TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

KIRA GRIGORIADOU
TEACHING MATHEMATICS IN MIDDLE SCHOOL WITH SUG-
GESTOPEDIA METHOD

Master of Science Thesis

ABSTRACT

KIRA GRIGORIADOU: Teaching mathematics in middle school with Sug-
gestopedia method
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An application of Suggestopedia method in teaching mathematics to 8th graders is pre-
sented in this thesis. The experiment was held in Tampereen Normaalikoulu during the
springtime between 21.3.-1.4. 2016 for seven lessons.

Suggestopedia is a teaching method, which was developed by a Bulgarian psychiatrist
George Lozanov in 1970. Suggestopedia is a portmanteau of the words "suggestion" and
"pedagogy". In Suggestopedia the physical surroundings and the atmosphere in a class-
room are the vital factors to make sure that the students feel comfortable and confident,
including art and music.

In practice, during the implementation, the suggestopedic lesson was divided into three
main parts: the warm up, the active concert and the passive concert. The experiment had
the following structure: students were taught during the first three lessons with a normal
teaching method and the next four lessons with Suggestopedia. In the end of both teaching
methods, tests were given to the students. Furthermore, in the end of the experiment, the
students were given a questionnaire, where they were asked their opinion about the
method.

According to the results from both tests, the student's performance of solving exercises is
dropping with the use of Suggestopedia, while the results of the questionnaire are showing
that more than half of the students liked the Suggestopedic method. These results are
understandable because of the short time of the implementation, which makes the result
not statistically significant. Certainly, Suggestopedia is the method that has a lot of po-
tentials. It can be very helpful for students who have difficulties in finding motivation or
for hyperactive students. Moreover, Suggestopedia with Suggestological self-develop-
ment might help with the fight against depression. It is not sure if that method can become
a general teaching method in schools, but certainly it can be applied in some schools
where the environment is suitable.

TIIVISTELMÄ

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Tässä opinnäytetyössä esitetään suggestopedia-menetelmän soveltaminen matematiikan opettamiseen kahdeksannelle luokalle. Kokeilu pidettiin Tampereen Normaalikoulussa keväällä 21.3.-1.4. 2016 seitsemällä oppitunnilla.

Suggestopedia on opetusmenetelmä, jonka kehitti bulgarialainen psykiatri George Lozanov vuonna 1970. Suggestopedia on yhdistelmä sanoista "ehdotus" ja "pedagogiikka". Suggestopediassa fyysinen ympäristö ja ilmapiiri luokkahuoneessa ovat tärkeitä tekijöitä sen varmistamiseen, että oppilaat tuntevat olonsa mukavaksi ja luottavaiseksi. Tähän käytetään apukeinoja, kuten taidetta ja musiikkia.

Käytännön toteutuksen aikana suggestopedia-oppitunti jaettiin kolmeen pääosaan: lämmittely, aktiivinen konsertti ja passiivinen konsertti. Koe oli seuraavanlainen: opiskelijoita opetettiin ensimmäisen kolmen oppitunnin aikana tavanomaisen opetusmenetelmän mukaisesti ja seuraavat neljä oppituntia suggestopedia-opettajan kanssa. Molempien opetusmenetelmien lopussa suoritettiin kokeita opiskelijoille. Lisäksi kokeen lopussa opiskelijoille annettiin kyselylomake, jossa heiltä pyydettiin lausuntoa menetelmästä.

Molempien testien tulosten mukaan suoritukset heikkenivät suggestopedisen opetusjakson seurauksena. Kyselyn tulokset osoittavat kuitenkin, että yli puolet opiskelijoista piti suggestopedisesta menetelmästä. Tulokset ovat melko ymmärrettäviä, koska toteutus oli lyhyt, minkä vuoksi tulokset eivät ole tilastollisesti merkittäviä. Ehdottomasti suggestopedia on menetelmä, jolla on paljon potentiaalia. Se voi olla erittäin hyödyllistä niille opiskelijoille, joilla on vaikeuksia motivaation kanssa. Myös hyperaktiiviset opiskelijat ehkä hyötyvät suggestopedisestä opetuksesta. Lisäksi suggestopedia, jossa itsensä kehittäminen on keskiössä, saattaa auttaa masennuksen torjunnassa. Ei ole varmaa, voiko tämä menetelmä tulla yleiseksi opetusmenetelmäksi kouluissa, mutta varmasti sitä voidaan soveltaa joissakin kouluissa, joissa ympäristö on sopiva.

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E: Second test

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E: Second test

1. INTRODUCTION

Mathematics is the science of logical thinking. The word mathematics comes from the Greek word μάθημα- /mathima/, which means "knowledge, study, learning". Many people associate math with ancient Greek mathematicians and philosophers who were studying math and science under the blue sky, using sand as their paper, drawing shapes and proving theorems. Mathematics is one of the most ancient sciences, since we have already some evidences about 2000 BC from Babylonian mathematicians [1]. Even though it is the science of strict and defined structure, the advanced mathematics are related, according to many people, with philosophy.

Many people, especially from technical fields, are considering mathematics as a useful tool. They see the beauty of mathematics and for them studying math is interesting. Unfortunately, mathematics is not raising so positive emotions generally to the society. Mathematicians are considered in many countries as clever and a bit weird people and math, as a science and as a school subject, is one of the most difficult. The same scenario prevails in school. Students are usually afraid of math, they don't understand it and they can't see any connection between studying math and their everyday life. At this point, we can refer to the results from the questionnaire of Anna-Sofia Kantola's research, where five out of eleven students in 9th grade believe that math is boring and hard [2]. Moreover, many students with artistic tendencies, can't cope with the "dryness" of math.

All this atmosphere brings challenge to a math teacher. One of their biggest challenges is motivation. How to motivate the students to study: Why is it important to study math? Where will they need it in their everyday life? And in the end, why is it fun to study math? The atmosphere during a math lesson is usually rough. Many students are struggling to understand the general idea of the new topic, while other ones are trying to cover the gaps from previous years. In mathematics, as well as in all-natural sciences, there is a logical equivalence. The previous knowledge is used as the foundation for further knowledge. It is like a chain: if one part is missing, it is very hard to have it as one piece. Moreover, the economic and political situation of the country is affecting the children's motivation. But how can a math teacher face all those challenges?

Acknowledging all those challenges and getting familiar with modern educational ideas and theories, suggestopedic theory is proposed as a solution. After studying the theoretical backgrounds of the method, the principals and the means of Suggestopedia, a small experimental study case was designed and applied in teaching mathematics with Suggestopedia for 8th grades in Tampereen Normaalikoulu.

In this thesis the results of the experimental part will be presented and analyzed. Furthermore, the thesis has strong theoretical backgrounds, containing modern teaching approaches, learning theories and suggestopedic backgrounds. The aim of the thesis is to investigate if Suggestopedia as a teaching method can face all those modern challenges and raise students' motivation for learning.

2. PROBLEM-SETTING AND THEORETICAL BACKGROUND

Teaching mathematics in a new method, friendlier and near the students, has become a necessity for our society. New technologies and generally the evaluation of society can't stand anymore the "dry"-conservative teaching method of mathematics, as it was pointed out in the introduction. The research problem comes up from that observation and it is: the lack of motivation from the students in studying mathematics. In the current chapter the important aspects during the learning process of mathematics from the data collection will be presented.

One of the biggest issues in learning mathematics is the self-confidence. The lack of self-confidence is usually causing anxiety. Unfortunately, it has been observed that mathematics usually cause anxiety to the students, which is a disturbing factor for the learning. Using the data collection, the key themes to math's anxiety according to Jessica Norman, are pointed out below. [3].

- The pupil identity: It is very important how the students identify themselves in the classroom. If from the beginning of the lesson they have placed themselves to the non-active participants of the lesson, this attitude will affect a lot the learning process afterwards [3]. That can be part of their low self-confidence during the math lesson and unfortunately this factor is usually hard to change during the whole academic year. The rest of the classmates usually place the student in the group of non-participating, so afterwards they will rarely interact with that student during the lessons, since they believe that he or she is not interested. Unfortunately, this behavior has been observed also from the teacher. Sometimes the lack of time is setting its own rules during the lesson, so the teacher doesn't manage to give a lot of attention to the non-participating student. Sometimes, the teacher doesn't want to enter the students' own space. This attitude has been observed especially for example in Finland, where the borders of a private space are wider compared to the southern European countries.

- The gender: It has been frequently researched and believed that females are less able than males in mathematics [3]. That prejudice, which continues through centuries, has the effect of causing more anxiety to the female students. In terms of ability, females appear more likely to score at least as well as males in math [3]. However, females seem to have a higher level of anxiety and a master approach, while they want to learn to understand, rather than to show high performance [4], while males are more likely to believe themselves to be good at math [5]. At this point, it would be good to mention that in Finland this prejudice is not so strong nowadays, since it is the country of equal rights between men and women, not only in theoretical aspects but also in reality.

- Ability of grouping: The ability of mixing the abilities of the students and creating a varying environment through different group works [3]. As J. Boaler has mentioned, the mixing ability in the class, gives the opportunity to students to interact

with others from various social classes, cultures and abilities and therefore, encouraging students to approach math in more diverse ways [6].

- Teacher-pupil interaction: The interaction between teacher and student is very important and it can affect the whole process of learning, the student's achievements as well as the overall classroom climate [3]. The teacher has numerous long-term effects, linked to students' construction of identity [7]. Educational goals do not include only learning. Intelligence, a strong character and the ability of having good judgement are the aspects that walk side by side. All those goals can be achieved by having a warm relationship between student and teacher. Many students afterwards remember some of their teachers until the end of their life. A math teacher for a student should not be only the person who knows math, a person who is teaching how to solve a second-degree equation, but also an example in life, someone who helps the student to build up a unique character. [3]

- Perceptions and beliefs: It is highly important that the students believe that the knowledge of math is useful in life. Generally, students hold strong beliefs about math and mathematicians [8]. At this point, it would be nice to refer to one conversation which took place at a bar at 2 am. The almost graduated students from university (future teachers in Finland) after a glass of beer had an interesting conversation: "- Do you remember your math teachers only as "teachers" or also as "people" in normal life?" "- No, for me they were just my teachers, nothing more", was the answer from most of the students. "-But you are going to be soon a math teacher, do you want your students to see you only as their teacher? Aren't you a person?". As we can see from the previous example, even future teachers, who want to change those perceptions, have the same ideas about their own teachers.

Another important aspect in teaching mathematics is the critical and creative mathematical thinking. Mathematics is not only a mandatory subject in school, but it is also the subject among the others, which is responsible to teach students creative, critical and abstract thinking, a very useful skill generally in life.

Critical thinking is now widely seen as a basic competency, akin to reading and writing skills, which needs to be taught. Critical thinking is a skillful activity, which meets standards of clarity, relevance, adequacy and, thus, is contrasted to unreflective thinking [9]. According to Fisher, critical thinking skills require the ability to interpret, analyses and evaluate ideas, arguments and observations [10]. It also requires skills in thinking about assumptions, in asking pertinent questions, in drawing out implications, necessary skills for software development students and practitioners [9]. As we can see, creative and abstract thinking can help students in making decisions in their everyday life, while it is very useful in their professional career, as well. Many institutes and companies are searching for employers with such abilities.

Creativity is also mentioned as an important aspect of our education. One definition of creativity in Problem Based Learning is: "Creativity is the ability to produce novel, high-quality, and task-appropriate products." [9, p. 15], given by Eleni Berki and Juri Valtanen. In their paper, the authors are examining the suitability and applicability of mathematical thinking in the traditional higher education context and in the challenges of modern software development. Furthermore, in the paper it is mentioned that special programs have been developed, which teach thinking [9].

The role of the teacher is very important during the lesson. Since our goal is a modern approach in teaching mathematics, the role of the teacher is different than it used to be. No one can imagine a strict teacher, without any humor or either any emotions, in front of the class giving a pleasant lesson. Many books are trying to find the magic recipe for a successful teacher. No one can give an absolute definition about how the best teacher is. In the end, it is a very objective statement and varies a lot from person to person, but there are descriptions of the necessary characteristics, which the teacher should have during the lesson.

Firstly, the teacher must create a pleasant environment for everyone to be there. Secondly, the students should be able to work productively. Setting up the new limits in that new role is very important. The teacher need to be friendly to the students, while at the same time, being an authority and moral figure is necessary. The teacher's figure needs to inspire respect. Being just a present figure in the classroom is not enough, because the goal is the learning process.

Frederick Douglass said: "Without struggle there can be no progress." [11, p. 7]. From this saying Charlie Abourjilie started her book "Developing Character for Classroom Success". In the same book, Charlie pointed out some other important aspects, which are related to what is the correct role of the teacher inside the classroom. First, she underlines the necessity of a character education in the classroom. Furthermore, she mentions the importance of group work. The teacher needs to encourage everyone to want to work together, so there will be nice relationships between the classmates. Many good and practical pieces of advice on how to create the above-mentioned aspects, are given in the above-mentioned Charlie's book. Summarizing, we can refer to Charlie's believes that teachers are the key in education and they can and they do make a difference. The role of teacher it is very important in the classroom. [11]

Another book, in which there is underlined the importance of having the correct approach to students, is "Leading with Character to Improve Student Achievement". That book is addressed to school leadership. The context of the book refers to how to become a good leader and lead the class with character. Some of the discussed topics in that book are how a teacher can deliver bad news or how he/she can build a trustful relationship in the classroom. [12]

Important guidelines can also be found from booklets which are published and distributed by UNESCO's International Bureau of Education (IBE). From the first chapter of the booklet the authors refer to creativity. They underline that the influence of creative thinking happens through well-designed learning spaces, which can bring people together and can encourage their interaction and creative collaboration. Furthermore, in the next chapters, they suggest ways of raising the motivation. In the author's opinion motivation arise from the interaction with others. The booklet refers also to the environment of the classroom. It is important that there will be trust, where mistakes and sensible risk-taking will be allowed. [13]

Another important aspect is the student's learning activities, well summarized in the term "approaches to learning" [14, p. 60]. The student's learning activities are the "deep approach" and the "surface approach" [14, p. 57-58]. John Biggs gives the following definition of the surface and deep approach: "The term surface approach refers to activities

of an inappropriately low cognitive level, which yields fragmented outcomes that do not convey the meaning of the encounter [14, p. 60]. The deep approach refers to activities that are appropriate to handling the task so that an appropriate outcome is achieved." [14, p. 60]. The goal of the teacher during the lesson is the deep learning of the subject and not of the surface. [14]

That can often become a difficult task. Many students don't have so good backgrounds that are needed, so catching the deep idea becomes very hard. Trying to convert this to mathematical terms can become a challenging task. Everybody will agree that without the knowledge for example of basic operations, it will be extremely hard to deduct any expression and recognize afterwards that this is an equation of an ellipse. Some other reason for making that goal challenging, can be the different level of cognitive skills for each student [14]. If a teacher's lecture about a specific topic doesn't reach everyone's cognitive skills, deep approach of learning fails. Our grading system has a huge impact [14]. While the students are given the goal to get higher and higher test scores and they are trying to memorize all the possible details, they forget the most important, to understand the general idea behind of what they are learning so in the end they gain only a surface learning.

2.1 Learning theories

After getting familiar with educational publications which are adopting a new approach to teaching, in this chapter we will be introduced to learning theories. We will see analytically: Behaviorism, Cognitivism and Constructivism. Furthermore, cognitive load theory, cognitive capacity and the cognitive overload will be presented. These theories had and still have a huge influence on educational system. By understanding them we will be able to analyze the teaching methods that are used currently in education. In the end of the chapter Suggestopedia will be presented.

