten minutes (Möllehed 2001).

According to Butterworth & Yeo (2004) it is well known that mathematical activities can cause *anxiety.* This is specific to maths and not to generally difficult tasks. Anxiety in itself is known to inhibit performance in a variety of cognitive functions, including working memory. Emotional blockages are, according to Adler (2007), probably the single most important factor that can lead to students consolidating experiences of failure in learning.

*Biographical learning* is a concept which describes how we constantly recreate and shape our lives, developing new understandings when we have new experiences. It can be understood as the ability to tie life together. In our time each individual creates a course of life and thereby they develop identity. According to Alhetit and Dausien (2002, referenced in Larsson, 2013), this ability to create biography help people not to become helpless. The narrative is an important tool for biographical learning.

*Biological explanations: 1) Diagnoses;* Dyscalculia (according to Butterworth (2000) a lack of basic numbers comprehension that makes it difficult to compare different amounts, remember and achieve numeracy and perform mathematical operations.), Dyslexia (difficulties in learning how to read, spell and understand a written text.) ADHD, ADD, ASD (problems with e.g. concentration and attention). *2) General maths problems* (cognitive building blocks) are, according to Lundberg & Sterner (2009), a common concept that includes difficulty reaching

the goals of the basic school curriculum in mathematics. Problems with a wide range of cognitive building blocks indicate that the student has general mathematics difficulties (Adler, 2007).

*Constructivism* is a dominant paradigm for how to look at learning and teaching in international mathematics didactics, both as a research field and a field of knowledge (Engström, 1998). Through social interaction negotiation of meaning occurs; a common knowledge. Teaching is always in a social context and is influenced and limited by this.

*Language comprehension:* Some words in the Swedish language have an everyday meaning and a mathematical significance. When students encounter the word in its mathematical sense, there is a risk that they interpret the word in its everyday meaning. Many students read through the task quickly without caring much about analysing the text and instead they quickly start to work on the problem. They focus on particular words, so-called signal words that signal which arithmetic operation should be selected (Lundberg & Sterner, 2002).

Adults are considered to have an intrinsic *motivation* to grow and develop. Those who have not have been found to have a motivational problem (Ahl, 2004). According to Ahl (2004) and Gustavsson & Mouwitz (2002), there are differences between adolescents and adults that make it appropriate to have a special adult education; adults need more flexibility in relation to their life situation and their experience in and relation to other learning environments, like a workplace.

When analysing my informants stories I will use their statements, written as *narratives* as the material which is to be interpreted and understood. Narratives may occur in response to closed as well as open-ended questions (Mishler, 1986).

# 2 Previous research

An adult has lived many years and has had different experiences that may affect the present. There are sociological factors and emotional dimensions to be aware of. The teacher is important for the learning. Maybe the student has got some kind of disability or diagnose. I have searched the literature to find out what the common causes of maths problems are and what the common approaches to maths for adult students are.

## 2.1 The adult student

According to Gustavsson & Mouwitz (2002), the participants in adult learning are heterogenic in terms of prior knowledge, different goals and objectives for their studies, age, professional background, family, socio-economic conditions, ethnicity, and also of different attitudes and motivation for studies. Common to most of the students is that they have reached a greater maturity and a sense of security in adulthood. This, coupled with the need to study for future work possibilities, can make them dare to try working with maths again. A problem for adult students is the responsibility for the everyday life for him/herself and maybe for a family. Many of the students work extra in order to support themselves. According to Assarsson & Zachrisson (2005) adults take part in education for various reasons; they need the skills, have to qualify for study or work, for self-realisation, or need to make a living.

According to Östergaard Johansen (2006) there are four reasons to provide adults with mathematics education: preparing them for further education, giving them equal rights and possibilities to take part in education, strengthening prerequisites of the adults to participate actively in all aspects of life within society and giving them good numeracy skills provide them with an increasing ability to perform in all areas of life. What the students in adult education need is changing over time and it is both the needs of society and the individuals that should guide the variety of courses in adult education. In order to meet students' needs and establish good study opportunities for adults, there must be sufficient flexibility in the studies offered (http://www.skolinspektionen.se/documents/om-oss/dokument/olika-elever-samma-undervisning.pdf).

## 2.2 Pedagogical/educational factors

### *2.2.1 The teacher*

Teaching is culture bound - visible when comparing how education works in different countries. Teachers have a legacy from their own school days, which is often passed on to the next generation of teachers (Löwing, 2006). Ethno-mathematics is, according to Rönnberg & Rönnberg (2006), the mathematics practiced by identifiable cultural groups in society. Maths is regarded as a universal human activity, but also as a cultural product; each culture develops various tools to manage tasks such as counting, measuring, designing, classification and generalisation. With the increasing globalisation different mathematics cultures are approaching each other. There are significant differences in how skilled teachers are to help students and there are different views of what maths difficulties are and what to do about them. The Natio-

nal Agency for Education (2003) states that the teacher is the most important factor for the desire to learn. The teacher's commitment and ability to motivate, inspire, and be able to convey that knowledge is a joy in itself is essential. In order to optimise the interaction between the student and the teacher, it must start in the student and teacher requirements; students have different needs and teachers have different skills.

One of the difficulties with diagnosing numeracy problems is, according to Lundberg & Sterner (2009), to find a method to exclude inadequate teaching as a possible explanation for students' low mathematics achievements. The students may have got the wrong kind of help, worked for long hours or at too high a level. Gustavsson & Mouwitz (2002) emphasize the teacher's crucial importance for learning to happen. Learning scientific concepts presupposes a conscious guidance and regular dialogue with the teacher where the subject matter is in focus. The teacher must be able to identify what core concepts and theories in a field are and also have the knowledge of how to challenge the participants' thinking (National Agency for Education 2003). Fenwick & Tennant (2004) argue that

> "… the `learner` is not an object separable from the `educator´ in teaching-learning situations. The positionality of the educator (whether as expert, coach, liberator, observer, arbiter, commentator, guide, decoder) affects how learners perceive, feel, behave and remember." (p. 55)

One must, according to Löwing (2006), be clear about not only what goal each student is supposed to reach, but also whether the student in question has knowledge enough to be able to achieve this goal. If not, the communication will miss the target and the students' exchange of the initiative is bound to fail. Fermsjö (2009) argues that since the special education provided is procedure oriented and simplified, students have no opportunity to develop their knowledge of mathematical concepts. Adler (2007) notes that school mathematics content has not changed very much over the past few decades, although other knowledge areas such as cognitive psychology, neuropsychology and educational research have revealed a number of shortcomings in teaching methodology such as premature introduction of abstractions, overloading of students' working memory, using the textbook as a guide for teaching, too little communication between the students, too little logical thinking and problem solving. According to Lundberg & Sterner (2002) many classrooms are dominated by teaching mechanical skills, which could be devastating for students with limited memory.

One factor that is often mentioned in adult learning is the compressed and pressured mathematics courses. The course moves forward too fast and the student do not understand and cannot keep up with the pace of the class. The student believes he/she is alone in this situation and then puts the blame on him-/herself (Gustavsson & Mouwitz, 2002). Typical problems with fast study tempo are the students who have; general problems with mathematics, difficulty finding the abstract level or problems with language comprehension.

### *2.2.2 General maths difficulties*

Mathematical disorders can be divided into general and specific. The students with general mathematics difficulties have problems with a wide range of cognitive building blocks (Adler, 2007). These students are quite consistent in their performance from moment to moment and from day to day. They need more time in the learning process itself and simplified teaching materials. One cannot, however, scientifically demonstrate that it is possible to use the students IQ as a criterion to classify maths problems or to find the right educational measures (Lundberg & Sterner, 2009).

According to Adler (2007) students with maths difficulties have difficulty with: *1. Reading* (mix up similar numbers, perceive distance between numbers incorrectly, difficulty recognising and thus using arithmetic symbols like the four operations, problems with reading directions and reading maps, diagrams, or tables) *2. Typing* (difficult to reproduce figures or geometric shapes from a given model) *3. Language comprehension* (described later) 4. *Series of numbers and number facts* (hard to organise numbers by size, gaps in memory in terms of numerical facts as multiplication tables, problems with mental arithmetic, problems to count backwards in steps) 5. *Complex thinking and flexibility* (planning skills, logic and problem solving).

Complex thinking and flexibility are strongly linked to perception. It is about: *planning skills* (being able to pick out the right information from the text,) *logic and problem solving* (the ability to think in a well-defined sequence, multi-steps to a solution). According to Lundberg & Sterner (2009) it is obvious to everyone that we need to keep things in our head when we count. In mathematics, it is often a case of several steps. The student must keep in mind a subtotal as he/she moves forward and this memory storage has its limitations; s(he) needs to mobilise all s(he) has got as far as concentration and attention are concerned.