2.1.1 Behaviorism

Behaviorism is a worldview that operates on a principle of stimulus-response. All behavior caused by external stimuli (operant conditioning). All behavior can be explained without the need to consider internal mental states or consciousness [15]. The most famous experiment for that theory was made by Ivan Pavlov.

In 1890 a famous Russian physiologist conducted an experiment. He researched if his dog's salivation was only connected to the fact of being fed or if he could manage to make them salivate without giving them food. For researching that, he was always riding a chronometer before the dogs were getting food. After a while he started riding the chronometer but without giving any food to the dogs. At that point, he exactly noticed that the amount of saliva was the same as when he was feeding them. He continued the experiment changing stimulus from the ringing chronometer, to bell or even lamb but he always had the same result. His dogs were soon conditioned to produce saliva. Pavlov believed that he discovered how animals learn. [16]

The main focus on behaviorist approach to education is behavior. By controlling the behavior thought positive or negative reinforcements the education process is conducting. Educators are sources of power while they are transferring their knowledge to the learner. The learner in behaviorism approach is a passive receiver without significant power. [17]

Behaviorists believe all the students must behave in the same way according to universal standards. This is exactly the aspect that has made this theory not so popular nowadays, but despite of that fact there are applications of it in our modern society. For example, many times parents are educating their small babies mainly using behaviorism in their early age, when they are teaching to their beloved what is the accepted behavior. Usually, people who are holding these behavioristic ideas of education are associating a child with an empty blackboard ready to get filled up with information. [17]

Behaviorism has its impacts on class environment as well. Many times, behaviorism is used for shaping an appropriate student's behavior in the classroom. Typical example of behaviorism inside the modern classroom is the way that a teacher is obtaining discipline. Usually, the teacher is giving the right environment, where reinforcements and consequences are following from actions, such as rewards and punishments. The rules are clear from the beginning so the students must commit to them from the beginning. In these cases, the teaching process goes smoothly. [17]

Suggestopedic ideas do not come across very much with behavioristic ideas. In suggestopedic class there is space for individuals and the main idea of the method is to provide multiple features for spherical learning. Suggestopedia is more coherent with the idea that everyone is unique and special and that for everyone there can be found their own suitable way of learning. Despite the significant differences between the ideology of the two methods, Suggestopedia is using the bases of behaviorism as any other teaching method in preserving discipline in the classroom.

2.1.2 Cognitivism

Cognitivism is the second learning theory, which will be presented in this chapter. In the late 1950s, phycologists and educators started to switch from the behaviorism learning model to more cognitive science. Cognitive theories started to concentrate into internal mental structures [18]. Learning collated with different learning stages between knowledge rather that changes in the probability of response. As it is mentioned by Peggy A. Ertmer and Timothy J. Newby: "Cognitive theories focus on the conceptualization of students' learning processes and address the issues of how information is received, organized, stored, and retrieved by the mind. "[18, p. 51]

The main focus of Cognitivism in education is intelligence. This is achieved by providing the right environment for children: suitable activities and material for their age and their current development. They are organized, sequenced and presented in a manner that is meaningful to the learners. Learning happens when a child is ready for that. Children's stage lead to what they can learn. Children can't learn what they are not ready for according to cognitive theory. [17]

Educators in Cognitivism are observers responsible for promoting situations, where learners are searching for their own answers. The learners are active and they are responsible for their own learning. Cognitivism emphasize retention and recall though a quality teaching practices. [17]

In Cognitivism, all the individuals are respected. Being yourself is the main idea in cognitivism. In cognitive views, the mind is an information processor, like a computer. The knowledge needs to be discovered and invented. [17]

Cognitivism has more common features with suggestopedic method. The idea of retention and recalling the previously studied themes is also used in Suggestopedia as an idea of spiral learning. In spiral learning, the specific theme is presented many times during the teaching period to prepare the learner for the perfect moment when he/she will be ready for understanding, retaining and recalling completely and permanently. That happens through good organization of materials which are making the learner to get deeper and deeper in the subject.

Some other similarities between the two theories is the respect of individuals [17]. In Suggestopedia as well as in Cognitivism, every person has his/her own personal characteristics and a personal way of learning and that is why in suggestopedic lessons the information is given through many different sensory channels. Another common feature is the cognitive development which is achieved by creating a suitable environment for learning [17]. As we will see in the Chapter 2.3.3 the role of the teacher is significant in suggestopedic lessons due to the responsibility of creating a pleasant learning environment. We can refer to one more big similarity between the two theories, the focus on intelligence [17]. Versatility and intelligence play an important role in Suggestopedia as we will find out later.

2.1.3 Constructivism

Constructivism is one of the modern educational theories. According to Dr. Brada Steve Olusegun: "Constructivism is a learning theory found in psychology which explains how people might acquire knowledge and learn. It therefore has direct application to education. The theory suggests that humans construct knowledge and meaning from their experiences." [19.p. 66].

In Constructivism teacher and learners are having an active role. The teacher is not transferring ready knowledge to the learners. He is creating a learning environment where the learner is directly exposed to the material being studied. Afterwards, both are forming together the knowledge, through collaborative, creative and critical analysis. [19]

Experience plays a significant role in constructing the knowledge [19]. This is an easily observer phenomenon for example in arts, where a poem can bring some people to tears and to some others would not have any significant meaning. The same can be observed while someone is listening to music or while someone is watching a theatrical play. Some people have gained more sensitivity for specific issues through their experiences, while some others not.

Below are listed basic characteristics of Constructivist Learning Environments, which must be considered when implementing constructivist instructional strategies, according to Dr. Brada Steve Olusegun:

1. Knowledge will be shared between teachers and students.
2. Teachers and students will share authority.
3. The teacher's role is one of a facilitator or guide.
4. Learning groups will consist of small numbers of heterogeneous students.

[19]

All the above-mentioned aspects as we will see later, will be the key points of the Suggestopedia. In a suggestopedic lesson the power is divided between the student and the teacher. The teacher's role is being a guide for the students in the world of knowledge. The knowledge is shaped between the students and the teacher, since the goal of the method is the collective growth.

In Constructivism and in Suggestopedia there are many similar pedagogical goals. Below are listed the pedagogical goals of Constructivist Learning Environments:

1. To provide experience with the knowledge construction process (students determine how they will learn).
2. To provide experience in and appreciation for multiple perspectives (evaluation of alternative solutions).
3. To embed learning in realistic contexts (authentic tasks).
4. To encourage ownership and a voice in the learning process (student centered learning).
5. To embed learning in social experience (collaboration).
6. To encourage the use of multiple modes of representation, (video, audio text, etc.)
7. To encourage awareness of the knowledge construction process (reflection, metacognition).

[19]

All the above pedagogical goals are also followed during the implementation of suggestopedic lessons as we will see in the Chapters 2.3 and 3.5.

Constructivism is the teaching theory with the more overlapping in the basic aspects with Suggestopedia from the theories mentioned in this chapter. To conclude we will get familiar with some of the implications of Constructivism for teaching and learning, which are distributed to suggestopedic lessons as well:

- encourage and accept student autonomy and initiative
- use a wide variety of materials, including raw data, primary sources, and interactive materials and encourage students to use them
- inquire about students' understandings of concepts before sharing his/her own understanding of those concepts
- encourage students to engage in dialogue with the teacher and with one another

- encourage student inquiry by asking thoughtful, open-ended questions and encourage students to ask questions to each other and seek elaboration of students' initial responses
- engage students in experiences that show contradictions to initial understandings and then encourage discussion
- provide time for students to construct relationships and create metaphors
- assess students' understanding through application and performance of open-structured tasks [19]

Many similarities can also be found with specific type of Constructivism, the Social Constructivism. As Luke Mastin has mentioned. "Social Constructivism is the theory in Sociology and Learning Theory that categories of knowledge and reality are actively created by social relationships and interactions. A social construction (or social construct) is a concept or practice which may appear to be natural and obvious to those who accept it, but, is an invention or artifact of a particular culture or society." [20]

In Social Cognitivism cognition happens as an involving relation rather that an individual's mind [21]. Social Cognitive thinkers believe that solving global problems collectively is more efficient. This theory has many similarities with Suggestopedia since the learning in suggestopedic lesson is happening collectively, too.

2.2   Cognitive load theory

Cognitive load theory refers to the mental amount that need to be used in the working memory. As Ton de Jong mentioned: "The basic idea of cognitive load theory is that cognitive capacity in working memory is limited, so that if a learning task requires too much capacity, learning will be hampered. The recommended remedy is to design instructional systems that optimize the use of working memory capacity and avoid cognitive overload." [22, p. 105].

Theories of the architecture of the human memory make a distinction between long term memory and short-term memory. Long term memory is the memory where the things are stored for longer time or even permanently and short-term memory or in other words working memory, is the memory where things are stored for shorter periods of time. [22]

The capacity of working memory is certain so if there are more tasks that need to be processed than the available capacity, cognitive overload is taking place. At this point the working memory doesn't manage to process the given information. The goals for modern studies is to find ways for prevent overloading. [22]

Overload take place very often in our everyday life and especially in students' life. Growth of technology, social media, different sensory channels are bombing children every minute with the result to lower their working memory capacity. When those children, who don't manage to process all the given information fast and well, come to the lesson, their brain is already very tired so they are searching for easy learning solutions.

This is a wide problem in education. Below are listed some important points of what cognitive load theory has brought to the field of educational design. The three main recommendations that come from cognitive load theory are:

- present material that aligns with the prior knowledge of the learner
- avoid non-essential and confusing information
- stimulate processes that lead to conceptually rich and deep knowledge

[22]

Those recommendations can be a very useful tool for a teacher, because they give a very good axis in which a teacher should build the lessons. Fundamental things need to be presented first. Afterwards, on top of them the learner could start building more complicated theories. Those fundamental things need to be presented clearly and simply, avoiding non-essential and confusing information. By explaining it simply a teacher shows a well understood concept. A well understood concept has a simple logic behind it, which then is easily understood by students. The ability to prioritize in teaching is a useful skill.

The next stage of the basic understanding is leading the process conceptually to rich and deep knowledge, in other words, decorating the "dry" presented skeleton. Small interesting details and non-essential information is presented on that stage.

The above described recommendations were followed during the suggestopedic lessons as it will be shown later. The goal of learning in Suggestopedia is the deep learning and it is achieved with a help of spiral learning. Spiral learning is the implementation of the above-mentioned recommendations during the teaching period. The result of this implementation is the deep learning, while the learned information is moved from the working memory to the longer-term memory.

It is worth mentioning that in the class there are different students, with different working memory capacities and abilities. Following one strict line won't give any good results. A good teacher need to be able to personalize the teaching for the needs of each students. As J. Biggs said: "Good teaching is getting most students to use the higher cognitive level processes that the more academic students use spontaneously. Good teaching narrows the gap." [14. p. 58].

2.3 Suggestopedia

The two main sources of inspiration for teaching math in a different method are coming from the online course of Jo Boaler and from learning the Finnish language at Onnenkieli in Tampere with Suggestopedia, while the idea of that method is supported by many researches and papers. [23] [24]

Jo Boaler is a British education author and a Professor of Mathematics Education at the Stanford University, who has made many publications referring to the difficulties that many students have in learning math. In her online course- "How to learn math", targeted to parents and teachers, she explains and gives tips on how to make learning mathematics more fun and attractive. There she points out that learning math can become very hard,

since there are many stereotypes. One of the strongest is for example, that math is only for clever people. [23]

This stereotype has been carried on for many thousands of years in our society and it has very bad effects on students' learning. In her opinion, teachers and parents need to stay united to encourage the student to study, to support him/her in the moments of fail and to be aware of the stereotypes. Creating a friendly and supportive environment in the class-room and at home, will raise the motivation of the students and then, the road towards learning is open without obstacles. [23]

Learning a foreign language in an advanced level of almost a native speaker has been also a challenge for many people. While moving to Finland the language obstacle was imme-diately raised. Finnish language is considered as one of the most difficult in the whole world and since there wasn't any time to be wasted, a need of an intensive course was obvious. In Tampere, there is only one school that is teaching Finnish from 0 level to B2 (fluent) in one year. That language center is Onnenkieli and is in Hatanpään valtatie. In that school, they are teaching languages with Suggestopedia [2]. From the first day the method looked very attractive, because it was possible to learn very fast without getting bored. All the teaching was done through theatrical games, where the students had roles of customers, doctors, actors etc. At that point, a dream of teaching mathematics in that method was raised.

Through researching on the internet, the first article about Suggestopedia was found. In the article [25] Suggestology and Suggestopedia published in Paris in 1978 and written by G. Lozanov, a Bulgarian psychiatrist, the basic idea of what is Suggestology and Sug-gestopedia is explained. Since Lozanov is a psychiatrist, the first pages of the article re-ferring to Suggestology, are completely not understandable by someone who doesn't have strong medical backgrounds. But from page 21 onwards, Lozanov moves to the topic of Suggestopedia, where except of the theoretical part, applications of the method in teach-ing are presented. [25]

2.3.1   The principles of Suggestopedia

The principles of the method are:
- joy, absence of tension, concentration in psychorelaxation
- unity of conscious/unconscious and integral brain activation (participation of the two brains hemispheres)
- suggestive relationship on the level of the reserve complex [25]

The above-mentioned principles will be explained further. The first principle deals with the emotive aspect of the learner. Joy and relaxation are the necessary prerequisites for effective and fast learning. In classroom, the students should feel unthreatened and secure when involved in meaningful activities. [25]

The second principle, which is called "the unity of conscious and paraconscious and in-tegral brain activity" [25, p. 31] by Lozanov is about gaining access to the subconscious

capacities of the brain. This means that the teaching should be organized in such a way that both the conscious and paraconscious reactions and functions of the students could be utilized. [25]

The third principle should do with gaining access to the so-called reserve powers. The process of teaching should be constructed in such a way that mutual relations are created. Mutual trust and respect should prevail in the relationship between the teacher and the students. None of these principles discussed above can alone make learning successful. [25]

Analyzing those principles more we can conclude to the following statements:

- Suggestopedia is about love:
  Not a sentimental love but a love for life and humanity generally. A positive way of looking to life and a positive world view. This principle can be associated with the first above mentioned principle that Lozanov underlined, the joy.
- Suggestopedia is about freedom:
  Refreshing the historical backgrounds, when that method has been born, we understand that it was highly influenced by the hippie movement in 60s. The hippie movement was exactly about freedom. In Suggestopedia this freedom is revealed as a freedom of the learner to choose how to perceive knowledge. There aren't any specific places in the classroom where the learner is obligated to sit. The atmosphere of the class is friendlier and is lacking this conservative idea of the traditional school. During the implementation, the learner can be even without shoes and the surrounded environment is more relaxed.
- Suggestopedia is about the conviction of the teacher that something extraordinary happens:
  The positive attitude of the teacher and the believe in the abilities of each of his/her students has the result to unlock a student's reversal potential. The state of confidence that something extraordinary happens leads to a state of inspiration in the teacher.
- Suggestopedia is about multiple increased material learning:
  During the implementation of the method the material given by the teacher is big, since the needs of the non-traditional teaching method required many materials designed especially for that specific group.
- Suggestopedia is about the beauty of the whole part:
  In Suggestopedia the subject is a whole unit. If we are talking about learning a language, the language is not divided to sections like grammar or vocabulary. If we are talking about some subject in mathematics, it is also treated as a unit. Theory, historical facts, games based on that subject and exercises are composing a beautiful picture of one magnificent unit.
- Suggestopedia is about the golden proportion:
  The suggestopedic lesson consists of the golden proposition of everything: art, theatre, historical presentations, group games, projects etc. Everything can be found during the implementation even if it is a lesson in mathematics, physics or chemistry.
- Suggestopedia is about application of classical art and aesthetics:
  As it was mentioned above, a suggestopedic lesson can consist of everything, even of classical art and aesthetics. They are used in suggestopedia as particularly effective mediators of non-manipulative communicative suggestion because of their

ability to emit countless non-specific incentives that nurture the abundance of peripheral perceptions, inconspicuous for the consciousness. [26]

2.3.2 The suggestopedic means

Let us now consider the means through which the principles are realized. Lozanov divides the means into three different groups:
- psychological
- didactic
- artistic [25]

The above means will be analyzed below. Psychological means are considered as a separate group of means, even though they are also present in the other two means. They have a specific additional significance for suggestopedic teaching, especially in primary schools. Lozanov emphasizes the importance of peripheral perceptions (unconscious or partially conscious perceptions) and he claims that these peripheral perceptions play a significant role in the assimilation of any knowledge. To understand this, we can consider the following example: when children start learning how to read, pictures that may contain a word or a short sentence can be placed on the walls of the classroom. Without turning children's attention to these pictures, it was noticed that within a day or two, they began to read the words. [25]

According to Lozanov, high percentages of peripheral perceptions are learned, without loss of energy. The teacher must be well-trained to utilize unconscious perceptual and thinking processes in the educational process. [25]

The didactic means basically refer to the presentation of the learning material. Finally, the artistic means of Suggestopedia include, for example, the use of music, literature and acting. They enable the students to assimilate part of the material immediately. Lozanov emphasizes that the artistic means need to be built into the contents of the lesson, so that they are not separate parts of the class. [25]

2.3.3 The role of the teacher

The teacher has a role near to a guide or to an instructor in that method. To create the safe environment for learning, firstly the dominance of the teacher should be reduced. The class should provide a network of human relationships for the students, in which they feel secure and accepted. The teacher has a significant role in creating an interpersonal climate in the classroom. Similarly, different modes of working such as pair- and groupwork contribute to the increased interaction between the learners. [25]

Some other factors that make the role of the teacher very challenging are the tasks to overcome the anti-suggestive barriers of the student. By anti-suggestive barriers we refer to the ability of a human to accept or reject the effect of suggestion. Since the number of suggestions is immeasurable, if a human reacted to all the suggestions, she or he would become helpless. For this reason, human beings are equipped with so called anti-suggestive barriers. [25]

The first barrier is called "the critical logical barrier" [25, p. 13], which rejects everything, that reason judges unacceptable. The second barrier is "the intuitive-affective barrier" [25, p. 13], which rejects anything likely to produce a feeling of lack of confidence or insecurity. "The ethical barrier" [25, p. 13], is a final aspect that is in contradiction with the ethical sense of the personality. So, one of the most difficult tasks of the suggestopedic teacher is to overcome the anti-suggestive barriers. To illustrate this, the teacher should not impose on students something that is totally against their will, but rather find compromises between the suggestion and the will of a learner. Overcoming the anti-suggestive barriers is done by four means: authority, double-planeness, infantilization and concert pseudo passiveness. [25]

The authority of the teacher is the key term in changing students' attitudes towards their unrestricted capacities. The term authority should not be confused with authoritarianism. While having authority, the teacher is encouraging and supportive. It is the authority of the teacher that creates the secure feeling in the classroom. [25]

The second means, double planeness, refers to the two levels of communication: nonverbal and verbal communication. Double planeness has a special function in Suggestopedia. As Lozanov claims, if the words and other signals, such as intonation, voice quality, posture and gesture, contradict, one cannot talk about the effect of suggestion. As a matter of fact, the two levels should always be in harmony to maintain the authority: only when the behavior and function of the teacher is genuine and sincere, the information is convincing. [25]

Infantilization is a term used by Lozanov, which refers to "controlled state of intuitive activity, emotional plasticity" [25, p. 15]. With the help of these, the teacher attempts to relax the students and to encourage creativity in them.

The final means of suggestion is called concert pseudo passiveness. The word concert refers to two separate matters: firstly, it refers to music used in the concert session of the lesson. Secondly, it concerns the state of mind when listening to classical music - calm, relaxed and expectant. When the students listen to the music, they seem very passive, but in fact a lot of things happen in their mind. So, the passivity is not genuine, but rather pseudo. [25]

These means meet the levels of teaching competence mentioned by J. Biggs in his article "Higher Education Research and Development". In that article, there are three levels of teaching competence. The first level is the level, where the focus of the teacher is what the student is. The variety in the classroom of the different levels of the students are the first things that are considered by the teacher. In that level, if the student doesn't learn is due to a deficit: ability; attitude; study skills; motivation; even a student's ethnicity. [14]

In the second level, the focus is what the teacher does and it is still conceived as a transmission process. In this level, it is important how the teacher is providing tips and explaining important aspects. Below are listed some of the teacher's important tasks:

- establish clear procedural rules at the outset, such as signals for silence
- ensure clarity: project the voice, clear visual aids
- eye-contact students while talking

- don't interrupt a large lecture with handouts: chaos is likely [14]

In this level, the failure of the students is the teacher's fault. It is a view of teaching often held by administrators because it provides a convenient rationale for making personnel decisions. Teaching is a bag of competencies; the more competencies you have, the better a teacher you are. [14]

In the third and last level, the focus is on what the student does. In this level, the teaching requires some variety of teaching techniques. The teacher is concentrated in what students are doing and what is learned. In the third level the teaching is systemic, considering all components in the system. This implies a view of teaching that is not just about facts, concepts and principles to be covered and understood, but about:

- What it means to understand those concepts and principles in the way we want them to be understood.
- What kind of teaching/learning activities are required to reach those kinds of understandings.   [14]

This last level is exactly matching with the above mentioned suggestopedic means. As we can see, the role of the teacher in Suggestopedia is important and it is requiring good teaching skills and techniques.

To conclude this chapter, we can mention that Suggestopedic method can be applied in teaching many subjects. Lozanov has described in his paper Suggestology and Suggestopedia how to teach with Suggestopedia foreign languages for adults, first grade mathematics and even narrative subjects for upper school. Here we can see the exact chapters:

- Suggestopedic foreign language system for adults
- Teaching and learning to read in the first grade
- Teaching and learning to write in the first grade
- Teaching and learning mathematics in the first grade
- Teaching and learning a narrative subject (for example history) in upper grade [25]

Many schools in Bulgaria, after Lozanov, started using his method in teaching. Even though many subjects can be taught with Suggestopedia, nowadays the bigger application of Suggestopedia is in teaching foreign languages and especially in teaching adults. In Finland there are two schools, which are teaching with Suggestopedia, Onnenkieli Oy in Tampere and Nuevo Mundo in Helsinki.

After we have made ourselves familiar with the theoretical framework, we understand that they match with the learning theories presented before, with the guidelines of UNESCO's booklet and as well as with the rest of the ideas and theories of the above-mentioned publications.

3. RESEARCH METHODOLOGY AND MATERI-ALS

The current research is a qualitative research with some features of quantitative. It has strong theoretical backgrounds: literature review, teaching theories, theoretical backgrounds of the applied method - Suggestopedia, but in the same time it has features of quantitative research since it has a small experimental part. Unfortunately, this experimental part couldn't become bigger, conducted for longer time or include bigger groups since the experiment was taking place in a school from where there were given specific guidelines and timetables. Even though the experimental part is very small, it still can give us a small flavor of what kind of results there can be gained.

Before getting familiar with the research problem and the research questions, we will look at how a cognitive process is conducted. According to Morse one qualitative research distinguishes from another one is the way that this research is applied, targeted, sequenced, weighed, or used [27]. Below it is presented the phases of developing qualitative research design:

1. Stage of reflection
   a. Identification of the topic
   b. Identifying paradigmatic perspectives
2. Stage of planning
   a. Selecting a site
   b. Selecting a strategy
   c. Methodological triangulation
   d. Investigator preparation
   e. Creating and refining the research question
   f. Writing the proposal
3. Stage of entry
   a. Sampling
   b. Interview techniques
4. Stage of productive data collection and analysis
   a. Data management techniques
   b. Ensuring rigor of the data
5. Stage of withdrawal
6. Stage of writing   [27]

As it is presented in the above research design, everything started from the stage of reflection. Very important was to understand what the topic was and how someone could work on it. After realizing the topic, the stage of planning started. In that stage all the given guidelines, timetables, restrictions, ethics were considering. Unfortunately, it is not enough making an ideal plan, it must meet the real conditions under which the experiment can be conducted. [27]

The third stage of the research corresponds to Chapters 3.4 and 3.5, where there will be analytically described the stage of entry, in this case the description of the experimental part and the implementation. The fourth stage corresponds to the Chapter 4, where results will be presented and analyzed. The fifth stage of withdrawal correspond to Chapter 5, where the conclusions are presented. The last stage is the stage of writing, or in other words the stage of polishing and finalizing the thesis. [27]

It is worth mentioning that that research design illustrated above constitutes a loop. The last stage of writing relates to the stage of reflections and if an error occurs in that stage, all the design's stages need to be run again. This process happens as many times as in the stage of writing there isn't any new reflections. Even though, the experimental part of the thesis in our case couldn't be conducted again, the reflections of the analyzed results had changed many times, until they took their final form. [27]

3.1 Context, participants and teaching experiments

The teaching experiment took place in Tampereen normaalikoulu with the 8th graders during seven lessons in mathematics. The first three lessons were taught normally, using the normal teaching method that is used in Finnish schools. That group will be referred as the normal group. The theme of three lessons were Polynomials Chapters 33-36 from the course book Laskulaito 8 [28].

The next four lessons, after one month's break (because some lessons were taught by their own teacher and because of ski holidays) were taught with Suggestopedia. The classroom had changed and therefore an environment suitable for teaching with Suggestopedia had been created. This group will be referred as the suggestopedic group and it consisted of the same students. The theme of the lesson was "First order equations", Chapters 43-48 from the same course book, Laskulaito 8 [28].

In the end of the application of both groups, children had tests (Taitotesti), which were taken from their course book and can be found from Appendices B and E. That was done for validity reasons. Furthermore, a questionnaire was given to the students in the end of the experimental part. This questionnaire can be found in Appendix A.

In Table 1 below is presented the design of the study case with the exact timetables. In the first column of the Table 1 there are the exact dates of the lessons and the corresponding chapters from the book Laskutaito. Furthermore, from the table can be seen which lessons belong to the normal group and which ones to the suggestopedic group.

Below can be found the above discussed Table 1.

Table 1: *Timetables for the experimental part of the research.*

Date	Chapters/Titles
Normal group	
22.2.2016	Chapters 33&34: Polynomials and the addition of them
25.2.2016	Chapter 35: Subtraction of polynomials
26.2.2016	Chapter 36: Addition and Subtraction of polynomials
Suggestopedic group	
21.3.2016	Chapters 43 & 44: Revision: Equations and their solution step by step
24.3.2016	Chapters 45 & 46: Different equations and brackets in them
31.3.2016	Chapter 47: Rational Equations
1.4.2016	Chapter 48: Applications of equations

From Table 1 there can be found the dates, the exact chapters and the themes of each lesson of the experimental part. Each lesson will be analyzed in the following subchapters analytically. This table gives a visual representation of the study case.

Before moving to analyzing each lesson, some general information about the context and the participants will be presented. Tampereen normaalikoulu, in English translated as Teacher Training School, is a school which can be found by the address Kuokkamaantie 16 in the city of Tampere. As its title shows it trains future teachers with cooperation with University of Tampere. The school enjoys great independence. The Teacher Training School offers basic education (grades 1–9) as well as high school education. Every year there are 900 students in the Teacher Training School, and around 300 student teachers complete their training at this institution. [29]

As it can be found from the school's webpage: "The aim of the Tampere University Teacher Training School is to engage in high-quality teacher training and close collaboration with the university. Additionally, the school ensures high-quality curriculum work and teaching and develops multi-faceted teacher training as well as the use of educational technology." [29]

All the above-mentioned aspects create a present environment for innovations and researches. It is worth remembering that conducting a teaching research has a significant impact on students' lives and their knowledge. Huge responsibility was deposited on the back of the researcher, who understood that she has a huge responsibility in front of the students because their time could not be wasted. For eliminating that risk a very well-planned research was designed.

The research was conducted in the middle school and the participants of the experimental part were 8th graders from that school as it has been mentioned above. The class had 16 students all together from which 10 were girls and 6 were boys. The participants had Finnish as they mother tongue except of one student. This student had strong enough language level to manage in math lessons and for this reason the group is assumed as homogenic. More information cannot be published due to privacy reasons.

3.2 Aims

Goals of the research are divided into two big categories:

- Mathematical Skills
- Non-mathematical and social skills

Let's look at them more analytically.

By referring to mathematical skills, we refer to the ability to solve equations, understand more difficult problems, have the chance to work with some applications, be creative and start learning how to think in an abstract level.

By referring to the non-mathematical ones, we are speaking about the psychological impact of Suggestopedia. The goals are: to raise students' motivation, to raise their confidence, to make them generate positive emotions while studying math, to make them manage to cope with freedom and understand the relationship between freedom-responsibility.

In a social level, the goals are: critical thinking, being able to make good presentations, to know how to speak, how to stand in front of the class, to learn how to work in groups and to be creative. As Lozanov has mentioned, in Suggestopedia there is a suggestological self-development of personality [25]. For analyzing that part, the book Beyond the numbers was briefly used [30].

As Suggestopedia was born in 70's, when different kinds of humanistic thoughts were born, it uses them to provide alternative ways to learn and teach. Suggestopedia is not labeled as a pure humanistic method, but rather as an approach having humanistic elements in it. [25]

Here are five emphases within humanism, which we can see in Suggestopedia:
1. feelings
2. social relations

3. responsibility
4. intellect
5. self-actualization   [25]

Improving social skills is a very important aspect, especially in the northern countries, where the percentage of suicides and depression is high. Finland is in the 17th place out of 100 countries in International Suicide Statistics [31]. Providing the feeling of safeness to the children, might reduce mental problems and will open the road to raise motivation towards studying math.

3.3   Research problem and research questions

The main research problem as it was presented in Chapter 2 is the lack of motivation of the students in studying mathematics. Furthermore, this problem has an impact generally in the society, where mathematics is associated in many people's mind as a very difficult and dry topic. From the following observations, the research questions are formulated:

1. How can you make a math lesson more attractive and interesting to students?
2. What is the most suitable teaching method in mathematics for avoiding "dryness" of the subject?
3. What kind of relationship during the lesson should students and the teacher have between themselves?

The above-mentioned research questions also correspond to the three main types of the research questions according to G. J. Miller & K. Yang. According to them: "There are three general types of research questions and they focus on description, normative issues, and relationships. Descriptive questions do exactly that—they describe something. The researcher answers questions involving issues of who, what, how many, and how much. Normative questions focus on ''what is'' and compare it with ''what should be.'' Relationship questions address relationships between variables and may be phrased in terms of association or covariance, or if the researcher is ambitious, cause and effect, or impacts or outcomes, and may predict future impacts. A single study might involve one single type of question or it could involve multiple, that is, all three types of questions." [31, p.51].