### *2.2.3 Abstract thinking*

The mathematical world consists of arithmetic, where we expect and outline how many things come in a set, and geometry in which we describe one, two or more dimensions of a three-dimensional space. Numbers are unique tools and we do not read the numbers without interpreting them mathematically in our mathematical world. Without understanding that the numbers and letters are fundamentally different tools, we cannot understand the completely different difficulties that may arise in working with them (Ljungblad 2006). Butterworth (2000) argues that the primary goal of mathematics education is to get students to understand the abstractness and uniformity of arithmetic. Being able to enumerate sequences (as in a table) does not mean that the students understand what the components mean.

An important example of increased abstraction level is the transition from integers to decimal numbers, which have a completely different structure. Another example is the units we use for each dimension, such as meters for length, along with the decimal multiples and fractions. Maths students learn how to switch between the different units without always having to care about the reality of what is measured, something that may not be relevant in the calculating at the moment. At the same time, students have difficulties estimating the relevance of the solution.

A critical factor that teachers must help the students pay attention to is the structure of the problem solving tasks. The student have to identify a task that on the surface may look different but mathematically is the same problem type as they have solved before. Some students find it difficult to translate an everyday situation into a relevant written expression with mathematical symbols even if they understand the situation. It requires different skills than solving a task that is already expressed in symbolic form. Some experts talk about schemas; a category of many text items that are similar in structure and that help us recognise different types of problems. The more types of problems with the same structure that we have faced, the greater the possibility to discover links between previously known and new, unknown text data belonging to the same schema. A key concept in schema theory is the ability to transfer; to use old experience, knowledge and skills in new situations (Lundberg & Sterner, 2009).

Gustavsson & Mouwitz (2002) stress that perhaps because of the teachers' failure to explain the abstract nature as well as the purpose and character of mathematics, the students get a negative experience of the subject. The student must choose the right strategy for problem-solving, change strategy if a solution does not work, follow the steps in a mathematical cal-

culation, do feasibility assessments and determine whether the answer and the calculation are reasonable. Keeping a thread when solving maths problems includes the ability to retain solutions that work and switch from a concrete level to more abstract thinking (Adler 2007).

### 2.2.4 Problems with language comprehension

The National Agency for School Improvement (2008) stresses that a significant proportion of students today has a multilingual background; they use two or more languages in their everyday lives. Ramsfeldt (2006) stresses students with an immigrant background more often have difficulties in reaching the goals in maths compared to students with a Swedish background. According to Lundberg & Sterner (2002) students may understand mathematical concepts in their home language but not in Swedish. There might be problems if the students must express their knowledge and solve mathematical problems only in a language they do not master. If the students do not fully understand the language, they have to spend a lot of time on encoding the text. A well-developed language is a precondition for all other learning, also in mathematics. By using language to develop mathematical concepts students become aware of their skills and how to learn (National Agency for Education, 2003).

Reading mathematical texts is demanding on students' reading comprehension; an event or situation has to be translated into abstract mathematical symbols and models (Lundberg & Sterner, 2002). Sentence building can be complex and the students are expected to generalise ideas from single examples. The student must acquire the ability to create internal representations of textual content; information provided at various points in the text must both be integrated with each other and integrated with background information and past experience and knowledge that the reader has. Solving the text data in mathematics requires good reading skills and understanding of operations with numbers, being able to do calculations and identify the underlying structure in the text and to use the knowledge in new situations. Students who are good at doing arithmetic calculations are not necessarily those who are good at solving text data. Examples of other factors that are related to students' ability to solve text data is: working memory, attention, reasoning ability, ability to identify words and listening comprehension. Also the inner speech is important to create internal representations of the content and to keep current information in memory.

The preconceptions that students bring with them are crucial to their understanding of the text in a maths task. If the text data is linked to Swedish traditions and cultural conditions, maybe

some of the second language students do not get the same support in the text and thus not the same help to solve the task (Agency for School Improvement, 2008).

## 2.3 Disabilities and diagnoses

### *2.3.1 Specific difficulties in mathematics; dyscalculia*

A term that is increasingly being used in the community when speaking of specific mathematics difficulties is dyscalculia. Dyscalculia is, according to The Health Guide (2014),

> "... when you have specific numeracy difficulties that do not have its basis in a generally weak talent or lack of schooling." (Translated from Swedish)

Butterworth & Yeo (2004) argue that in general it is agreed that children with dyscalculia have difficulties in learning, remembering numbers and performing mathematical operations. Lundberg & Sterner (2009) propose that the term should be reserved for a neurobiologically based deviation that can lead to a poorly developed idea of numbers which leads to problems making calculations. In practice it is difficult to determine whether an individual has dyscalculia or mathematical difficulties for other reasons. Butterworth (2000) argues that a person has dyscalculia when he/she lacks the idea of basic numbers. This is a congenital disability that makes it difficult to compare different amounts, remember and achieve numeracy and perform mathematical operations. He argues that we are born with brain circuits that specialise in identifying amounts up to 5. According to Adler (2007) mathematics work concerns the entire brain. He believes that a person can be cured of dyscalculia; the diagnosis should be viewed as a description of the current situation to a maximum of one year. Total inability to count he calls ´akalkyli´; the individual is unable to manage numbers on an understandable level. Such difficulties are according to him due to a language disorder that affects the understanding and ability to substitute a concrete amount in figures and numbers. This group of students makes up only a very small portion of the total group that exhibits problems with their learning of maths. Adler also uses the term pseudo- dyscalculia; an emotional blockage of the student.

Sjöberg (2006) has made a multi-method study of compulsory school students with mathematics problems from a longitudinal perspective. He does not see dyscalculia as the main problem. The conclusion of his review is that…

> "…. the concept of dyscalculia ought at present to be used with great caution, or perhaps not at all."

He sees a great complexity of the problem area:

> "The low work input of the pupils during mathematics lessons, an unsettled working environment, large classes, problems of stress and anxiety prior to tests, and obstructive gender patterns are among the causes suggested by the pupils as explanations of the occurrence of the mathematics problems. Good teachers, in other words teachers who can explain, set limits and give encouragement, were significant factors in reversing the downward trend. Positive experiences of school changes, where the pupil felt that he or she could start again from the beginning, were also mentioned as significant by several pupils. Collaboration with fellow-pupils and the fact that the pupils themselves decided to come to grips with the problems were other important reasons for the change." (Abstract)

Butterworth (2000) argues that differences in mathematical ability, provided that the fundamental numeracy module has developed normally in our mathematical brain, is entirely dependent on our ability to learn the maths provided in our culture. The brain gets bigger if it is trained and its cells become more densely interconnected. More purposeful exercise leads to better performance. I would like to point out that Butterworth and Adler mostly refer to studies on children in their research. Butterworth also refers to adults who have had brain injuries.

### *2.3.2 Dyslexia and maths*

A person with dyslexia has difficulty learning how to read, spell and understand a written text. It is often hereditary and the difficulties to understand written language are often discovered at an early age. (http://www.1177.se/Skane/Fakta-och-rad/Sjukdomar/Dyslexi/). Many researchers have claimed that difficulties with maths learning depend on a weakness, or a combination of weaknesses, in more general or fundamental cognitive systems like short-term or long-term memory, ability to sequence, language ability, or spatial abilities. Dyslexic people often have problems with short term memory and language. They also have difficulties with attention and organisation problems all of which could delay mathematics learning as well as the learning of other subjects. Learning to understand the meanings of mathematical symbols may involve several problems for students with reading and writing difficulties. Students with reading disabilities often have difficulty learning new words and concepts. Text data in mathematics, where a problem is embedded in a natural context described verbally in writing, may pose unbeatable difficulties for a person who finds it difficult to identify words and understand the meaning of a text (Lundberg & Sterner, 2009).

### *2.3.3 ADHD, ADD, ASD*

There are many diagnoses that can cause problems when learning maths: a person with ADHD (Attention Deficit Hyperactivity Disorder) has difficulties with concentration and attention, is easily disturbed if a lot is going on and may have problem with: reading and writing, certain movements and taking instructions. Some have frequent mood swings or difficulty with social relationships. ADD is like ADHD without hyperactivity. Instead, they have difficulty getting started with activities and getting things done. Adults who have ADHD have difficulty with concentration, finding strategies to structure work and organising daily life. ASD (Autism Spectrum Disorders) is used as a generic term for various types of autism with varying difficulties. An adult with autism can experience great difficulties in everyday life, for example, feeling isolated, having difficulty organising life or having difficulties with social interaction within the family and with the community. (http://www.1177.se/Skane/)

## 2.4 Sociological factors

Gustavsson & Mouwitz (2002) stress that previous experience of school mathematics content and working procedure is crucial for the adult's approach and attitudes to mathematics later in life. The teacher's approach when meeting with the students is of great significance for their willingness to return to studying as adults.

Inadequate support and stimulation in the home can contribute to mathematics difficulties. Other causes could be students missing their mathematics lessons because of, e.g. illness, or they may have been victims of mal-treatment, abuse, neglect, frequent moves, changes of foster care and changes of school. The students may have received too little stimulation during the preschool period or have a phobia (Lundberg & Sterner, 2009). Ramsfelt (2006) stresses that it is common to blame the student, the parents or the culture when the individual has not been successful in school, when the focus instead should be turned towards the structures of society, such as education and labour market.