In the current thesis there exist three research questions, as we saw above, which correspond to the three analyzed general types of research questions. The first question can be assumed as a descriptive question. With that question, the researcher is trying to find a way to make a math more attractive and interesting to students

The second research question correspond to the second type, it is a normative question. With that question, the researcher is focusing on what is the most suitable teaching method for mathematics. It is worth wondering if the traditional method is the best teaching method.

The third research question corresponds to the third type and it is a relationship question. In this question, the researcher is wondering what the most ideal relationships in the classroom are, between the teacher and the student. What is the ideal environment for learning? Maybe an environment where making mistakes and asking questions will be not only accepted, but highly appreciated. Maybe a more relaxed environment with more sensory channels. At this point it is worth mentioning that the research problem and the research questions had been changed many times before they came out in their final form.

In the following subchapters, the lesson of each group will be analyzed - the normal and the treatment group. Details from the structure of each lesson and some general important remarks will be presented. Firstly, we will start presenting the three lessons of the normal group, where the students were taught with normal teaching methods used in Finnish schools. Afterwards, the lessons of the suggestopedic group will be presented. During that time, the students were taught with the Suggestopedia.

3.4   In normal group

The lesson of the normal group will be analyzed in this chapter. The theme of that group was Polynomials and the duration of the implementation was 9 days. During that period 3 lesson was conducted. In the end of the third lesson a test was given from the students' book Taitotesti. This test can be found from Appendix B. The teaching method was a normal method that is used in Finnish schools, but the lessons were designed to be more interactive than usual so the students would gradually be prepared for the implementation of Suggestopedia. The main structure behind the lessons was: from basic concept to more advanced exercises. New technology, as smartboard, was used during the implementation.

3.4.1   The first lesson

The first lesson was on 22.2.2016 on Chapters 33&34 "Polynomials and the addition of them" from the book Laskutaito 8 [28]. The goal was to meet the new class and create a warm working atmosphere.

Active participation of the students was the key for learning. For that reason, the lesson was planned and presented in the class using PowerPoint slides on the smartboard. It was noticed from the previous teaching experience that students were willing to participate and even come to write on the board, if the teacher was using the smartboard. The smartboard preserves all the color, which is more attractive for students. Playing some background music is an easy task with the use of it or presenting educational videos. For the above-mentioned reasons, the use of smartboard was chosen.

The lesson started with a welcome slide, which was opened right after the break so the students could see it while coming inside of the class. This was done on purpose for preparing the students for a friendly atmosphere and for rising their interest to follow the beginning of the lesson.

Below is presented the first slide of that lesson. It is worth mentioning that the language of the lesson was Finnish and that is why all the slides are in Finnish. Translation of the slides will be presented before or right after the figure. In this case, the teacher is saying: "Good afternoon!".

Figure 1: The welcome slide of the first lesson.

After the welcome slide and the teacher's presentation of herself to the new class, they went through the students' homework. The method of checking their homework was left the same as they had with their own teacher. The method is the following: during the break a group of 3-4 students write the exercises that they had for homework on the blackboard. When the lesson starts the teacher checks those exercises and corrects them if this is necessary.

It is worth mentioning that the own permanent teacher has a different vision about how the lesson should be. He is an amazing teacher, but he is not fun of using new technologies in his lessons. The role of the teacher is very strong during his lessons and the lessons are not very interactive. Applying Suggestopedia exactly to that class was very challenging, because the two teaching methods are so far from each other. It would have been completely challenging to teach students with Suggestopedia, without preparing them a bit. For this reason, the first three lessons, even though they were taught using the normal teaching method, were designed for being more interactive.

The lesson was designed using cognitive thinking and avoiding cognitive overload. From simple things, the students were lead to more complicated. The knowledge was not delivered as a readymade product as in behaviorism but through collaborative working. Teacher and student were building up theories or in our cases important rules for dealing with polynomials. They were together investigating why something works like that.

For this reason, after presenting the title of the current lesson and a small part of the theory, questions were directed to the students. In this way, they would follow better the lesson and from passive followers they turned to active participants, who were using their brain in understanding the new material. They shouldn't have known the right answer but they were asked to participate in investigating it.

The small theory which was presented was what is a monomial, binomial and polynomial through oral formulated definitions and through examples. Below, in Figure 2, the investigative slide is presented. During the lesson, the teacher wrote in the space near of each term the name of it, after asking students if they had any guesses. The happy smiley face in the right corner of the slide was giving an important information to the students.

The teacher asked if the students knew why those names were given to the terms. Since students did not know she explained that they come from Greek language, where the word μονο -/mono/ means "one", δυο -/dio/ means "two" and the word πολυ- /poly/ means "many". The goal was not to make students learn Greek language, but to understand that there is always a logic behind something in mathematics and even the names have some meaning. In this way, the names would also stay more easily in students' minds.

Below the investigative slide is presented. Translation of the slide: "Why are they called like this? What are the terms of the polynomials?". Happy face is thinking: "The sign is part of the term".

Miksi niitä kutsutaan? Mitkä ovat polynomien termit?

- x^2:
- $x^2 - 5x$:
- $x^2 - 5x + 2$:

Etumerkki kuulu termiin

Figure 2: The investigative slide.

After the investigation, a properly written theory was presented and explained, with some visual representation of monomials, binomials and polynomials. Afterwards the students were asked to make one exercise together with the teacher for applying the new learned theory. The exercise was asking to fill the gaps in the table containing monomials, binomials and polynomials. Students were raising their hands to answer and teacher was filling the gaps on the board. This is a good technique to use during the lesson because the

teacher directly gets a good picture of the class. The teacher can notice directly who understood the theory and who would need more explanation.

The students were given one more exercise, which was a bit more complicated. The students had to arrange the terms of polynomial -10+6x+3x2 according to their degree, from the biggest to smaller one. Afterwards they had to find the value of the polynomial, when the x=0. This exercise was asked to be written in their notebooks. The teacher was walking around the class and looking after if some student needed help. After the given time was expired the teacher solved the exercise on the smartboard.

The solid base for moving on was created. The next step was to teach to polynomial's addition. From previous experience it had been noticed that it was difficult for students in their age to understand that terms 3a + 4b cannot be added together. For this reason, the next visual representation was created. Look at the Figure 3.
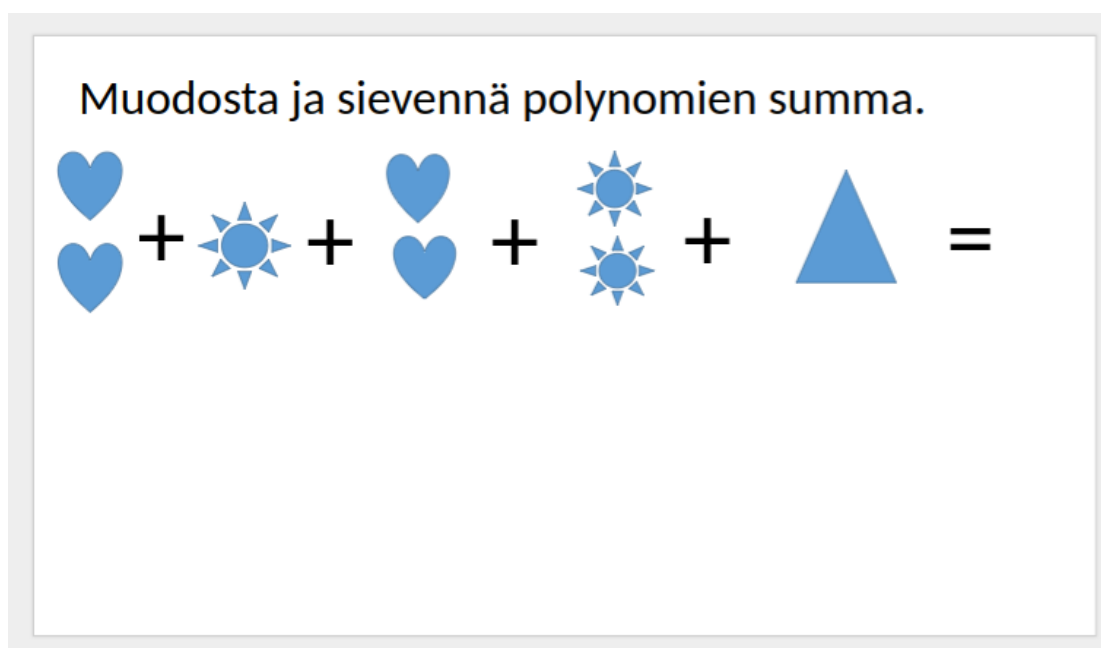
Figure 3: Teaching the addition of polynomials with visual representation.

The principle of addition in polynomials is illustrated in the above Figure 3. The sum of the given polynomial is asked to be formed and to reduced. Of course, in the beginning all the students started smiling. They were not ready for this kind of exercise. The teacher asked them to write their answers in their notebooks. Afterwards, some volunteer wrote the answer on the smartboard.

Everyone directly understood that you cannot add hearts, suns and triangles together. So, their answers were written as 4 hearts + 3 suns + 1 triangle in their notebooks. The goals of the teacher were accomplished. She underlined again that it would be super funny if someone would give an answer of 7 sunhearts since this thing doesn't exist. Then she moved the exercise to the next level. She replaced the hearts with the letter "h", the suns with the letter "s" and the triangles with the letter "t". On the smartboard, there was then written 2h+ 1s+ 2h+ 2s+ 1t. Now she pointed out that this was a mathematical expression.

The exercise asked the students to form the polynomial and this part was done. The other part of the exercise asked the students to reduce it. For doing it the principle of addition

of polynomials was needed, which was explained by the teacher. Mathematically, the following was written on the board:

2h+ 1s+ 2h+ 2s+ 1t   =   Underlining the same terms

4h+ 3s + 1t   =   Adding the same terms

4h+ 3s +t.   Reducing the expression

                         (coefficient 1 is not written usually before the term)

The theory of addition of polynomials was explained and more exercises were done collectively, firstly students were writing the answers in the notebooks and afterwards some volunteers were presenting the solution on the board. The teacher was correcting them if there was a need for that.

Next exercise was the verbal counting. It was done for reminding to the students how the signs outside of the brackets are behaving. The exercise that was given is the following:

Reduce:

- - (- 2x)
- - (+ 2x)
- + (- 2x)
- + (+ 2x)

As it was suspected by the teacher this exercise caused a bit of confusion. This part is always difficult for students so it was a good idea to revise it. After the revision, things were clear and students were ready for more advanced exercises. One more exercise was done collectively and afterwards the students were given a list of exercises that they should solve alone or in small working groups. The teacher was walking around the classroom and helping those ones that needed help. They had twenty to twenty-five minutes for themselves left. This practice section is a very important part of the lesson because the students have the chance to apply the new learned material directly in practice and ask for help if that is needed. Students that were advanced were given more demanding exercises after they had shown the previous done exercises to the teacher.

It can be stated out that the lesson was good. The students met a new teacher and they accepted her. The new method of teaching seemed to be attractive for them, since they were active during the lesson. The practice section in the end of the class showed that they understood the theory and they could apply it. Some of the students were already solving more demanding exercises in the end of the first lesson.

3.4.2 The second lesson

The second lesson was on 25.2.2016 on Chapter 35 "Subtraction of polynomials" from the book Laskulaito 8 [28]. The lesson was planned to use the same principles as the first one. The students were offered to have an active role during the lesson. The material was

presented following the direction from the basic ideas to more complicated details. Furthermore, the knowledge was not given as a readymade product, but the teacher had designed questions leading the students to discover the new theory by themselves.

The lesson started in the same way as the first lesson described above. A welcome slide demonstrated in Figure 1, was on the smartboard, while the class went through their homework on the blackboard. There weren't any specific difficulties with the exercises from the homework so it was the right time to move towards the new material.

The topic of the current lesson was presented and an exercise was given to the students. That exercise was made by the teacher on the board, while students had an active participation. Below is presented the given exercise.
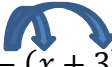
Tehtävä 1

Sievennä
1. $-(x+3)$
2. $-(x-3)$
3. $-(-x+3)$
4. $-(-x-3)$
5. $+(x-3)$
6. $+(-x-3)$

Figure 4: The first exercise of the second lesson [28].

In Figure 4, the first exercise of that lesson is presented. The students were asked to reduce the given mathematical expressions. Operations with negative numbers were already taught to them last year and after the revision of them in the previous lesson, this exercise had just one new feature - a polynomial in brackets. After asking some guesses how the students would solve this exercise, the teacher reminded that the negative sign outside of the brackets is affecting all the terms inside the brackets. The following picture was drawn on the board.

$$-(x+3) = -x - 3$$

The students were familiar with working with a negative sign outside of the brackets by the end of that exercise. The next step was to present subtraction of the polynomials. The teacher explained that a subtraction of polynomials can be treated exactly in the same way as the previously made exercise, just by remembering that the negative sign outside the brackets is distributed to all the terms inside it. Here are the steps that were presented to the students:

1. Open the brackets
2. Combine like terms

3. Make the necessary operations, addition or subtraction
4. Write your answer in proper form (terms are written in decreasing order - the larger exponent first etc.)

Next is presented the example exercise that was made on the board.

Simplify: $5x^2 + 5x + 7 - (2x^2 + x + 1)$

$5x^2 + 5x + 7 - (2x^2 + x + 1)$	$=$	Open the brackets
$5x^2 + 5x + 7 - 2x^2 - x - 1$	$=$	Combine like terms
$5x^2 - 2x^2 + 5x - x + 7 - 1$		Make the necessary operations
$3x^2 + 4x + 6$		Write your answer in proper form

The teacher made sure that the following steps were understood by everyone. Afterwards, the students were divided into small groups and a small mathematical game took place. The game was the following. Nine small exercises of subtraction of polynomials were given to the students. The answer of each was matched with a letter. After solving correctly all the exercises the students would have found the name of an ancient Greek mathematician. The winner group, would be the group that would find the correct name and would write it first on the blackboard.

This exercise was taken from the school book but it was redesigned a bit and presented to the students in a form of a game. The goal was to raise their motivation. The students were very keen on winning the game so they started directly to solve the exercises. Since they were working in groups they were helping each other. Almost all the groups found the name at the same time and that's why it was decided that the winner was the whole class.

To conclude the collaborative part of the lesson, the teacher presented one more exercise. That exercise was a bit more challenging, but the students were happy to solve it. Afterwards, the practice part of the lesson started. The students had time to solve the exercises by themselves, while they could ask the teacher for help. They were also allowed to work collaboratively, in small groups of two or three people. Almost all the students preferred to work alone and asked for the teacher's help when that was needed.

For raising student's motivation during the practice session, the teacher pointed out that the homework will be given from the list of the exercises which were given for the practice section and were written on the blackboard. In other words, the more exercises a student solved during the practice section in school, the less he/she got as homework. The students were very happy with this arrangement.

The second lesson was successful. The students were active and less shy. They learned the new given material and they were able to cope with more demanding exercises. They looked happy and it was pleasant for them to be in the classroom.

3.4.3 The third lesson

The third lesson was on 26.2.2016 on Chapter 36 "Addition and Subtraction of polynomials" from the book Laskutaito 8 [28]. This lesson was a revision lesson for the two previous lessons, while more complicated exercises and problems were given to the students.

The lesson started again with the welcome PowerPoint slide, which can be found in Figure 1, on the smartboard and the exercises given as their homework on the blackboard. Because a normal lesson was conducted, all the above principles from the sections of the first and second lesson were followed.

In the beginning of the collaborative part of the lesson an exercise with subtraction was given. A volunteer student solved it on the smartboard. Next step was to get into more demanding exercises so the following exercise was presented on the board.