Engström (1998) stresses that a teacher cannot give any student knowledge, but he/she can influence the student. The social interaction between the student and the teacher is significant. But how this interaction is perceived and interpreted by the students is nothing the teacher can control. The interpretation and the construction the student accomplishes are always personally meaningful.

## 2.5 Challenges

### *2.5.1 Anxiety*

Many adults have strong blockages and in some cases resistance when facing mathematics (Gustavsson & Mouwitz, 2002). It happens that providers of adult education assume that students have unpleasant experiences from school or are unaccustomed to studies (Assarsson & Zachrisson, 2006). Being anxious is the normality and becomes legitimised in this way. According to Butterworth (2000) to cope poorly provokes unease, uneasiness leads to avoidance of mathematics, avoidance leads to poor performance, which in turn induces more uneasiness and possibly a phobia towards mathematics including increased heart rate and sweating. Anxiety to perform well enough in school depends not only on doubts about the student's own ability, but also on self-doubt as a person (National Agency for Education, 2003).

Maths anxiety troubles a substantial percentage of the population (Ashcraft & Moore, 2009). The higher one´s level of maths anxiety, the fewer maths courses one takes, and this of course influences decisions on a college level concerning career paths. Participants with medium and high maths anxiety respond quite slowly, compared to low-anxiety participants whenever asked to perform beyond the level of single-digit arithmetic. The anxious individual uses his/her working memory resources worrying and the load on the memory when given a maths task becomes even more intense. According to Ashcraft & Kirk (2001) research show that individuals with high math anxiety demonstrate smaller working memory spans. This reduced working memory capacity leads to lower levels of performance in maths or maths related tasks.

In research by Giannakopoulou & Chassapis (2012) concerning anxiety towards doing maths experienced by adults who have returned to school, the scientists have assumed that negative emotions and mathematics anxiety drive individuals to avoid learning and use mathematics, and also to exclude themselves from participating in many aspects of social, cultural and civic life. Finally it becomes a constituent aspect of their mathematical self-determination. The researchers distinguish two dimensions of mathematics anxiety on the basis of its context. Maths anxiety related to 1) mathematical/numerical activities of everyday life situations like use of elementary arithmetic skills in practical situations and skills necessary for making money decisions and 2) mathematics anxiety related to school mathematics; lessons, textbooks and examinations. A significant number of adults report that they feel no anxiety carrying out numerical activities in everyday life, but situations of personal anxiety have been reported when the adults carry out activities related to school mathematics. The anxiety is much stronger in problem solving situations related to school evaluation tests and exams.

According to the participants in the research, the sources of their anxiety were related to their difficulties in understanding mathematical texts, their negative experiences from school mathematics and their lack of confidence when answering mathematical or numerical questions. They feared disapproval from others and had a feeling of shortcoming concerning their mathematical knowledge. They believed school mathematics was useless outside the school contexts. According to Lundberg & Sterner (2009) the feeling of inadequacy can accommodate the feeling of worthlessness; not being good enough. The overwhelming difficulties may cause anxiety and despair. But one can also develop strategies to avoid these feelings. In an effort to preserve self-esteem mathematics can be degraded to something irrelevant and meaningless; not worth the energy.

The scores for maths-anxious persons are lower than their true ability (Ashcraft & Moore 2009). According to Lundberg & Sterner (2009) there is a link between working memory and perceived stress. A student who is asked to implement a mathematical solution process step by step to the entire class may develop anxiety and feelings of panic about not mastering the situation.

### *2.5.2 Motivation*

The National Agency for Education (2003) argues that the pleasure and joy that arise with the feeling of success in anything is highly motivating. Conversely, students who meet consistent failure in school work, especially in mathematics, quickly lose motivation. Information given at the right level challenges the students' abilities optimally and supports their motivation and desire to learn. Confidence in your own ability to learn mathematics appears to be the most important factor in the desire to learn. The probability of completing a task in a teaching situation is greater if the student believes he/she will succeed. Butterworth (2000) argues that students who like mathematics perform better on maths tests than those who feel badly about the subject. To have fun with maths is to realise the connections between different facts, different ways to solve a problem and different ways of thinking. That is how the greatest mathematicians, but also the rest of us, make progress; by being creative. According to Håkansson & Sundberg (2012) there are links between motivation and clearly communicated expectations. The teacher's strategies are important; research shows that motivation can be enhanced if the teacher can assign more responsibility to the students for their own learning.
Ahl (2004) argues that there is a crucial difference between adult learning and children's learning; youngsters are obligated to go to school. There is nothing that contradicts that the theories of child and adolescent learning also could be applied to adults, but there is more to it;

adults find themselves in a different life situation with completely different requirements, constraints and opportunities than children. Participation is voluntary and there are competing demands from family and work. There may be a problem keeping the adults in the studies. Learning needs to be linked to clear objectives, which are perceived as a desirable value, interesting and valuable. There will be negative effects on learning if adults feel they are forced into training (Gustavsson & Mouwitz, 2002).

According to Gustavsson & Mouwitz (2002) self-confidence and motivation are important for the development of an individual's cognitive abilities. By giving attention to informal adult learning in education, the individual's self-confidence and belief in his/her own abilities are strengthened. A vital issue for adult education is how to recognise and appreciate the adults' often substantial learning in non-formal and informal settings, such as working life, family life, and the voluntary sector and leisure activities. The adult's math skills are often valued only in relation to the school mathematics curricula, which puts the adult in a humiliating situation relapsing into "Back to school". By paying attention to and validating the adult's informal knowledge in a more flexible way, the confidence and motivation can be strengthened and lingering mathematics anxiety and blockages might be lifted.

Important factors for students maintaining the desire to learn is the comprehensibility and relevance in the mathematical content. Many students express that they neither understand maths nor how they will benefit from it. Once the content is not perceived as meaningful and the students do not understand what they are working on, it is hard to maintain interest and motivation for the subject (Rönnberg & Rönnberg, 2006). According to Ahl (2004), motivational problems can be seen as lack of discipline. She also believes that there is a correlation between social aspirations and an approach to training where class belonging can cause an individual to believe that it is not for him/her to participate in higher education. Butterworth & Yeo (2004) stress that many people think difficulties with basic maths is due to stupidity or lethargy, which reminds them of how reading disabilities were looked upon 20 or 30 years ago.

Gustavsson & Mouwitz (2002) argue that it is regarded by many as a sign of intelligence to succeed in mathematics, a way of sharpening the intellect. Negative school experiences in adolescence shape adults' self-image and self-confidence. This is especially true for maths learning. The researchers reflect that given the blockages many adults have developed in relation to maths, it is remarkable that adults still come back to maths studies and are prepared

to make great personal sacrifices to study the subject. One explanation may be the need to take revenge on the failures from their youth.

# 3 Theoretical framework

There are many ways to understand people´s successes and difficulties when studying maths. The teacher is important, but also the students environment. Some people seem to have a tendency to easily become anxious in the face of data that are difficult or overwhelming. The desire to learn is essential. In this chapter I will describe different ways to understand my research problems.

The aim of the study is to present an understanding rather than an explanation to how second language adult students learn maths. Following an interpretative epistemology, I want to grasp the subjective meanings people create when studying maths as adults. The rationale behind this theoretical outlook is that people understand and engage with the world in different ways and that our ways of relating to the world depend on how we understand and manage to make sense of our situation. At the same time, however, I will also pay attention to important conditions that affect people and their maths-studies, both educational (the teachers roll, abstraction- and language comprehension) and sociologic factors (in what way the students´ backgrounds affect them) as well as emotional (the students´ desire/anxiety to learn). I will also mention biological factors (different diagnoses and general maths problems) because they are contemporary models of explanations to maths problem. In order to create a broad understanding I will present and pay attention to resources from a number of theoretical traditions.

## 3.1 Constructivism

There are theories which place *an emphasis on the teachers' actions*. *Constructivism* is a dominant paradigm for how to look at learning and teaching in international mathematics didactics, both as a research field and a field of knowledge (Engström, 1998). Constructivism is both an epistemological position and a pedagogical philosophy. Constructivistic teaching is based on the opinion that the student uses what he/she already knows to develop personally meaningful solutions and sees mathematics as a cultural and social manifestation. According to v Glasersfeld (1989, red 1998) Jean Piaget was the most productive constructivist in our century. He believed that knowledge is an adaptive function; knowledge is never acquired passively. Among mathematics didactics there is a growing consensus that maths should be

seen as a social construction. In every classroom a mathematical culture is established through the way in which students can meet and make use of mathematics (Engström, 1998). The teachers' lack of subject knowledge or lack of connection to the student´s experience as well as false teaching methods can be devastating for the student. In my study I will use constructivism as my epistemological position and as a background explanation to my pedagogical philosophy. As a teacher in the constructivistic tradition I am interested in examining the students' *abstraction- and language comprehension* e.g:

- The abstraction of decimal numbers; of two decimal numbers always one is greater than the other, but there is no single, unique, number to follow (Butterworth, 2000).
- The abstraction of problem solving tasks; for different reasons the students are missing the implied meaning and structure of the text. This has an effect on the students´ thinking when working on the actual maths problem (Lundberg & Sterner, 2002).

### 3.2 Biological theories

Some biological theories place an *emphasis on a person's individual characteristics*; the students' difficulties are linked to a brain injury or other physical or mental disabilities. The neuropsychological researchers Adler (2007) and Butterworth (2000) study their patients' cognition, working with *specific difficulties* in mathematics and especially the diagnosis *Dyscalculia*. If a student has problems with a wide range of *cognitive building blocks* they are likely to have *general maths difficulties*. The building blocks are (Adler, 2007): 1) numbers and numeral order 2) number concepts (greatness, comparisons, ordinal numbers) 3) the ability to switch between numbers and amounts 4) moving between the numbers in the number system and on the number line and compare different sizes, positions, systems 5) working memory and attention 6) perception (how to processes and interpret information from the sensory organs) 7) spatial ability (the ability to imagine, to see the options and opportunities in advance, how we perceive the world around us) 8) planning skills 9) time perception 10) logic and problem-solving (the ability to think in a well-defined sequence, in several steps, until a solution). I will only brief mention biological theories.

### 3.3 Anxiety

Some theories are about *the challenges the students are exposed to*. According to Giannakopoulou & Chassapis (2012) *anxiety* is a psychological and physiological state of a person characterized by somatic, emotional, cognitive and behavioural components. According to Ashcraft & Moore (2009) mathematics anxiety is a person´s negative emotional reaction to circumstances concerning numbers and mathematical calculations. It is a feeling of tension; an

anxiety that hinders the handling of numbers and the solving of mathematical problems in a diversity of regular life and academic situations.

### 3.4 Motivation

There are also theories about *the desire to learn*, using the concept *motivation* in order to explain maths problems. The research is generally about obstacles for motivation:

> Theories specifically about motivation and adult learning are chiefly concerned with obstacles for such motivation. They rest on humanistic psychology and assume that adults have a natural disposition to learn, which will flourish once obstacles of various kinds have been removed. (Ahl 2004, Abstract)

The obstacles can be: lack of confidence, lack of information, absence of appropriate courses or difficulty in combining study with family responsibilities, previous school experiences providing a negative image of education or negative identification with a social group. It could also be lack of time, interest or concrete expected results of the studies. Deficiencies on the structural level can be lack of accessibility to a school, information on study opportunities, childcare facilities, student funding, scheduling problems or a pedagogy that is not designed for adults' way of learning. Structural barriers of a general nature can be social norms or the idea that education does not lead to a better job. Maybe there is no reason to study according to the student.

### 3.5 Biographical learning and narratives

The adult mathematics students are affected by various *environmental (sociological) factors* both in their present and in their past lives and their backgrounds play a big role in who they are today. There may be a connection between their parents' level of education and students' school performance. Bron (2005) and Alhetit and Dausien (2002, referenced in Larsson, 2013), use the German sociologist and adult educator Alheit´s (1995) concept *`biographical learning´* in order to describe how we constantly recreate and shape our lives in the context of our environment. We interpret and understand an event or incident in the moment we are making our experiences. It affects our perceptions of ourselves and our actions in the world we live in making us not standing helpless. They also found that people in the danger zones - unemployed youth, women after a divorce, teachers out of work, immigrants - are pretty good at dealing with the collapse of traditions. We are able to make different choices, and through education and self-reflection we can influence the external circumstance which in turn leads to new knowledge. The language, initially the mother tongue, is crucial for the development of this

skill; it provides the conditions and the structures that are needed to create stories - narratives. It can be most difficult to learn via the new language environment, which also includes non-verbal communication (Bron 2005, with reference to Bron 2000, Bridge & Lönnheden 2004).

In order to make sociological factors visible I will use the concept *biographical learning;* in the light of new experiences and events new meaning is given, using the narrative as an important tool. Changes in society can undermine old identities like fundamental questions about who we are and who we aspire to become. Adults actively contribute to shaping their own identities and studies become a tool to try to take a hold of their own lives and find new ways that correspond to changes in society. I will use the context biographical learning when I examine anxiety and motivation.

With the purpose of finding the theory behind the informants' stories I will use their statements, written as narratives, as the material which is to be interpreted and understood. Narratives may occur in response to closed as well as open-ended questions. Mishler (1986) stresses that telling stories is one of the significant ways individuals construct and express meaning. The story is a joint production; the interviewer´s presence and form of involvement is integral to the response of the interviewee. Both questions and responses in the interview are formulated in, and then developed through, the dialog between the two involved.

# 4 Methodology

## 4.1 The researcher and the target group

My informants are my own maths students on the basic level with incomplete grades in maths from secondary school, or they have failed in their maths studies in upper secondary school due to a low level of knowledge. They are over 20 years of age and they are all immigrants and have arrived in Sweden as adults.

My students are very respectful and they want a good grade in maths; sometimes they do not tell me when they do not understand my explanations of the maths they are exposed to. I can speculate about the reasons; "I have never been able to understand – best not show that to the teacher", " I will understand from the context later on", "it is probably not that important", "I will ask a friend instead". In the end it is I who will judge their performance and give grades -

maybe they do not want to tell me how they feel. This has made me wonder what particular strategy concerning maths studies my students' have. Also I am curious about; if they reflect and if so in what way as well as why a lot of them drop out without finishing the course. This has made me wonder about my students' understanding and engaging with maths.

### 4.2 Ethics and bias

After giving information about my research to the students, I asked them if they wanted to participate. According to "Ethical investigation principles in social science research" (Vetenskapsrådet, 1990) I had to inform my students about the purpose of the research, what methods I was going to use, their right to choose to participate, and also that no unauthorised persons would access to the information. Likewise they had to know that the information they provided me with only would be used for my research. I produced an information sheet that the students could sign concerning this matter.

There is an advantage in using my own students in the interviews; the students know me and are used to me working with them - we have common experiences. They know how I use the mathematical language and it means that we avoid many misunderstandings. The students who accepted the invitation to participate in my investigation trusted that I would treat them and their history in a respectful way. On the other hand, I cannot take into account the students statements about the teacher's role in adult studies without risking bias.

Another disadvantage could be that the students were dependent on me for giving them grades and there was a risk that this would affect what they said. According to Dalen (2008), it can be difficult to find the right balance between closeness and distance between the researcher and the informant. The researcher has the ascendancy and the power, both linguistically and symbollically, through the cultural capital he or she possesses. This becomes especially important when interviewees are talking about difficulties. She also argues that the researcher's solidarity with the interviewees may pose a methodological problem, especially if the researcher has chosen to study a topic that he or she is touched by. In my case I do like my students and I want them to succeed, but on the other hand, I have been a teacher for twenty years and I am used to looking at the criteria for the subject instead of listening to my feelings towards the student.

Dalen stresses some central difficulties that I have considered in my analysis – the researcher:

- feels that he/she knows the area so well that the interpretation of the events and statements is based on an incorrect understanding.

- is so very familiar with the field of study that he/she has trouble seeing features and special characteristics.

According to Mishler (1986) analysis and interpretation of the interview are based on discourse and meaning; it is the informants' own perceptions and perspectives that form the basis for the analyses. But the interviewer has the power to respond to and reformulate the original question or accept the answer and this affects the answers that the respondents give. Reliability in quantitative research assumes that the methods for the collection and analysis of data in an acceptable way can be validated by other researchers. In a qualitative study like this the researcher's role is an important factor, developed in interaction with the informant and taking the current situation into account. Motivated by Mishler and Dalen (2008) I have sought to be accurate in the descriptions of the individual stages of the research process; the interview situation and also the analytical procedures used while processing the data material.

### 4.3 Data collection

I have performed a semi-structured qualitative research interview in order to describe my students' approach to studying maths as adults; getting the story behind the students' experiences and maybe finding changes in the students' general approach. I was also interested in the students' particular strategies in their studies. Inspired by Bryman (2012) I designed an interview guide in order to ensure that the same general areas of information were collected from each interviewee, but still allowing a certain degree of freedom and flexibility in giving the information; I could vary the order of questions or ask new questions that followed up the replies from the interviewees. The guide included my students' backgrounds, perspectives and feelings towards the subject. The interview guide is presented in the appendices.

Before the interview, which I recorded, the students performed a mathematical test (presented in the appendices). The students got their tests back as the interview started and at that moment they got the correct answers. The test served two purposes:

1. The test would set the agenda; the focus was taken from the interview. This kind of conversation is natural for me and my students, we are relaxed and do what we usually do – talk about them and their progress. Hopefully this made it easier for the students to perform the interview; an atmosphere of trust from the start.

2. The students could comment directly on what was easy and what was not. We started out talking about strategies; I was able to see if they had a deep or shallow understanding.

Besides the recorded interview I noted background variables; factual information, such as the informant's age, gender and for how long (s)he had been studying maths in Sweden and as adults. I asked them how many years they had studied mathematics as youngsters and at what level, their parents' occupation and educational level as well as for how long they have been in Sweden.