Write the mathematical expression that is asked below and evaluate it, when x= 5.

a. Add monomial 7x to binomial 2x+8
b. Subtract binomial x-4 from monomial 3x
c. Add binomial 8x-4 to binomial 10-x
d. Subtract binomial 2x-5 from -x-6

The students were given time to think and to solve the exercise in their notebook, after the teacher gave them some hints. In the end, the solution of the exercise was presented analytically on the board by the teacher. The teacher's solution can be found below.

Solution:

a) $(7x) + (2x+8)$ $=$ Open the brackets

  $7x+ 2x+8$ $=$ Combine the like terms/make the necessary operations

  $9x+8$ Write your answer

  When x=5, Plug "5" instead of x in your answer
  $9(5) +8$ $=$ Calculate
  $45+8$ $=$ Write the answer
  53

b) $(3x)- (x-4)$ $=$ Open the brackets

  $3x-x+4$ $=$ Combine the like terms/make the necessary operations

  $2x+4$ Write your answer

  When x=5, Plug "5" instead of x in your answer
  $2(5) +4$ $=$ Calculate
  $10+4$ $=$ Write the answer
  14

c) $(8x-4) + (10-x)$ $=$ Open the brackets

8x-4+10-x	=	Combine the like terms/make the necessary operations
7x+6		Write your answer

When x=5,		Plug "5" instead of x in your answer
7(5) +6	=	Calculate
35+6	=	Write the answer
41		

d) (-x-6)- (2x+5)	=	Open the brackets

-x-6-2x-5	=	Combine the like terms/make the necessary operations
-3x-11	=	Write your answer

When x=5,		Plug "5" instead of x in your answer
-3(5)-11	=	Calculate
-15-11	=	Write the answer
-36		

After the teacher's solution on the board, the students had a clear picture of the solution and possibly existing misunderstandings were vanished.

The second exercise that was presented was taken from the school book Laskutaito 8 [28]. In the student's opinion that exercise was more challenging. Below is presented that exercise.

Tehtävä 3

459. Päättele, mikä polynomi sopii ruutuun.
a) $(8x + 5) + (\boxed{}) = 0$
b) $(\boxed{}) + (-4x - 1) = 0$
c) $(3x^2 - 6) - (\boxed{}) = 0$
d) $(\boxed{}) - (4x^2 + 2x - 3) = 0$

Figure 5: The third exercise of the lesson [28].

The exercise in Figure 5 was the third exercise of the lesson and it asked the students to find a suitable polynomial for the empty space. In student's opinion that was a challenging exercise, but after they got the main idea behind it with the teacher's help, they could process in solving the rest of the exercises without any problems.

One more exercise was done on the board, before moving to the practice part. Usually, the students were given the exercises, which they were solving alone or in small groups. In this lesson, the number of students who wanted to work in a group raised. That could be caused from the level of the given exercises, since they were more demanding. On the other hand, that phenomenon could be also caused by the fact that the students got familiar with the idea of group working and they started liking it.

In the end of the lesson, a short test from the course book Laskulaito 8 [28] for 10 min was given. The test can be found from Appendix B. The results of the test will be analyzed later in Chapter 4. Overall, the lesson was good and the challenge for applying Suggestopedia was already very near.

3.5   In suggestopedic group

This section is devoted to the application of Suggestopedia in mathematics and it is forming the experimental part of the research. Here the suggestopedic lessons will be analytically presented accompanied with photos from the classroom. The faces of the students will be covered for privacy reasons. The main focus here is the application of Suggestopedia. For this reason, many teaching details not connected with Suggestopedia are left out, since they were already analyzed in the previous section.

In the following chapter, the ways Suggestopedia was implemented to 8th graders are described.

During the second part of the teaching experiment, the environment of the classroom had changed. The students weren't obligated to sit on chairs during the whole class. The classroom had bean bags and round working tables. Furthermore, outdoor shoes were not used in the classroom. That was also aiming to make the atmosphere more relaxed, as if they were home.

The lesson had three main parts: warm up, active concert and passive concert.
- Warm up: By this term we refer more to the warm up of the brain. The students formed a big circle in the middle of the classroom and threw to each other the microphone, which was a children's soft ball, while asking easy questions related to math.
- Active concert: The presentation from the teacher of the new material, presentations from students as part of their homework, group works and individual work were included in this part of the lesson. Classic music was played in the background in some parts.
- Passive concert: Relaxation, called passive concert, was held in the end of some lessons, where the new material of the lesson was presented. During that time, the lights were switched off, relaxing music was played, while the teacher with steady and relaxing voice was reading the basic theory related to the current subject.

Important aspects during implementation

- **motivation-**

- One of the most important goals was to raise the students' motivation. Learning must be an interesting process that was made for yourself and not for the results of some test. Furthermore, the learning process shouldn't stop after the test, but the mental journey must continue afterwards. The students must understand that they don't learn for the test but for themselves.

- **freedom-** breaking the conservative idea of school
  - More freedom is given to the students. They were allowed to move in the classroom freely, to choose the way and the place where they wanted to work. The teacher's role can be described better with the words "guide" and "instructor".

- **responsibility-** the other side of the freedom
  - Since they were given more freedom, their responsibility was raising. This was a very important relationship to be understood.

- **confidence-**
  - Numerous researches have shown that many students don't have confidence in math and especially in algebra. They don't believe that they are able to understand and solve any problems. They think that math is a subject for clever and gifted students and they can't believe that in school level, everyone can achieve good results just by making some efforts.

- **creativity and abstract thinking-**
  - These opportunities were offered through homework. At home, they had the chance to use their creativity and to prepare presentations. Afterwards, in the class, they had the possibility to dig more about those topics by listening to their classmates' presentations as well as the teacher's. Presentations could have any possible form: writing on the blackboard, using the projector, using PowerPoint slides or even singing a song or making a theatrical play.

- **spiral learning-**
  - Even though the time was quite short, the students should be encouraged to use every possibility to dig deeper in the subject every time they came up with it.

3.5.1 The first lesson

The first lesson was on 21.3.2016, almost a month later, on Chapters 43 & 44 "Revision: Equations and their solution step by step" from the book Laskulaito 8 [28]. The idea of the lesson was to revise the material from previous years and to move onwards. Based on the results of the previous test, which were very good, the idea of teaching in a bit higher level was born. However, it was not a genius idea, as it was proved in the end of the lesson.

The lesson started in the middle of the class by making a big circle. There was a microphone, a children's soft ball, which the students and the teacher were throwing to each

other while asking questions. In the beginning, the questions were not related to math, but after 2 or 3 throws, the teacher started asking to make easy math computations.

It was a big surprise when they were trying to throw the ball to everyone and not just to their friends. Despite this fact from the Figure 6 below, can be noticed that inside of the big circle, there are some subgroups. Students feel more comfortable to stand closer to their friends than to random classmates. This phenomenon was reduced during the next implementations.

In the beginning, students were feeling shy. The teacher assumed that their shyness was caused from the fact that they had to share their mistakes with the other classmates. Usually the students were trying to raise their hand to answer, only when they were sure that the given answer was correct. In this situation, they didn't have this choice. The teacher underlined many times that making mistakes was a natural thing during the process of learning. Slowly-slowly the students started realizing it.

The shyness can be easily seen from the body language of the Figure 6 below. There is small awkwardness. Almost all the students are having their hands in front of them or in their pockets. The photo is taken exactly in the beginning of the lesson and that is why those signs can be usually noticed. But by time the students were feeling more relaxed and comfortable, so many of them took their hands from the pockets and started participating in throwing the ball/microphone more actively.

Figure 6: The students during the warm up.

This was the warm up part of the lesson. Afterwards, the students could sit wherever they liked: around the round tables or in the bean bags. The boys were extremely excited to sit there, while the girls preferred to sit around the table.

The active concert started by revising the equations, while it had been assumed that they knew the basics from last year. As the lesson was progressing more formal notation was introduced.

It was the time to speak about moving the terms from one side of the equation to the other, by changing the sign without including all the steps in solution (for example, adding or subtracting numbers from both sides of the equation). That caused some troubles due to the different level between the students. Since that part of the lesson was the active concert, classical music (Vivaldi-Four Seasons-Winter) was played in the background, while the teacher was explaining the new theory. The students seemed surprised but they were happy.

Group work took place afterwards. This group work was named as "group work in terminals", since different group works were designed in four different places inside the classroom. The students were divided into groups and each group was occupying one point-terminal. After the given amount of time and the teacher's command, the groups were rotating clock wisely.

For that group work bananas, oranges and some geometrical shapes were brought into the classroom. One terminal task was to formulate equations with the help of a scale, using bananas, pens, Legos or whatever was available there. In Figure 7 there is a photo from the group work, while they were trying to find the balance in the scale and formulate the equation using the given objects.
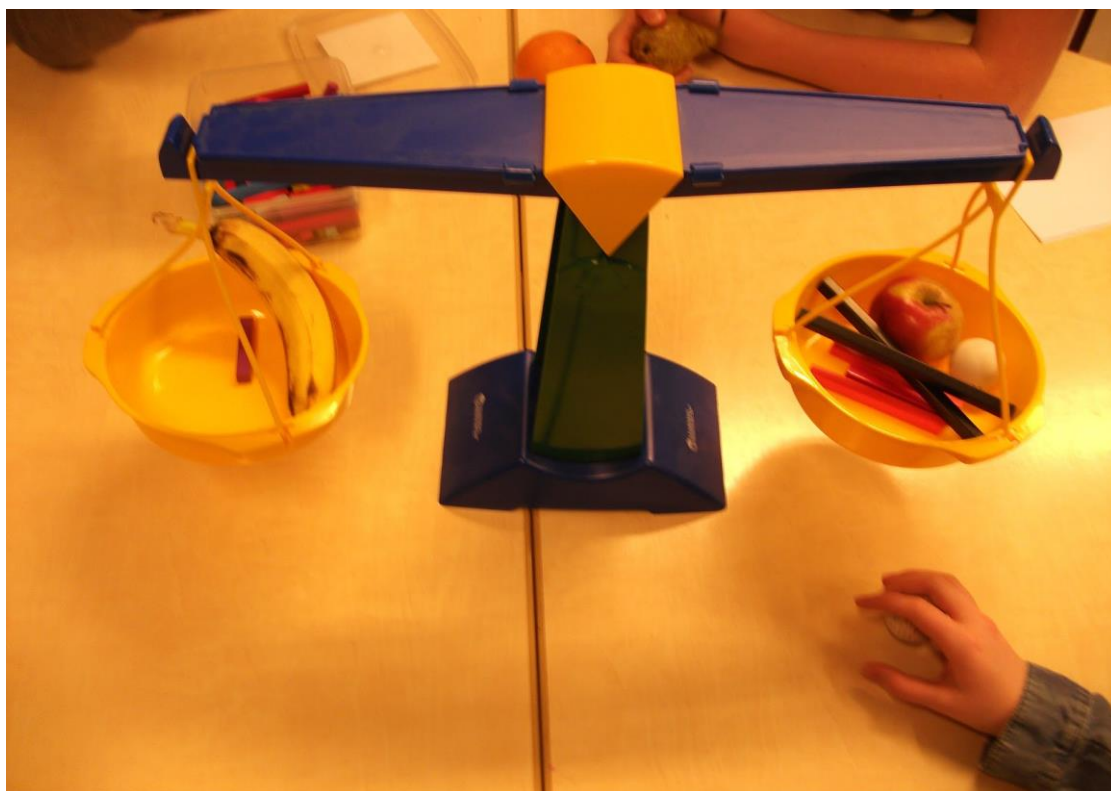
Figure 7: *From group work: making equations.*

The principle of equation was shown to the students as it is illustrated in the Figure 7. Here, the students of the group found the balance of the scale and with the help of the teacher started thinking how to form an equation out of that balance.

After some time, they ended up with the following equation:

1 banana + 1 lead refill tube = 1 apple + 1 pingpong ball + 2 black pens + 3 red pens

Replacing the names with letters we have the following form.

1b + 1l = 1a + 1b +2 bp + 3rp

The above form is a mathematical expression, which is representing the balance of the scale. Now, equations started to appear more attractive to the students, even though they had some difficulties in the beginning with understanding the task. As it turned out for them the question did not have any meaning previously, it was just some symbols written in a piece of paper. After that task students understood why they were taught equations in school and how important they are in their life.

Food break followed for 30 minutes. Afterwards, the scale was put in front of the classroom, and the basic idea of what equation is, was explained in front of the whole class. One girl had the courage to ask exactly that question before the food break, so the teacher found a fertile ground to underline that this was her question. The teacher also said that it was a very good question, something that made the girl very happy. Furthermore, it was good for the other students also, who understood that making questions were accepted and even appreciated in the classroom. Some more example exercises were made on the blackboard by the teacher and then the students continued working individually.

For individual work, some exercises were given from the school book, while some more exercises were prepared by the teacher. There was a difference in the level of the students, so that aspect was considered. In Appendix C can be found some of those exercises.

In the end of the lesson, passive concert was held. Students sat on bean bags, closed their eyes and relaxed. The lights were switched off and relaxing music was played in the background (part of the song from a secret garden), while the teacher was reading with stable and not loud voice, the summary of the theory of the current lesson. Below can be found the text that the teacher read.

Passive concert text: "Make yourself comfortable. Close your eyes. Breath calmly. Relax your body and your brain. Imagine that you are in your dream place." The teacher waited until everyone found a comfortable place and until students' breath became calm. Then she continued: "Today our theme was solving equations. First step in solving equations is separating constants from variables. Move all the variables to the left part of the equation and all the constants to the right part of the equation. Remember by moving terms from one side of the equation to the other, you need to change the sign. Afterwards, combine like terms and make the necessary operations. Last step is to divide both sides of the equation with the coefficient of the variable. Now, on the right part of the equation we have the answer." After finishing the reading of the theory, the teacher was quiet until the end of the lesson. Two minutes before the break started, the teacher suggested with calm voice to the students to start waking up their body and brain for continuing the school day.

Here are some remarks from the passive concert. The boys were very happy to go and sit on bean bags, while some girls decided to stay and sit around the table. There wasn't any pressure from the teacher, but she encouraged them to try new things even if they might look a bit strange in the beginning. The lesson was very nice, but still the atmosphere was

not so relaxed as it was targeted, which is very understandable, since they had just been introduced to a completely new method and they were still very shy.

As homework they were given equations, which had to be solved. Those equations can be found in Appendix D in the end of the thesis. After solving them, they had to put their answers into the paper in random order and create a painting. They were given the chance to use their creativity and imagination to produce a piece of art, even in a math lesson.

3.5.2 The second lesson

The second lesson was on 24.3.2016 on Chapters 45 & 46 "Different equations and brackets in them" from the book Laskulaito 8 [28]. The lesson started with the warm up part. The students were asking each other to solve easy equations, while they were throwing the ball/microphone.

Next was the active concert: some specific cases of how to solve equations were explained on the blackboard with the same background music as it was used during the active concert in the first suggestopedic lesson. Afterwards, they had a lot of time to concentrate on solving exercises. They could choose if they wanted to work individually or in groups. They sat around round tables and formed four groups. All of them chose to work individually, but they were having small discussions every now and then, when some members of the group had some difficulties.

The teacher had prepared more demanding exercises for the students who were willing to try them out. It turned out that there was not enough time for solving the given exercises from the course book and the exercises in the teacher's photocopy. For this reason, this photocopy was asked to be brought to class next time.