### 4.4 Questions for the interview

According to Mishler (1986) an interview is a speech event and the discourse of the interview is constructed jointly by interviewer and respondent. The way I was asking the questions in the research interview drew upon my everyday understanding of the language. Mishler suggests that

> "… the varied and complex procedures that constitute the core methodology of interview research are directed primarily to the task of making sense of what respondents say when the everyday sources of mutual understanding have been eliminated by the research situation itself" (p. 3).

In order to find the students´ technical approach to maths I gave them a maths test. The content of the test was a revision of what the students had previously studied with me. Since algebra and geometry are the last parts of my course, I chose not to include any of them. Also percent and statistics are later parts on in the course and all the students had not had time to learn it. Therefore these areas were considered only briefly.

The specific mathematical questions based on the test were about; understanding the decimal system (integers and decimal numbers), the number line, (negative numbers and fractions) and problem solving (with the four operations (addition, subtraction, multiplication, division), decimal numbers and converting units). Problem solving also includes: seeing connections and patterns, understanding the text, anything else the student wanted to talk about when looking at his/her test results throughout the interview.

I began the interview by explaining why I was doing this research, what kind of questions I would ask and thank them for participating. I handed them the test they had done. We talked

about their results and analysed what went wrong; by talking about the maths test I could include the other questions where suitable. In the end I checked that my key categories were answered, asked additional questions and made sure that I had not misunderstood my interviewees.

### 4.5 Analytical procedure

Before analysing the interviews I made transcriptions. If the interviewees showed obvious pleasure or other feelings, I tried to include them as well. When presenting the material, I concentrated on the meaning of the statements. The quotes are carefully changed according to Swedish language rules, as closely to the original content of the message as I could make it. Afterwards I translated them into English. I changed the names of the students.

When I analysed the material I examined the students´ abstraction- and language comprehension and what their thoughts were when they solved the maths problems. I examined the challenges my students had been exposed to and also their desire to learn. The biological theories are mentioned only briefly as they occurred only momentarily in the investigation. In order to make sociological factors visible I used Alheit´s concept (Bron, 2005) biographical learning; in the light of new experiences and events new meaning was given using the narrative as an important tool.

Mishler (1986) stresses that the researcher looks for the meaning of a question and the use of cultural understanding. The basis for the assumptions I have made when interpreting the meaning of the interview material has its base in the previous research I have referred to in the literature review. In my case my questions can neither be neutral nor objective; I took into account that my students already knew my views when I analysed the outcome of the interviews. As narratives I used students' responses with: 1) a metaphor that showed comprehension 2) an explanation I had not asked for 3) an exposition of the subject that was longer than a few words, 4) an amplification of a feeling.

When I analysed the narrative, I examined the degree to which the students could understand what I was asking for. All the students are second language learners and their linguistic abilities vary. The better the language, the higher the level of abstraction we could keep in the interviews. The higher level of abstraction, the more narratives of what they wanted to express (such as feelings or examples when we talked about mathematics) they could give me.

### 4.6 Data presentation

I went through the material searching for categories that could bring together and organise the material in a new way, giving me the ability to understand the content on a more interpretive and theoretical level. In order to get an overview of the material, I created a table of background variables and the students approach to maths. In the result part I sorted the responses from the interviews in themes. That made me see what the key issues were. I looked at the language in the narratives compared to how long the students had been in Sweden; I compared language and abstraction level with the students level in understanding decimal numbers and strategies in maths; I looked for common characteristics of the informants' history in order to present the variation; and I looked for a turning point – the students approach to maths before and after coming to Sweden. In order to answer my research question I have in the discussion part, with relation to the literature review and the theoretical frame, presented major patterns and variations in my data.

# 5 Findings

Below is a summary of the responses from the interviews, sorted into themes, in order to find what the key issues are and where the focus of the analysis should be. The names are changed for confidentiality.

### 5.1 Background variables and approaches

I have conducted nine interviews. The interviewees have been in Sweden between four and nineteen years. They were all adults when they arrived. Now they are at the age of 25-38 years. Eight different countries from three different continents (Latin America, Asia and Africa) are represented. All the students in the study had completed at least one semester of their studies. Some students were studying the same mathematics course a second semester. Some were not fulltime students in order to manage to get through the course.

The students in the study were likely to pass the course when we performed the interviews. Three categories of students declined participation; 1) students that for some reason left the course prematurely, 2) students who had good knowledge of maths and only needed to revise and 3) one student would not participate because I was going to record the interview. Six months later six of the participating students finished the course with passing grades, and three have taken a break.

The table is showing the students' and their parents' level of education and the parents' occupation and also (briefly) the students´ approach to maths.

| **1) Name**<br>**2) Years in Sweden**<br>**3) Previous schooling**<br>**4) Semesters in my group** | **The parents level of education and profession** | **The students´ approach to maths** |
|---|---|---|
| **1) Adnan:**<br>2) 4,5 years in Sweden<br>3) 11 years before<br>4) 3 semesters in group | His mother (housewife) 8 years in school, his father (a supervisor at a service company) went to upper secondary school. | He used to hate maths, but now he wants to do it, saying; "If you go to the maths classes, nothing is difficult". |
| **1) Christos**<br>2) 5 years in Sweden<br>3) 6 years before<br>4) 2 semesters in group | Both went for 6 years to school. Both work in their own hardware store. | He did not like maths as a child, but now he does. He is suffering from procrastination and because of that he is not sure about what he is doing and that gives him low self-confidence. At the same time he thinks that he could have been one of the best. |
| **1) Taman**<br>2) 14 years in Sweden<br>3) 12 years before, but she did not get a grade in maths<br>4) 1 sem. in group | Her mother went to secondary school, her father is illiterate. Both are farmers. | She claimed she knew nothing from school and in Sweden she has developed. Maths is fun but it is hard to find time to study. |
| **1) Sezen**<br>2) 3,5 years in Sweden<br>3) 8 years before<br>4) 1 sem.in group | Her mother (a housewife) is illiterate, she does not know about her father's education. Her father is a chauffeur. | She hated maths as a child but now it is working well. She understands and it is easier than learning Swedish. Everyday life gets easier with maths. |
| **1) Ishak**<br>2) 4,5 years in Sweden<br>3) 7 years before<br>4) 1 sem. in group | He does not know about his mother's (who is dead) education. His father (who owns a shop) went to school for 6 years. | He left school prematurely and considers that a huge mistake. It goes pretty well with maths even though he has little time to study, but he is worried because his eyes are "jumping" in the text. |
| **1) Sahra**<br>2) 19 years in Sweden<br>3) 9 years before<br>4) 4 semesters in my group | Her mother (a housewife) went to secondary school, she does not know about her father's education. He is a chauffeur. | Bad memories from school affect her studies as an adult; she has concentration and memory problems. Now maths is fun, but it is the wrong time in life to study, with a family to take care of. She has self-confidence when she thinks about maths her in life, when shopping and so on, but not in school. |
| **1) Nina**<br>2) 4,5 years in Sweden<br>3) 12 years before<br>4) 2 sem. in group | The parents can only read and write. Both are farmers. | She likes maths now, it's more fun than studying Swedish. In her country maths was difficult; only private students who paid for themselves got good teaching. |
| **1) Mirah**<br>2) 6 years in Sweden<br>3) 8 years before<br>4) 4 semesters in my group | Her mother (a house wife) is illiterate, her father (who builds refrigerators) went to secondary school. | Things are going well; she struggles and does a lot of homework. She wants to study more maths because it is fun. She liked maths as a child, but she had forgotten all about it. Everything is easy, but she thinks it is easier to learn as a child, adults are slower. |
| **1) Kamila**<br>2) 6 years in Sweden<br>3) 12 years before at home and on distance<br>4) 2 sem. in group | Her mother is a house wife, her father owns a restaurant. | Sometimes she does not understand the language and she has problems with maths. She likes maths, but in order to finish the course in time, she does not study full time. |

### 5.2 Struggles and Challenges

All of the students report that the reason for studying is that they want to go to university or college and that requires maths skills. The students also want to do something for themselves. One student can see the need for education in how Swedish society works; it is important in today´s society to educate oneself in order to have a good job and a good salary.

The students face a number of challenges. Five of the students have to work extra in order to support themselves and their family, in addition the responsibility to manage the household takes a lot of time. Some of them use the words ´struggle´ or ´fight´ in order to describe their studies in maths.

> "I struggle because I want to feel like I am doing something of value for me."

All the students but one are doing homework every day. The student that does not is the only one that has no family. Christos is a victim of shifting moods and he does not do his homework even though he has got the time to do it and that gives him low self-esteem:

> "I am not a person who goes home, grab a snack and then opens the books. Because if I did, I would be one of the best; I am not stupid. But my problem is that sometimes I do not want to open the books. The only things that stick in my head are the things that I do in class. And therefore I have low self-esteem, because when I do a test, I might not have studied enough. But I do the test anyway to see if I can."

For various reasons it can be stressful to study maths and seven students said that working with maths is hard for them. Three students experience test fear. Two of them feel great stress and have trouble sleeping before the tests.

There are students who do not complete their studies in mathematics. In some cases the student has got a job or has become pregnant. The economy may be a problem and many of the students work alongside their studies. Three of my students had ideas about the reasons for other students dropping out of their studies in mathematics: no need for the course, the course is too difficult, the course takes too much time. Ishak has a biological explanation:

> "It may relate to the genes. Adults from other countries do not know that there are things like Autism and Asperger's Syndrome that can make it difficult to grasp things."

### 5.3 Development and change

The students' former life has a casual impact on their approach to maths. Their understanding of and engagement with maths in relation to their studies in childhood/youth has changed, but for one student there is continuity; Mirah liked maths even as a child. For the others there is a contrast; they did not like maths when they were young. They can see differences between childhood and adulthood; it is easier to learn as a child, you do not think about the future when you are a child, children are forced to go to school but adults understand why they have to study and struggle because they need to.

Two students have bad memories. In Sahra´s case the memories sometimes affect her present study situation:

> "The war came to my homeland when I was three and that of course affected my family; we moved often and my parents quarrelled a lot. I went to school for nine years, but it was hard to concentrate. I have my picture of mathematics from school as a child, and when I come to school nowadays I remember how it was. I get ´red´ inside my head."

Ishak was a child soldier. His expression shows a great deal of pain as he says:

> "I was young and stupid and did not study. I did not do homework and I skipped school a lot, but I was doing well anyway. I left school after the seventh grade and became a soldier. If I had continued, I would have studied for twelve years, but instead ... it was a huge mistake in my life. I escaped from the army after five years. I wasted my time and I cannot get it back."

In some students´ homeland the schooling was not for everybody; private expensive schools or teachers who did not give proper explanations, punishing the students when they failed.

After living in Sweden for a while, the students have come to the conclusion that they need more qualifications in order to get a job with better conditions and salary and thus improve their chances of a good life. They feel that there is a fundamental value in developing themselves. They describe their challenges, efforts and successes with strong emotions; joy, triumph, relief. Most of the students did not previously like maths, but now they have changed their minds, e.g. Christos, the man with the procrastination problems, laughed out loud:

> "I was afraid of maths when I was a child because all the numbers. When I began studying as an adult I started to become interested in maths and that has changed my everyday life.

> Now I see that I am not such a jackass as I thought. You know, a person can do more than he thinks; I am very pleased. I can do things I did not imagine I could do; things that we are doing right now, like coordinates, yes such things."

Taman has a long and emotional explanation to her new feelings about maths:

> "I grew up in a small village and I knew nothing; I did not know if the earth was round or flat and I had never travelled. I told my teachers when I started to study in Sweden that I did not know anything because I had not been able to study in my country. But I have done it; I did it! I am so happy that I have managed to study, especially maths. I think it is great fun to be able to do maths."

Taman tells me this with triumphant shining eyes. She laughs out loud:

> "I've said to everyone, even to my parents, that I understand maths. Now that I have discovered maths, I want to educate myself to become an engineer. I have to struggle."

### 5.4 Awareness of maths

The mathematical strategies described below are chosen in order to represent the basic knowledge for the understanding of mathematics. If a student is unable to acquire an understanding of decimal numbers it is hard to continue the mathematical studies. Therefore, it is interesting to know how the students think in terms of abstraction compared to what the students think about studying mathematics. It is also interesting to understand the students´ approach to their new maths skills.

The students express what maths they use in life; the four operations and percent when they shop, the units when they bake or fill the car. They also calculate square feet when buying an apartment. One of the students uses the units Giga and Mega a lot, since he has started a computers company. All this maths, except for the four operations, they have learned in Sweden.

One student stated that mathematics is the most difficult thing. Others claim that things are difficult to begin with, but not when you have understood them. They state that attending classes is essential for the understanding of the subject. Two students stress that studying maths is easier than studying Swedish. Many of them state that decimal numbers, fractions and problem solving are hard to understand and the four operations are easy to understand.

If the students cannot solve a mathematical problem they ask the teacher for an explanation. Several of the students have relatives who can help them. Some stress that their husbands are highly educated, but they cannot explain mathematics in a way that the student understands. Some students search the internet for explanations in their mother tongue. A method to solve a more difficult task may be to transfer the task to an easier problem. Only two of the students showed an understanding for this method. The students seem to see an internal number line. All the students did well on the negative integers when reporting the size of them and most of the students could also solve the problem when instead of integers there were negative decimal numbers. When asked how they knew the answer, most of the students referred to the number line. All the students said that they learned negative numbers as adults, after they arrived to Sweden. No student passed the task with fractions on a number line, they were looking for decimal numbers. When told that they should think fractions, everybody understood.

The decimal digits create problems for all the students. A few of the students recognize decimal numbers from their childhood, but most claim that they have not seen them before maths lessons in Sweden. Numbers that students can easily count when presented with integers become much more difficult when the numbers contain decimals. Especially when they use the operation multiplication, the students get the wrong amount of zeroes and decimals in their answers; they do not see connections and patterns. Even the most knowledgeable of the students report that they have trouble with the decimal numbers, especially when they are stressed.

All the students were able to operate with addition, subtraction, multiplication and division when they started their maths course. But all the students have trouble distinguishing when to use multiplication and division in problem solving tasks with decimals and when the units need to be converted.

The students manage to solve the problems on most of the occasions if the numbers are integers and if the units are adapted to the magnitude. Only one of the students, Mirah, who has studied five semesters of mathematics with me, and was the only person in my investigation that claimed that she liked maths when she was a child, could explain to me how she thinks when she works. The intuitive understanding of the solution to a task seems to come much earlier than the real understanding of the same. The ability to explain how they were thinking when solving the task seems to be even later.

The students work with mathematics on different levels of abstraction. A turning point in the learning progress is the understanding of decimals. I find three categories of levels of maths abstraction:

1) *Low level of abstraction* (1 student): The students can work with algorithms, units and problem solving with integers. The students understand decimal numbers on a shallow level, but cannot adequately put the knowledge in relation to the above criteria.
2) *Medium level of abstraction* (6 students): The students pass the above criteria even with decimal numbers, but because the size of numbers confuses them they often make errors in problem solving.
3) *High level of abstraction* (2 students): The students usually handle problem solving tasks. In some cases, students can either explain what they have done, come up with an example to show that they understand, or explain why it is difficult. However, there are students who have trouble understanding the Swedish language and trouble explaining what they mean in Swedish but are good at handling the higher abstraction level in maths.

All the students describe their previous schooling as too short. In some cases it has been stained by disturbances, poor school systems or bad teachers. The less educated have studied 6-8 years in school. Those with 9-12 years school background did not get a final grade in maths. The length of the students' studies as children do not seem to matter in terms of understanding decimal numbers; either they have not learned decimal number before or they have forgotten them / not understood them before. The students have studied from one to four semesters with me. The length of adults maths studies play an important role for the abstract understanding of decimals.

## 5.5 Numbers and tales

### *5.5.1 Understanding the text*

The students' experienced significant differences in approach in the education they receive now compared to the training they received in their homelands. Several of the students did not remember using the language when doing maths, just numbers. Both the mathematics language and the Swedish language as it is used in mathematics was difficult for the students and they had to read the text many times. They thought it was difficult to understand the language in tests and it was even more difficult to express themselves when writing the answers. One of the students did not always understand what the teacher was saying. After class, she went home and looked up explanations in her home language on the Internet. She learned the Swedish

mathematics words by heart, but they were still difficult to understand in combination with the Swedish language. Another student stated that the Swedish language is easy. She takes her time and reads the texts several times with focus on the maths language. Then she considers different solutions. One of the students claimed that he misses important words, especially at the end of sentences. He suspects that he has dyslexia. He also stated that his life is very stressful since he is taking the double amount of courses, is working extra and has family responsibilities.

In one of the tasks the students have to reflect on the plausibility of the right amount of buses:

> 563 soldiers need to be moved from Camp Alpha to Fort Baxter. Each bus can take 40 soldiers. How many busses will be needed for the journey? http://www.mathematicalbrain.com/test.html

When solving it the calculator says 14,075, but it is impossible to have 0.075 of a bus. If rounding down you will leave three soldiers behind - you need 15 busses. Only one of the students (Christos) passed the task. Three of the students laughed out loud when I explained the problem to them.

### *5.5.2 Language skills and maths*

The students were in varying degrees able to understand what I was asking for and able to describe their thoughts. The better linguistic ability the students' had, the higher level of abstraction we could keep in the interview. With better language skills, they also could produce richer narratives and therefore they were able to give me better examples of what they wanted to express. I used students' response with; a metaphor that shows comprehension; an explanation I had not directly asked for; an exposition of the subject that is longer than a few words; an amplification of a feeling, as narratives.

The students have been in Sweden for between 4-19 years. However; those who have been over fourteen years in Sweden understand most everyday language and those who have only been in Sweden for four years have the least understanding, but those who have been here for five to six years fall into all categories of linguistic understanding. I found three categories of linguistic understanding:

1) *Group A (4-6 years in Sweden):* Problems also on the concrete linguistic level; the students have trouble understanding what I say and trouble explaining what they mean. Four of the students are included in this group. The number of narratives in their interviews was 0-3.