Another interesting thing, which was observed was that almost in every group, there was only one student with more difficulties in solving equations. Without realizing it, they divided equally the students with more difficulties into the groups. All the members of the group were very keen on helping each other and especially those ones with more difficulties. It was extremely nice to observe this as a teacher.

Homework has a special role during the suggestopedic lessons. Expect of learning the new material well, it has an art dimension on it. That is the reason why during the previous lesson students were asked to create a painting. As it turned out everyone solved the equations, which were given to them as homework, but only one girl did the painting.

The next homework made a bigger step in the directions of creativity. Since they would have had almost a week until the next lesson, because of Easter holidays, they were asked to make a presentation about equations. They weren't given any precise instructions on purpose, just some general guidelines and few examples of what they were expected to do. Some of the given examples were:

- make a song with lyrics related to the topic and sing it
- make a game that could be played in the class
- make a historical presentation
- anything else

In this group work, they could choose the members of the group. In the end of the lesson the teacher had a list, with the group name and the students in it. It was underlined to them that the purpose of that homework was to have a nice time with friends while doing math and be creative. All the materials had to be sent by mail to the teacher until Wednesday 12:00 in the afternoon, since the lesson was on Thursday.

The reactions of the students when they heard about the homework, were multiple. Firstly, all of them were very surprised. After a short time, the teacher asked if they liked the idea. No one really replied. Then the teacher asked every group and every group member individually, while she underlined that this was invented for them and if they didn't like the idea, they could switch to normal math exercises. Everyone said that they were ready to work on the presentations, while one girl stated out that it was a nice idea but not as every day's homework. The teacher assured her that would never happen, during a normal working week.

Passive concert was held in the end of the lesson exactly in the same way as it was held in the end of the first suggestopedic lesson. During that lesson, some girls became more courageous and went to sit on the bean bags. The lesson overall was good and the students were able to solve the basic exercises from the course book.

3.5.3 The third lesson

The third lesson was on 31.3 on Chapter 47 "Rational Equations" from the book Laskulaito 8 [28]. This lesson was taking the students' knowledge one step ahead and it seemed like the students were ready for that step.

The lesson was prepared well by the teacher. The only thing that was making her anxious was the homework. She was wondering if they managed to do it and if they were interested in doing it, because only one group had sent her their presentation.

The teacher had prepared one presentation related to the topic as well. In that presentation, the teacher would turn to be a magician. The outfit was also considered. A black hat, which is usually used by magicians was taken to the class. The teacher wore also comfortable and bright colored clothes to get the students' attention and to make them feel relaxed, since there still were some students quite skeptical about the new method.

The lesson started normally with a warm up. A circle was made and the students were solving easy equations while throwing the ball. After that, the teacher said that it was time for presenting their homework and asked the only team that had sent a presentation to her e-mail to start.

This team was a girls' team. Their presentation contained one nice slide with the basic theory of equations. They presented their material very well in front of the class, while they were a bit shy. The teacher praised them after their presentation, while she pointed out the good sides of the presentation. The girls seemed very satisfied.

The next team, which was asked to present was a boys' team. It was a big surprise for the teacher when they stood up, because they hadn't sent any material to her e-mail. Their presentation was about the history of equations, starting from Babylonians. The teacher was extremely happy to observe their group work, because it was truly a group work. In

this team, there was one boy from abroad, who had some difficulties with the Finnish language and all the other members of the team were helping him with pleasure.

Next group was again girls' team. They had prepared the game bingo and they hadn't either sent their material to the teacher's e-mail. They walked towards the blackboard and started writing the equations. They assumed that everyone knew how to play, so the teacher had to coordinate them a bit and make them understand that the rules of the game weren't known by everyone. That was done by encouraging one boy to ask about the rules from the girls and not by the teacher. The game went very well and many students managed to make BINGO. Below we can see a picture of the girl's presentation, the game BINGO.
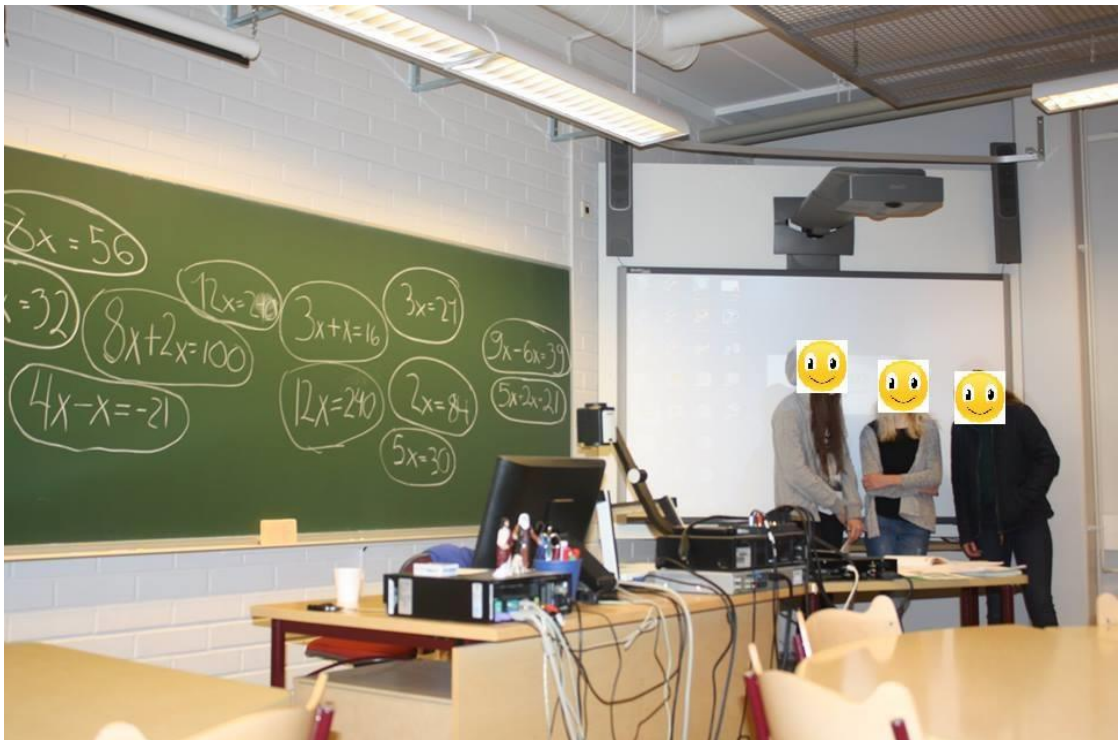
Figure 8: *Student's presentation, the game Bingo.*

There was one more group left. It was again girls' team but they had not prepared anything. They claimed that some of the members were sick, so they didn't have time. It was interesting to observe that they did not form any group, where there would have been both girls and boys. The groups were clearly divided by the gender and by the friendships.

It is worth mentioning that a questionnaire had been prepared and it would have been given to the students in case no one would have done the homework. They would need to explain the reason of not doing the presentation. The questionnaire was anonymous and aimed to understand the students' psychology. Below are multiple choice answers:

A.   I did not have enough time
B.   I was not interested
C.   It was hard task
D.   Problems with group working
E.   I was afraid of presentation
F.   Other reason: _____

According to the plan of the lesson, the questionnaire was supposed to be given to them at that point of the lesson, but it turned into a nice surprise when everyone had done such a good work so giving the questionnaire was considered unnecessary.

The teacher's presentation was left to the end. The teacher turned into a magician, wearing her black hat. Some of the students were looking at her strangely. Maybe they were thinking: "How can a teacher wear this hat during the lesson". But this was the purpose. To get students away from the traditional way of thinking about what a lesson is and what role a teacher has, and get used to the new teaching method. In Suggestopedia teacher and students have different manifestations. In Figure 9 there is the photo representing the teacher in the role of a magician.

Figure 9: *Magic in action.*

The magic trick was the following. The teacher asked the students to choose a number in their mind without saying it loudly. That was their imaginary number. After making some operations (addition, multiplication, subtraction), which were instructed by the teacher the students gave the result to her. The teacher's job was to guess their imaginary number.

The trick worked very well. The teacher/magician guessed all the students' imaginary numbers. The students were interested in how this could work. After the teacher had guessed everyone's imaginary number, she asked the class if they knew how the magic happened. One clever boy had noticed that the teacher always subtracted from the given answer the number 3. The teacher was very happy that he noticed that, even though he didn't know why this happened.

In the end, teacher and students went through the magic with the help of mathematics. They formed equations from the steps that the teacher asked them to do just a while ago. Now, everyone could guess the imaginary numbers by solving simple equations. This trick was aiming to raise the student's interest. Maybe they would make that trick to some friends. That would make them continue solving equations with pleasure, even in their free time.

The lesson continued with active concert and the practice section, when they had their own time for solving equations. During that lesson they were offered the choice to continue solving exercises or having passive concert. Most of the students, basically everyone except two students, wanted to have passive concert so in the end of that lesson the passive concert took place. In Figure 10 below, there is a photo of that day's passive concert.

Figure 10: Passive concert in the end of the lesson.

That lesson was evaluated by the teacher as the best of those four suggestopedic lessons in the end of the research. There are multiple reasons for that. The students started getting used to the new method, they became more familiar with the teacher and accepted the new perspectives. They were active participants and they enjoyed the new features of Suggestopedia. For example, passive concert was held in the end of the lesson because the students voted for it. They started to develop their artistic side using mathematics and they were not afraid of demonstrating it. They stopped feeling so shy and could relax and enjoy their time there. The atmosphere in the class was nice and friendly contributing for cognitive learning.

3.5.4 The last lesson

The last lesson was on 1.4 on Chapter 48 "Applications of equations" from the book Laskulaito 8 [28]. It was a revision lesson, which contained more advanced applications. It was the last suggestopedic lesson and the last lesson of the whole experimental part.

The lesson started as usual with the warm up. Afterwards a math competition took place. Two students were chosen as captains of the teams and they had the right to choose the member of their teams. Furthermore, two of the students were chosen as judges by the class voting.

The competition was held in the following way. One team at a time was on the blackboard solving exercises during a specific time (they had 1'30" time), while the others were following their solution. The exercises of the competition were presented on the smartboard and they were prepared by the teacher. Both teams had similar exercises.

The judge's job was to say if the answer which was written on the board, was correct or wrong. If the answer was correct, the current team would get 2 points, if it was almost correct 1 and if it was not correct 0 points. The other team had the right to oppose the judge's decision. If they saw a mistake on the blackboard that the judges hadn't noticed, then they would get the points of that exercise.

The teacher paid also attention to the first slide of the presentation. In Figure 11 there can be found the first slide of the competition, which was on the smartboard while the teacher was explaining the rules of the game and while the students were forming the groups. The title of the first slide is "Applications of equations - Group works", has a powerful message.

Figure 11: *First slide of the math competition.*

An English language idiom says: "A picture is worth a thousand words and this is what it is illustrated in the above Figure 11. By using that slide, the teacher wanted to demonstrate the power of group work and how it should be conducting for reaching the best possible results.

Below some of the exercises are presented that was included in the competition. Letter a) is showing the exercise given to the first group and the letter b) the exercise given to the second group.

1) Solve the equation
   a. $2x + 3 = 4x - 11$
   b. $5x + 3 = 10x - 12$

2) Solve the equation
   a. $0{,}5x = 0{,}1x + 0{,}8$

    b. $0,9x = -0,1x + 5,5$

3) Solve the equation

    a. $\frac{3x}{6} = 4$

    b. $\frac{5x}{7} = 5$

4)

    a.   What should be the value of the variable x so that the expressions $3x + 4$ and $x-2$ would get the same value?

    b.   There are given two polynomials: $P(x) = 2x + 4$ and polynomial $Q(x) = -3x + 7$. At what value of x the polynomials get the same value?

5)

    a.   There are given three polynomials: $P(x) = 2x-2$, $Q(x) = x + 1$ and $R(x) = x$. Solve the equation when $Q(x) = 3R(x)$

    b.   There are given three polynomials: $P(x) = 2x-2$, $Q(x) = x+1$ ja $R(x) = x$. Solve the equation when $P(x) = Q(x) - R(x)$

Those were some of the exercises, which were given to the students during the math competition. One more exercise containing principles of calculating areas with the help of equations was included in the competition. That exercise was taken from the photocopy that was given to the students during the second lesson and was aiming to help them.

Unfortunately, that game didn't work out well. Some of the students didn't want to participate, so they started looking around and talking to their friends. Two of those students had many difficulties in mathematics generally, so they went and sat away from both groups. Since they didn't participate in the competition, exercises from the course book were given to them [28]. A couple of other students were looking at the religion's books that were nearby in the shell, so the teacher had to give them a note.

At this point it is worth mentioning that on that lesson, there were many students that had come to the suggestopedic lesson for the first time, because they had been either sick or in special teaching. They didn't have any clue about the method and many of them had many difficulties in solving basic equations. Giving them so much of liberty at that point was not a good idea, since they were not able to be responsible for their own learning.

At this point it is worth mentioning that even that lesson is not considered as one of the best in the teacher's opinion, one student is mentioning it in his positive comments in the questionnaire that was given to them in the end of the experimental part. That comment can be found from the Chapter 4.2 and the questionnaire in Appendix A.

After the game, the need of explaining how to solve basic equations was clear. The teacher explained and reminded on the board to the students the basic principle of solving equations. As examples were taken the equations from the competition.

Practice section followed. Students had time for their own work on more advanced exercises. Those exercises were prepared by the teacher. Some of the students needed to concentrate in solving basic exercises and they were assisted by the teacher in doing that.

In the end of the lesson the second test was held. That test can be found in Appendix E. The teacher was surprised positively when many students were asking for a passive concert. Unfortunately, there was not any reason for making passive concert from the point of view of suggestopedic theory, since the passive concert is held to revise the new learned theory. New theory was not presented during that lesson, since it was a revision lesson so passive concert was not included in the plan of the lesson.

In the teacher's opinion the lesson cannot be considered as a successful lesson. Students were not able to be responsible for their own learning, while they were given more freedom. Many students were not familiar with Suggestopedia (it was their first lesson) so coming to the fourth lesson and joining an advanced lesson from many points of view, was hard. The lesson was assumed advanced regarding to the level of math exercises that were asked to be solved. From suggestopedic point of view the level was also advanced due to high skills of group working which were requested.

Despite of those disadvantages, the teacher believes that the lesson was satisfied, since testing one's own and the class' limits, is a good thing and maybe the only way that can contribute so much to one's future development and to widening one's horizons.

4. RESULTS AND DISCUSSION

In this chapter the results from both tests, which were made in the end of each set of the lessons will be presented. The tests can be found in Appendix B and E, in the end of the thesis. Furthermore, here will be presented an analysis of the results of the questionnaire, that was given to the students in the end of the experimental part. The questionnaire can be found in Appendix A.