2) *Group B (5-6 years in Sweden):* Good understanding on a concrete level; with explanations, simplifications and misunderstandings. The narratives had short and incorrect sentence structures. Two of the students were included in this group.
3) *Group C (5-19 years in Sweden):* Good understanding both in a concrete and an abstract level. Wordy answers. In spite of this, I must explain carefully what I mean and misunderstandings occur. Three of the students are included in this group with 3-9 narratives.

All the students that had made narratives also showed, at least on one occasion, stronger emotions; laugh, pain, etc. Most of the emotional manifestations described the happiness (joy, triumph, relief) in actually being able to cope with the maths course. It was rare that the narratives described maths; how to count. However, there were some examples of what joy the students experienced when they succeeded in solving a maths problem or when they understood the finesse of a solution. The most emotional occasions, when students showed emotions that I interpreted as; pleasure, pride, triumph, but also as the pain of difficult memories and surprise at an unexpected solution, entered when we were talking about; lost time, difficult memories about failure, success, when coping with "impossible" matters, the children, struggling with a problem that they were then able to dissolve.

### *5.5.3 Maths language*

During the part of the interviews that dealt with the solution of tasks, it appeared clearly that the quality of the response from the students depended on two things: how much they understood in maths and also what they could express linguistically. A strong criterion for when students understand something is when they come up with an example of the phenomenon in question. I found that the correlation between the understanding of the Swedish language and the ability to describe maths is not obvious. Only three of the students made longer explanations when they were describing maths tasks. Only one of the students in the group with high level of linguistic understanding (group C) ended up in this group, the two others were in group B.

## 5.6 Contextual influences; relatives and teachers

Except for Adnan, whose parents had secondary/upper secondary education, the students have a background with little or insufficient education and also their parents have inadequate schooling. This may have affected the students' previous knowledge and engagement in maths-studies. There are also current social conditions that affect adult migrants' engagement in maths

studies. The students' responsibility for everyday life and family has been described in 5.1.2. Also relatives and teachers are important.

Family reasons can be the engine of the study interest: Ishak mentions his children; he wants to be a model for them and he wants to be able to help them with their studies. No one in Sahra´s family have managed to get into university and she wants to do it, but she gets poor support from her family, but in contrast to her mother she is doing all right. Mira's husband was a support for her when she arrived in Sweden.

The teachers, who are said to work in a different way than in the home country, are identified as important for the success. It is easier to learn when you have a teacher you can communicate with and it is important that the teacher wants to teach.

# 6 Discussions

Our ways of relating to the world depend on how we understand and how we manage to make sense of our situation. The aim of the following chapter is to answer the research questions by presenting the subjective meaning students create when studying maths as adults and give a glimpse of what they have actually learned in the subject. Together this will give an understanding of how second language adult students learn maths. When presenting the material I will pay attention to resources from the theoretical traditions I introduced in chapter 3 and make comparisons with previous research from chapter 2.

## 6.1 Redefining

*How do adult migrant students in Sweden understand and engage with mathematics as adults compared to their recollection of their previous engagement with the subject as children in their native country?*

Adults find themselves in a different life situation with completely different requirements, constraints and opportunities than children; participation is voluntary and there are competing demands from family and work (Ahl, 2004). A student may have been victim of mal-treatment, frequent moves and changes of school and this can cause bad maths results (Lundberg & Sterner 2009). The students reflect on their childhood and see differences; e.g. private expensive schools not for them or teachers not giving proper explanations, punishing the students when they failed. Two students had bad memories of war and a disrupt schooling and one of the students had been taught at home throughout her school years.

According to Bron (2005), the adult students´ backgrounds play a big role in who they are today. There may be a connection between the parents' level of education and the student´s school performance. None of the students' parents had education higher than upper secondary school. Three parents were illiterate and two could only read and write. The parents were working as farmers, shop owners and chauffeurs. One father, who had studied on upper secondary level, was a supervisor in a factory. Several of the mothers were housewives. Except for one of the students, whose parents have secondary/upper secondary education, the students have a background with little or insufficient education just like their parents.

All the students that made narratives also showed, at least on one occasion, stronger emotions; laughter, pain, etc. Most of the emotional manifestations described the happiness (joy, triumph, relief) about the success; actually being able to cope with the maths course. The most emotional occasions, were when the students showed emotions that I interpreted as; pleasure, pride, triumph, but also as the pain of difficult memories and surprise at an unexpected solution. All but one of the students describe a contrast; from having a problematic relationship with maths they have redefined their relation to the subject. It is a turning point when they discover that they understand what is taught. It is a success when, despite concerns to the contrary, the maths studies turned out to work all right. They express pleasure and surprise; they can understand maths. Their reaction is comparable to the child's happiness to withstand harsh things.

### 6.2 How to cope

*What particular challenges do adult migrant students in Sweden face and how do they deal with them?*

When we make different choices we can, through self-reflection, influence the external conditions which in turn lead to new knowledge (Bron, 2005, referring to Alheit, 1995). It is a social and cultural process in which other people represent role models for us. After living in Sweden for a while, the students have come to the conclusion that because of how the Swedish society works it is important to be able to count; finding the cheapest phone subscription and doing banking transactions via the Internet etc. (Ljungblad, 2006). Also the Swedish society is changing from producing traditional jobs to a knowledge-based service culture (Hager, Holland & Becket, 2002). The students see a need to study and this gives them *motivation* to study; a desire to learn. Common to most of adult students is having reached a greater maturity and a sense of security in adulthood (Gustavsson & Mouwitz, 2002). Because of greater maturity they dare try working with maths again.

Theories about motivation and adult learning are primarily concerned with obstacles for such motivation (Ahl, 2004; Rönnberg &Rönnberg, 2006). Students with reading disabilities often have difficulty interpreting text data in mathematics, where a problem is embedded in a natural context (Lundberg & Sterner, 2009). Some of the obstacles mentioned I have found in my investigation was: lack of confidence and negative memories of education.

Obstacles my students think other students had are:

- a feeling that education does not lead to a better job
- the course is too difficult
- lack of ; time, interest or concrete expected results of the studies
- no reason to study, according to the student
- diagnoses e.g. dyslexia, ADHD, ADD and ASD

The students are exposed to a number of challenges. Mathematics anxiety is a person´s negative emotional reaction to circumstances concerning numbers and mathematical calculations (Ashcraft & Moore, 2009). Negative emotions and mathematics anxiety drive individuals to avoid learning and using mathematics (Giannakopoulou & Chassapis, 2012). The feeling of inadequacy can accommodate the feeling of worthlessness; not being good enough (Lundberg & Sterner, 2009). Anxiety to perform well enough in school depends not only on doubts about the student's own ability, but also on self-doubt as a person (National Agency for Education, 2003). Three students' experienced test fear. Two of them felt great stress and had trouble sleeping before the tests.

### 6.3 Hamper or help

*What current social conditions and resources affect adult migrants' engagement in maths-studies?*

Family reasons can be the motivation for an interest in studying: making a better life for the family, being a role model for the children and helping them with their studies. One student wanted to be the first one in the family making it in the university and in contrast to her mother get a higher education. One student mentioned her husband as a great support to her, stimulating her to study.

It can be difficult combining studies with family responsibilities (Ahl, 2004); the family can be a hindrance to the student and some of them use the words ´struggle´ or ´fight´ in order to describe their studies. The students have a great responsibility for their everyday life and family.

Five of the students have to work extra in order to support themselves and the family, in addition the responsibility to manage the household takes a lot of time. When the children are put to bed the students do their homework. One student suffers from procrastination; with no family he has time to study and he is not doing it. One student claims her husband complains about her studying, instead he wants her to go out to work.

Knowledge is never acquired passively; through social interaction a negotiation of meaning occurs (Engström, 1998). The teachers are identified as important for the success. Most of the students testify that their earlier schooling was bad; the teachers were ignorant and uninvolved. The students believe that they have good teachers in Sweden and that this plays a big role in their success with their studies.

The limited time per day the students have to study creates stress and frustration. One person procrastinates and does not do homework. To overcome this problem he visits the library.

### 6.4 Making sense

In order to get a grade in secondary school maths, the students must gain an understanding of decimal numbers and problem solving. The abstraction level is high and thus the students must increase their capacity for abstract thinking. Therefore the language comprehension, both the mathematical and the Swedish, is important. *What significance does knowledge of the Swedish language have for the ability to study maths?*

#### *6.4.1 Abstraction comprehension*

The teachers' lack of subject knowledge or lack of connection with the student´s experience as well as false teaching methods can be devastating for the student (Engström 1998). One student stated that mathematics is the most demanding thing, others that it is difficult to begin with, but not when you have understood; visiting classes is essential for the understanding of the subject. The students describe their previous schooling as to short and state that all maths, except for the four operations (addition, subtraction, multiplication and division), is new to them.

The students have no problem identifying amounts or performing mathematical operations with integers. They work with mathematics on different levels of abstraction. A turning point in the learning progress is the understanding of decimals; numbers that students can easily count when presented with integers become much more difficult when the numbers contain decimals (Butterworth, 2000). The length of the students' studies as children do not seem to matter in

terms of understanding decimal numbers; either they have not learned decimal numbers before or they have forgotten / not understood. The students have studied from one to five semesters with me. The length of maths studies in adulthood play an important role for the abstract understanding of decimals.

Solving maths problems includes the ability to retain solutions that work and switch from a concrete level to more abstract thinking (Adler, 2007). According to Lundberg & Sterner (2009) the more tasks with the same structure the students face, the greater the possibility to discover links between previously known tasks compared to old ones with similar structure. Only two of the students could see such links and only one of them could explain how she thinks when she works.

### *6.4.2 Language comprehension*

According to Lundberg & Sterner (2002), students often miss the implied meanings in the text and cannot draw conclusions based on abstract relations. Words and expressions in the text lead the student in the wrong direction and this has an effect on the student's thinking when working on the actual maths problem. When comparing with maths education the students received in their homeland, several of them did not remember using language when doing maths, just numbers. Both the mathematics language and the Swedish language as it is used in maths are difficult for the students and they had to read the text many times. The students stated it was difficult to understand the language in tests and it was even more difficult to express themselves when writing the answers. One student stated that the Swedish language is easy; she takes her time and reads the texts several times focusing on the maths language.

According to Lundberg & Sterner (2002) students may understand mathematical concepts in their home language but not in Swedish. Reading mathematical texts is demanding on students' reading comprehension; an event or situation has to be translated into abstract mathematical symbols and models. During the part of the interviews that was dealing with the solution of tasks, it appeared clearly that the correlation between understanding the Swedish language and the ability to describe maths is not obvious; there are students who have trouble understanding the Swedish language and trouble explaining what they mean in Swedish but are good at handling the higher abstraction level in maths. According to Lundberg & Sterner (2002) the students' written language skills do not express their true linguistic understanding. Students who are good at doing arithmetic calculations are not necessarily those who are good at understanding text data.

Ramsfeldt (2006) stresses that students with an immigrant background more often have difficulties in reaching the goals in maths compared to students with a Swedish background. The language, initially the mother tongue, is crucial; it provides the conditions and the structures that are needed to create stories - narratives (Bron 2005, with reference to Bron, 2000; Bridge & Lönnheden, 2004). The better linguistic ability the students' had, the higher level of abstraction we could keep in the interview. With better language skills, they could also produce richer *narratives* and therefore they were able to give me better examples of what they wanted to express. Rarely the narratives described maths; how to count. However, there were some examples of the joy the students experienced when they succeeded in solving a maths problem or when they understood the finesse of a solution.

# 7 Conclusions

The quote from the National Agency for Education (2003) stated in my *"Aim and research question"* in chapter one, proposes that previous negative feelings towards the subject sometimes are replaced by a much more positive and fruitful approach. I have examined how adult students' understand and engage with their mathematics studies. The main idea was that we are constantly recreating and shaping our lives in the context of our environment. In this chapter I will make some conclusions regarding the study´s main contribution to research; the significance and possible impact of my investigation and also speculate about further studies.

## 7.1 Decompensation and rehabilitation

As I was able to show above, the students experience themselves in a different life situation than children with completely different requirements, constraints and opportunities; participation in studies are voluntary and there are competing demands from family and work. The students had bad memories about war, punishment and a disrupt schooling. Except for one, the students have a background with little or insufficient education and so do their parents. The students' former lives have a casual impact on their approach to maths. Gustavsson & Mouwitz (2002) stress that previous experience of school mathematics content and working procedure is crucial for the adult's approach and attitudes to mathematics later in life; given the blockages many adults have developed in relation to maths, it is remarkable that adults still return to maths studies and are prepared to make great personal sacrifices to study the subject. *Maybe the difficult experience of being forced to leave the home country, together with a wish to take*

*revenge on the failures from their youth, can lead to a kind of struggle for decompensation that can be reflected in the participants' positive evaluation of their mathematics studies.*

### 7.2 The power of a family

As we have seen in the findings, family reasons can be the motivation for an interest in studies; building a better life for them all. The family can support or oppose the student, and in some cases be the cause of a desire to take revenge. The family can also be a hindrance to the student and some of them use the words ´struggle´ or ´fight´ in order to describe their studies. On the other hand; the student without family suffers from procrastination. The limited time space per day the students have to study creates stress and frustration but the students with limited space are the ones that do their homework. It looks like the "hindrance" part of having a family also helps the motivation. *Because of their families the students are highly motivated and that gives them power to overcome the challenges when studying maths.*

### 7.3 To conquer abstractions

As mentioned earlier in my research, the abstraction level in secondary school maths is high and therefore the students must increase their capacity for abstract thinking. A turning point in the learning progress is being able to understand decimal numbers and mathematical texts, which none of the students were good at when they started to study maths as adults. The length of the maths studies in adulthood play an important role for the abstract understanding of decimals and mathematical language. Some of the students created meaning by presenting themselves as victims of shifting moods, with lack of confidence and negative memories from previous school experiences as a result. The feeling of inadequacy can accommodate the feeling of worthless-ness; not being good enough. Anxiety to perform well enough in school depends not only on doubts about the student's own ability, but also on self-doubt as a person. *The memories of previous failures with incomprehensible, abstract mathematics characterise the students' inception of the subject.*

### 7.4 Delight of a redefined aptitude

There has been a change; in the light of new experiences and events new meaning is given to the life of the students. Although many of the students claim that decimal numbers are new to them, in contrast to before they are able to express sufficient understanding. Although none of the students have achieved a higher abstraction level, their successes in this matter are satisfactory to them. There is a turning point when the students understand what is taught. Most likely the students have found an approach that leads to new knowledge - something they had

not found before, as youngsters. The migration and the change from a different situation, with the difficulties encountered when studying a new language, still does not prevent these second language learners from performing relatively well in mathematics. When the difficult experience of not understanding maths changes into knowing, the participants expressed pleasure, surprise and pure joy. Their reaction is comparable to the child's happiness about withstanding harsh things.

We interpret and understand an event or experience in the moment we experience it. It affects our insights about ourselves and our actions in the world we live in. It is when we digest our impressions, reflect on and adapt the new knowledge to ourselves, to our biography, that learning will take place (Bron, 2005, referring to Alheit, 1995). It seems that it is possible for children who had a problematic relationship with maths to "redefine" their relationship with the subject as adult. *Adult students can understand themselves in a new way and redefine their relationship with maths and their own ability to study the subject.* They have also discovered the joy of self-realisation.

### 7.5 Future issues

By working with this research, my general understanding of my students has increased and I can respond to them in a different way. I have strengthened my belief that many students need a mathematics education with focus on concretising the abstract parts. My future research attempts will focus on this.

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# Appendices

### Appendice 1 - Interview guide:

1. What made you decide to start studying?
2. How are your studies progressing?
3. How do you feel about studying mathematics?
4. What is your previous experience of studying mathematics?
5. Why do you think some students drop out of their studies in mathematics?
6. What math skills do you use in your everyday life?
7. Is there anything in mathematics that you think is more difficult and is something easier to remember and understand?
8. If you cannot solve a mathematical problem – what do you do?
9. If you know how to solve an easy task, are you usually able to transfer the method to a difficult task?
10. How do you cope with your homework?
11. How do you feel about mathematical tests?

**Appendice 2 – maths test**

**1) The decimal system (**Integers and decimal numbers)

Write in developed form: 345,026

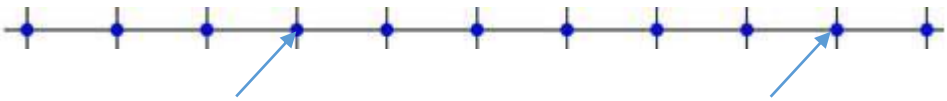
**2) Number line** (negative numbers)

Write the characters “greater than”, “less than” and “equals” between the following numbers:

a) – 67 and – 32 b) – 0,05 and – 0,3

**3) Number line** (fractions)

Which numbers are the arrows pointing at?



4) **Problem solving** (multiplication/division, integers and units)

a) A grocery company possesses 400 stores. Every business buys 32 000 items per year. How many items will bought in total?

b) One day a restaurant serves 200 portions of chicken. The chicken in each portion weighs 150 g. How much do the chicken weigh altogether? Answer in kilogram.

5) **Problem solving** (addition/subtraction, decimal numbers and units)

On Monday Anders is boiling 34.8 litre juice. On Tuesday he is boiling more juice. Now he has totally 72.5 litre juice. How many litres did he boil on Tuesday?

6) **Problem solving** (multiplication/division, decimal numbers and units)

How much is 850 g grapes if the unit price is 45 kr/kg?

7) **Problem solving** (multiplication/division, decimal numbers, rounding or reality)

563 soldiers need to be moved from Camp Alpha to Fort Baxter. Each bus can take 40 soldiers. How many busses will be needed for the journey?

http://www.mathematicalbrain.com/test.html