4.1 Mathematical skills- test results

The average of the first test from the book Laskulaito 8 was 8.17/10 and the average of the second test from the same book was 6.5/10*. Below in Figure 12 can be found a visual representation of those results.
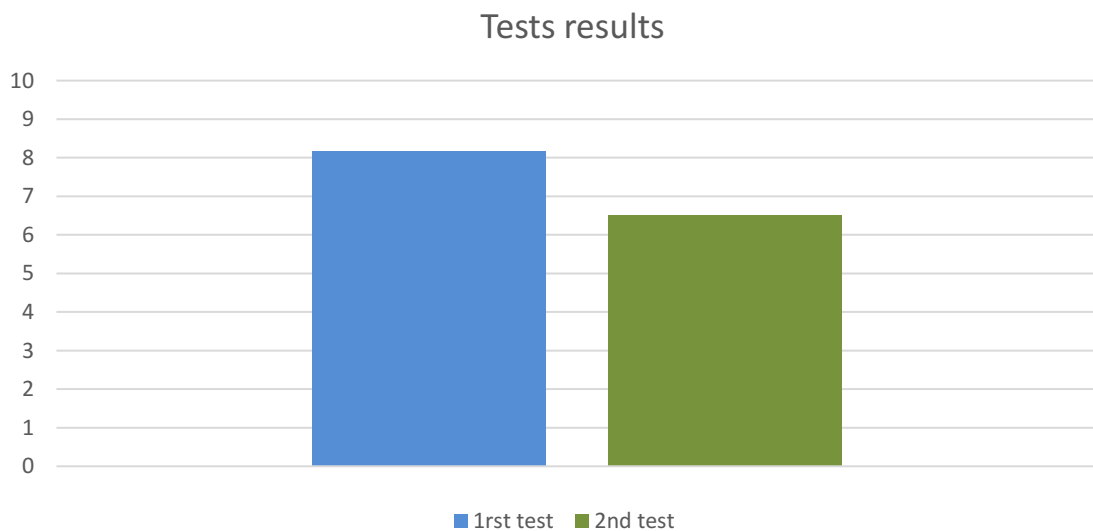
Tests results

Figure 12: *Students' results from both tests.*

Even though we see from the Figure 12 that the percentage is dropping, the short time of implementation as well as other challenges have affected that drop. Those challenges are presented explicitly in Chapter 4.3.

The importance of the grading system is worth mentioning at this point. Both tests were designed for measuring the performance of the students with normal teaching method. The current grading system is concentrated on performance of students in the test and do not count in any way their motivation or the depth of the gained knowledge. Despite those reasons, it was chosen for validity reasons. Another important aspect was the lack of time to design a completely new grading system and to apply it just for four lessons in the class.

In conclusion, we can state that the mathematical skills are satisfied. The student had the chance to work with more advance level problems, be creative and to think in an abstract

level. The average from the last test, shows that the ability of solving basic first-degree equations is present in more than half of the students.

* the average is calculated from the students that had been at least twice during the lessons.

4.2 Social and non-mathematical skills -questionnaire results

In the end of the experimental part a questionnaire, presented in Appendix A, was given to the students. In the questionnaire there were six questions, to which you could give the answer using the scale from 1 to 5. The last question was an open question, where students could write four good things and four things that could be improved during the implementation of Suggestopedia.

The results for every question are presented separately in a horizontal bar chart. The bar chart was done using the program Excel. The values in x-axis show how much the student liked something. The minimum of the scale is 1 and the maximum is 5. In y-axis there are placed the answers of each student. The questionnaire was anonymous, so the students are named under the number 1, 2, 3 etc.

First question: Was it nice to be in the lesson?

Below in the Figure 13 are demonstrated the results of the students to that question.
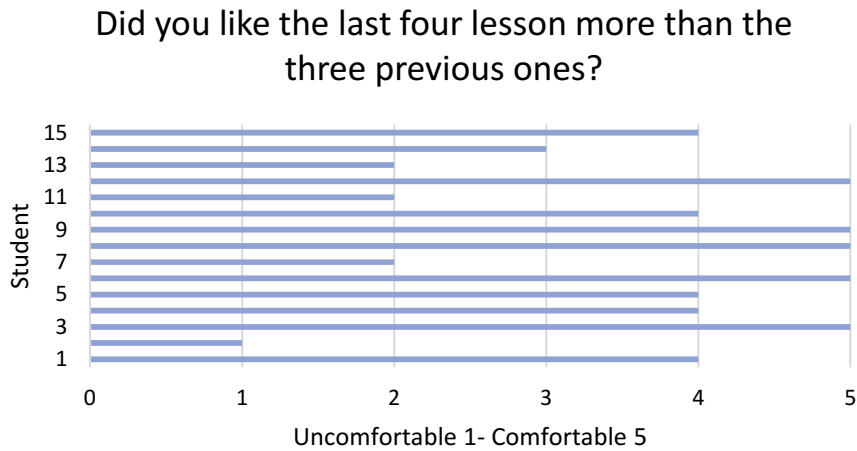

Figure 13: Students' results from the first question.

From the graph in Figure 13, we can see that 14 out of 16 students gave a rate bigger or equal to 3. The average is 3.73 out of 5. It seems that they enjoyed being there, a very important thing which was one of the first goals during the implementation.

The second question: Did you like the last four lessons more than the three previous ones?

Below in the Figure 14 are demonstrated the results to that question.

Did you like the last four lesson more than the three previous ones?

Uncomfortable 1- Comfortable 5

Figure 14: *Students' results from the second question.*

From the graph in Figure 14 we can see the following results: 11 students out of 15 gave an answer more or equal to 3. The average of that question is 3.67 out of 5 which shows also that the students liked learning mathematics in Suggestopedia. One child did not answer that question.

The third question: Did you like the warming-up part of the lesson?

Below in the Figure 15 are demonstrated the student's results to that question.

Did you like the warm up part of the lessons?

Uncomfortable 1- Comfortable 5
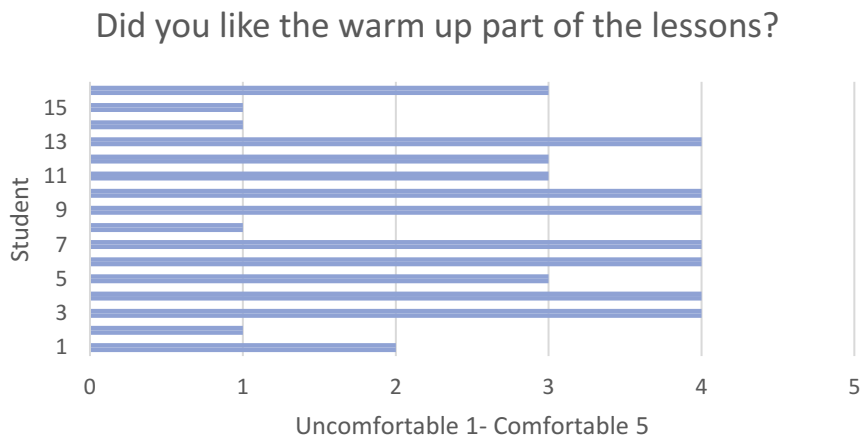
Figure 15: *Students' results from the third question.*

From the graph in Figure 15 we can see that 11 out of 16 students gave rate more or equal to 3. The average of the question is 2.875 out of 5, the lowest average of all the questions. It is suspected that it is caused by the shyness of the students and by the fear of making

mistakes in front of others. Considered the short time of the implementation, it is believed that the result is still good.

The fourth question: Did you like the passive concert?

Below in the Figure 16 are demonstrated the student's answer about passive concert.

Did you like the passive concert?
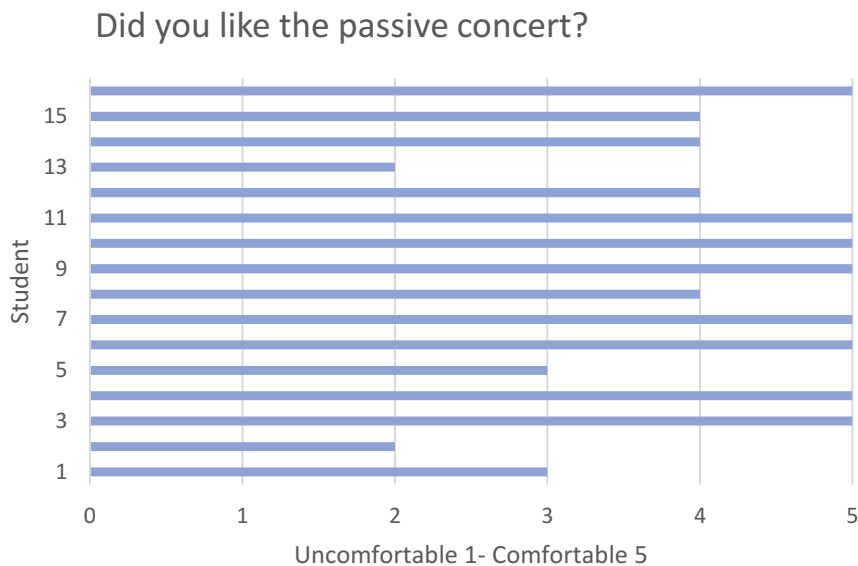
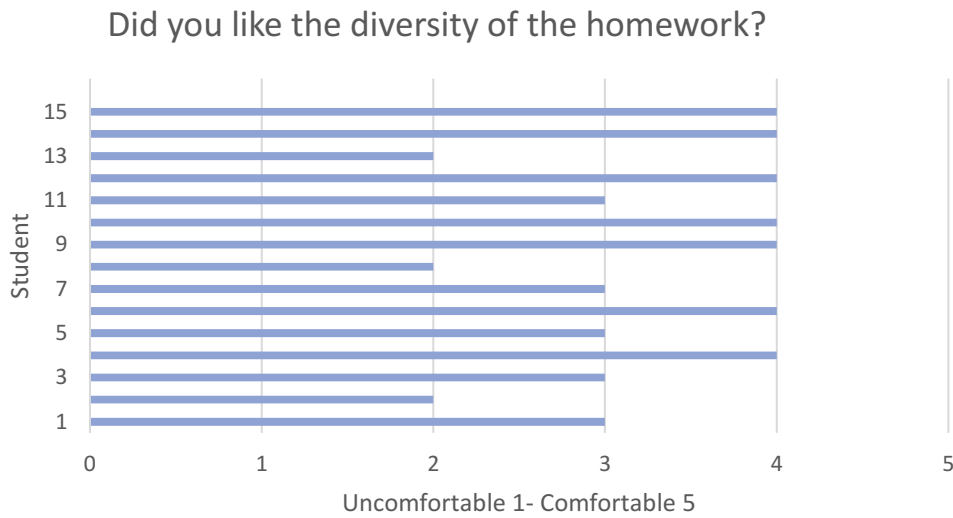**Figure 16:** *Students' results from the fourth question.*

From the graph in Figure 16 we can see that 14 out of 16 students gave rate more or equal to 3. This graph shows that students liked the passive concert, since the average is 4.125 out of 5. The results are expectable, since the students were asking for it during the implementation of the last suggestopedic lesson.

The fifth question was: Did you like the diversity of the homework?

From the graph Figure 17, we can see that 12 out of 15 students gave a rate bigger or equal to 3. One student didn't answer that question because he/she was absent on the day of the presentations, as he/she commented in the questionnaire.

The average is 3.267 out of 5. It is an expected result, since for example, almost all the students did the presentation which had been given as homework, so the students enjoyed participating in more creative homework. It seems that the implementation of Suggestopedia widened the students' horizons and they were ready to combine deep learning and creativity.

Figure 17 demonstrates the students' answers about the diversity of the homework.

Figure 17: Students' results from the fifth question.

The sixth question: Would you like to continue studying math with that method?

From the Figure 18, we can see that 11 out of 16 students gave a mark bigger or equal to 3. From this data, it seems that the students would like to continue studying with that method.
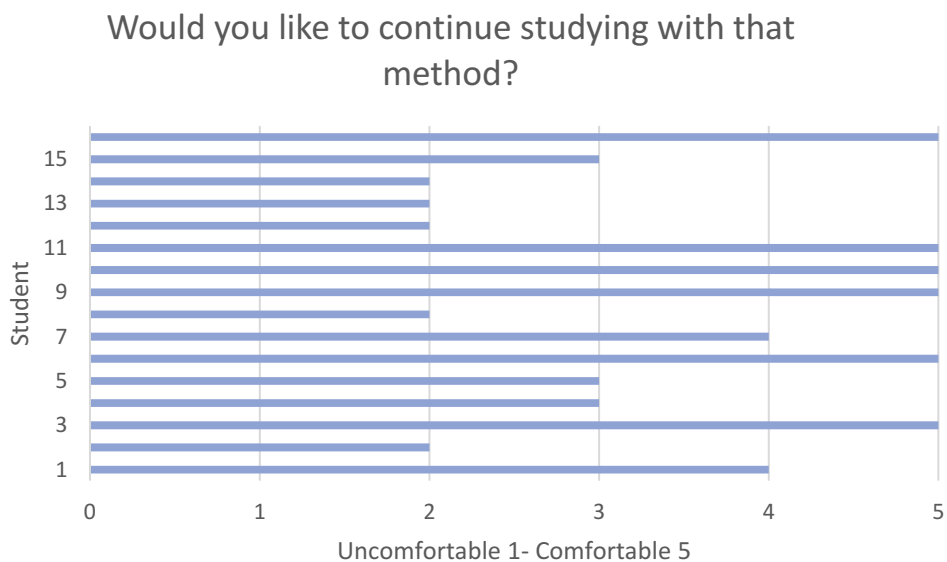
Figure 18: Students' results from the sixth question.

In the above Figure 18 the average is 3.56 out of 5, which is an encouraging result for future studies.

The seventh question: Write 4 good things and 4 things that could be improved during the implementation of Suggestopedia.

Below are presented the student's answers. Since the implementation was conducted in a Finnish school and in Finnish language students' comments are in Finnish. For validity reasons, the students' answers are represented as they were written exactly in the questionnaire. Translation of each comment are placed exactly below of it so the risk that something could have been lost in the translation is avoided.

It is worth mentioning that not all the students answered the last question of the questionnaire. Three students had left the question empty. Below are the children's answers:

+ kiva luokka   - vaikea aihe

+ esitelmä oli hyvä   - liikaa työtä

+ konsertti oli hyvä

+ *nice class*   - *a difficult topic*

+ *the presentation was good*   - *too much work*

+ *the concert was good*

+ passiivi konsertti   - päässälaskut

+ läksyt   - opetustyyli: taululla

+ kiva ope

+ mukavaa

+ *passive concert*   - *verbal counting*

+ *homework*   - *teaching style: on the board*

+ *nice teacher*

+ *nice*

+ sai istua missä halusi   - ei tehty paljon kirjan tehtäviä

+ erilaisia tehtäviä

+ ryhmätehtäviä

+ esimerkit

+ *could sit where you wanted*   - *did not manage to do a lot of book tasks*

+ *various tasks*

+ *group assignments*

+ *examples*

+ monipuolisuus   - tarkkuutta taululle kirjoittamisessa opettaja

+ paljon laskettavaa   - passiivi konsertti oli tylsä

+ paljon haastavia tehtäviä

+ *versatility*   - *accuracy for writing on the board by the teacher*

+ *much to calculate*   - *the passive concert was dull*

+ *lots of challenging tasks*

+ hyvä ope

+ hyvin opettaa

+ *nice teacher*

+ *nicely teaching*

+ sai istua missä halusi

+ passiivi konsertti

+ pallo peli

+ *could sit where you wanted*

+ *passive concert*

+ *ball game*

+ passiivi konsertti

+ *passive concert*

+ hyvä ei liikaa läksyjä

+ oppi hyvin

+ tykkäsin passiivi konsertista

+ *good that there were not many exercises*

+ learned well

+ I liked the passive concert

+ viimeinen tunti

+ last lesson

+kiva ope :)

+ nice teacher

Oli monipuolista mutta oli ahdistavaa kun piti kaikkien kuullen kertoo vastaus enkä osaa mitään joten niin!

There was diversity but it was stressing when you had to give the answer while everyone was listening to you and I didn't know anything so like that!

On ollut mukavaa

It was nice

Kiva vaihtelua

Nice variation

Those were the students' comments in the seventh question of the questionnaire. After getting thought all the comments we can see that 29 comments were positive and just 7 were negative. Furthermore, by grouping some of the above-mentioned comments, for example those ones that are referring to the same thing but are using different words, we could have the following groups:

- Classroom- referring to the place where the lessons were conducted
- Teacher's work on the blackboard- referring to the examples that were presented by the teacher on the blackboard
- Passive concert, which will include also the general idea of having concerts during the lesson. In this case it will include one more student's comment- the general world "concert".
- Exercises given to the students during the class
- Teacher
- Atmosphere
- Versatility
- Warm up referring to the beginning of the lesson and the ball game

- Last lesson
- Theme of the lessons, in this case equations

Collecting the above data and placing it in the corresponding groups, can lead to the following Table 2.

*Table 2:* *Timetables for the experimental part of the research.*

Groups	Amount of positive comments	Amount of negative comments
	+	-
1. *Passive concert*	5	2
2. *Warm up*	1	2
3. *Exercises*	6	2
4. *Teacher's work on the blackboard*	2	2
5. Classroom	3	
6. Atmosphere	1	
7. Teacher	6	
8. Versatility	4	
9. Last lesson	1	
10. Theme		1

In the Table 2 the row data from the students' comment is transfered into a statistical data. Especially the first four rows of the table give a chance for making a comparison. As we can see most of the students liked passive concert as well as the exercises that were given to them during the class.

The beginning of the lesson, the warm up part has left negative feelings to the students. As it can be seen from the second row of the Table 2, there are two negative comments and just one positive. Memorizing the results from the third question of the questionnaire, which also got the lowest average from all the questions, we can state out that the warm up was not the favorite part of the lesson for the students. This aspect does not make that part less useful, but it shows that there is space for future work.

In the fourth row of the Table 2, teacher's work on the blackboard can be found. It got equal score - 2 positive and 2 negative comments. That might show the diversity and the existence of different levels of students inside the class. For some of students the exercises were too challenging and for the other once they were interesting, while they were giving them the chance to keep their motivation high.

All the above discussed comparison can be seen in a visual representation of Figure 18. Below with a help of clustered column chart the first four rows of the Table 2 are represented in comparison. Blue color is used for positive comments and red color for negative comments. Below is the Figure 19.
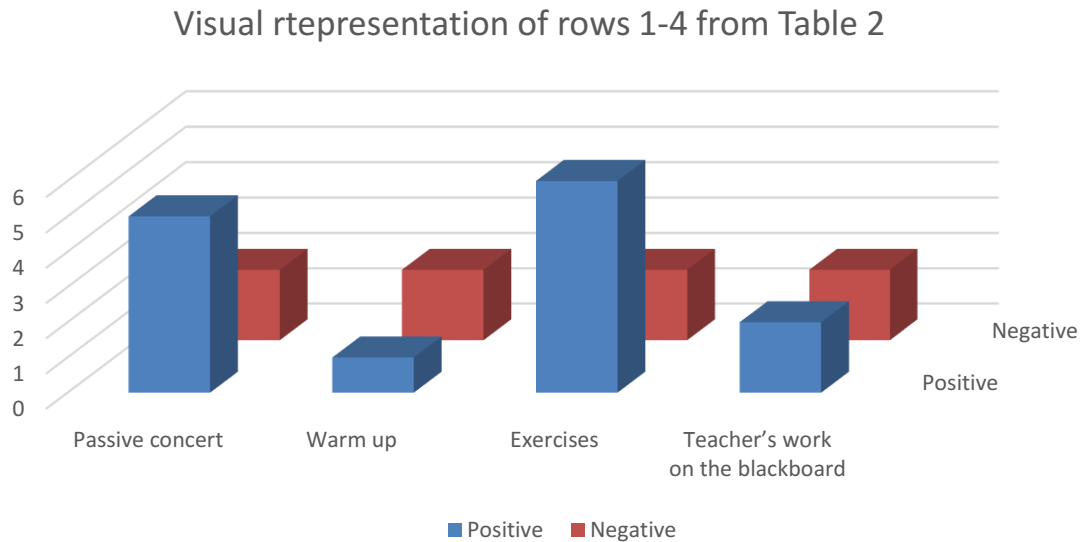
Figure 19: Part of the students' results from the 7th question.

In Figure 19 the results of first four rows of the Table 2 are presented. The next rows of the Table 2 do not allow any comparison. For this reason, their visual representation was chosen to be in a pie chart. The positive comments are represented with shades of blue color and the negative comment with red. Below is the Figure 20.
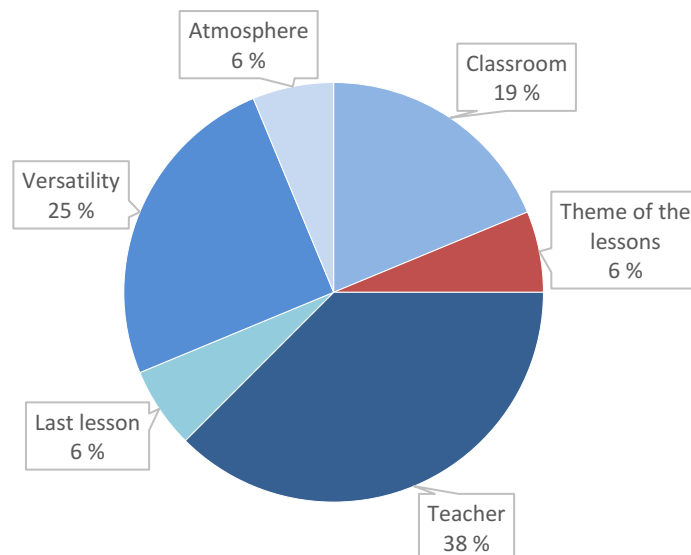
Figure 20: Partial data of Table 2 - red color negative comments, shades of blue positive.

From the Figure 20, can be seen that the positive comments occupy bigger space of the pie chart. That can be confirmed as well from the row data, where 29 comments are positive and just 7 are negative.

As it can be seen from Figure 20, the biggest percentage gathers the group "teacher". From the Table 2, we can see that 6 students are mentioning the teacher's figure in the positive comments in the seventh question. This question is showing us once again the importance of the teacher, as it was discussed in Chapter 2.3.3. The role of the teacher is important in every teaching method, not only in Suggestopedia as it can be seen from Chapter 2.

The second biggest percentage has the group of versality. It seems like the students liked the diversity inside of the lesson and that's why four of the students are mentioning it in their positive comments. Probably the use of smart board, the use PowerPoint Slide, the played music, the group works, the different games or the competition have affected their opinion.

The high percentage might also be due to the diversity of the homework, where students had to use their creativity. Furthermore, from the above presented results, students appreciated the chance that was given to them for creativity. The question number five has an average of 3.267 and 12 out of 15 students gave a rate bigger or equal to 3, which underlines the importance of the diversity.

Another reason for the high percentage in versality can be caused by the structure of suggestopedic lesson. Suggestopedic lessons are quite diverse since they have three different parts inside of one lesson. For example, many of the students liked the passive concert as it can be seen from the above comments in the seventh question. The fourth question which is asking the students if they liked the passive concert got the biggest average 4.125 of all the questions. Furthermore, passive concert got 5 positive comments versus 2 negative as it can be seen in Table 2.

The importance of the classroom is shown in the third biggest percentage in Figure 20. In students' opinion having a nice and cozy classroom is important, since three students are pointing out that in their positive comments. Probably the existence of bean bags and the freedom of sitting wherever they felt more comfortable made them to write those positive comments.

The last three groups have gathered the same percentage. One student is mentioning in his/her positive comments the nice atmosphere of the class. Furthermore, the first question of the questionnaire, which is referring to the general feeling of being in the classroom, got the second biggest average of all questions. In this question 14 out of 16 students gave a rate bigger or equal to 3 while the average is 3.73 out of 5. This is another evidence that shows the importance of the nice working environment.

The fact is very surprising that one student is mentioning the last lesson in his positive comments. According to the teacher/researcher the last lesson was not significantly good. That comment points out once again that raising the level of the class, giving more difficult exercises and requesting a bit more than the students used to, is a good thing. That comment can be a factor of showing the raised motivation for dealing with more challenging tasks.

The last 6% of the Figure 20 is the negative comment and that is the reason why it is presented with red color, while all the other groups are presented with shades of blue. As it can be seen from the Table 2, one student left a negative comment about the theme of the last lesson. The selection of the topics in math lesson cannot be affected by the teacher and first-degree equations are definitely a very useful topic. More investigation could be

requested for analyzing this comment. Maybe this student just did not like the topic, maybe it seemed difficult, maybe he/she did not like the application of Suggestopedia or maybe he/she was absent during most of the lessons and that is the reason for not liking the topic.

According to the previous presented results, we can see that the non-mathematical goals have been accomplished. The students' motivation and confidence seemed to be raised, since everyone was interested in participating during the lesson and in doing the more creative homework. The implementation of the lesson made students to generate positive emotions as it can be seen from the first question and from the Figure 20, where the group "classroom" has high percentage.

Furthermore, students like to cope with more freedom. As we saw in Figure 20 the group "classroom" gets the second biggest percentage, which shows that the students liked the new rules of behavior inside of the class. The existence of bean bags or round tables wouldn't have given any positive emotions if the students wouldn't have given more freedom to being able to enjoy the new surroundings.

In social level the goals have been accomplished, too. Students had many chances to use their critical thinking for example in more challenging exercises or while working in group works. Presentation skills were trained and developed. Questions as what is a good structure of a presentation, how to speak or how to stand in front of the class, were discussed during the implementation. It is worth remembering here the fact that students start greeting the teacher in the corridor just after the suggestopedic lessons. This fact will be analyzed later in Chapter 4.3.

The research questions that were set in Chapter 3.3 can be answered from above presented results. An interactive lesson is more attractive and more interesting to the students. This conclusion can be made from analyzing the results of the first question in the questionnaire, where 14 out of 16 students enjoyed being part of an interactive lesson.

Suggestopedia could be the method that would avoid the "dryness" of the subject. That can be seen from the results of questions two and six. The second question is asking the students to state if they liked more studying with Suggestopedia than with normal method. The average of that question is 3.67 and it is the third biggest average of all the questions. Furthermore, 11 students out of 15 gave an answer more or equal to 3, which shows the preference to the suggestopedic way of teaching. The sixth question of the questionnaire, which was asking if the student would like to continue studying mathematics with Suggestopedia got an average of 3.56, while 11 out of 16 students gave a mark bigger or equal to 3. From the above-mentioned results seems that Suggestopedia is an attractive method for students and features of it or the whole method can be used for avoiding the "dryness" of the subject.

The relationship between students and teacher need to be warm, full of care and respect. It has been noticed that students like informal dress code and need an easy approached teacher. From the seventh question can be found four positive comments towards the teacher- "kiva ope", "hyvä ope", "hyvin opettaa", "kiva ope :)", which means- "nice teacher", "good teacher", "teaching nicely" and "nice teacher and happy face". Those comments show that a friendly and an open-minded teacher is always more pleasant for the students. Furthermore, from the Figure 20 we can see the importance of the role of the teacher, where it is demonstrated that the biggest positive percentage of the comments is addressed to the teacher. It is very important not to forget to set the limits.

Few more remarks will be presented below about the results of the questionnaire.

It was not surprising that the smaller average from all the questions (but still high for that short time) was given to the warm up section. As one student comments (look at student's comments above), it was very hard to relax and to be able to share the mistakes with your classmates. From the above-mentioned answer, it is understandable that the fear of failing in front of others was quite big, since there wasn't anyone in the class that couldn't answer anything, as the student claims above. It is believed that especially in the Finnish society, that part of the method is necessary to be implemented, since the percentage of depression is quite high. The students need to feel safe in the class, so that they wouldn't be afraid of sharing their own mistakes with others. That requires a lot of time and effort from the teacher.

It is worth mentioning the comment about teacher's work on the blackboard. Even though the knowledge of the subject was on a high level, there were still some students with difficulties, for whom it was hard to follow examples without all the steps written analytically on the blackboard. It is clear now that the examples on the board especially in the beginning of the lesson need to include all the steps and be in a basic level. It seems that the best way to present more advanced material is during the time when the students are solving exercises. At that moment of the lesson, when a teacher has private time for each student, it is the best time for differentiating instruction.

Unfortunately, there comes the following problem: firstly, the teacher uses the best of student's time to explain something very easy on the blackboard, (while having a good chance to make him/her feel completely bored and unpleasant) and then again uses her/his time to explain more advanced examples individually. Everyone's time during the lesson should have the same value, while that constitutes many controversies.

4.3 Observations from the teaching experiments

During the whole lesson, the idea of the ball/microphone, which was introduced in the first suggestopedic lesson, was still alive. Furthermore, during the lesson, when one student was asked something, he/she was thrown the ball/microphone. This was aiming at keeping students active, both physically and mentally, because it is very hard to learn mathematics while someone is falling asleep.

Furthermore, the appearance of the teacher has a significant role. What she was wearing was always noticed by the students: what colors were the clothes, what shape, how was the makeup and what kind of jewelries were used. It was noticed that when she was wearing clothes with bright colors, free shapes (for example ponchos) which belong not to a formal dress code, the students were approaching her more easily. This was an unconscious behave from the students.

Another important observation was made by the teacher in the end of the suggestopedic lesson. Generally, in school culture was not included to greet teachers or researchers in the corridors. That aspect changed after the implementation of Suggestopedia. The students started to greet the teacher while they were having a big smile in their face. They

were even looking to her eyes, while it was noticed earlier that generally they were avoiding any eye contact with the teachers. This phenomenon did not last though very long. One or two weeks and afterwards the students return to their usually behavior. It seems that the role of the teacher changed in students' mind, while afterwards the huge impact of the surroundings can be noticed.

It was noticed as well that the magician experiment described in Chapter 3.5.3 had a huge impact on the students' behavior. It was clearly the biggest surprise that the teacher saw in their faces from the whole experimental part. Probably this experiment contradicted with the figure of the teacher that the students had in their minds before. Afterwards, it was noticed that their behavior became friendlier to the teacher, while they dared to ask more questions and had a longer lasting eye contact.

Ethical issues were taken seriously into account during the implementation of the experimental part. Issues like protection of data confidentiality and privacy of subjects had an important role during the implementation [31]. Especial since we were dealing with children and not adults, more stick guidelines were followed. Written permission from the parents of each student was provided from the school. The researcher itself decided to hide students' faces in all the pictures. Furthermore, in appendices cannot be found the students' tests or the questionnaires. That is done for anonymity reasons, since someone could recognize the student from the his/her hand writing.

The researcher had a strict prioritization. The first place in this prioritization line was occupied by the students' knowledge and not by the conduction of the experiment. During the implementation, happened that the plans of the lesson did not work very well. In these situations, the researcher was making decisions benefitting the learning of the students and not the experiment. As an example, can be presented the last suggestopedic lesson. In the end of the lesson before the test, the teacher had planned a short discussion, accompanied by music about the suggestopedic part of the lesson. This discussion was not conducted, since the teacher notice that the students needed more time for practicing so she decided to continue practicing and explaining equations rather than collecting a wider data for her experiment.

The implementation of the suggestopedic method in a normal Finnish school had some challenges. Firstly, the school environment in Finland, as in many other northern countries, is not so interactive as in the south of Europe, where that method was born. Furthermore, it was quite challenging to change the teaching method in the middle of the year for one class, especially when their own teacher's method was very different.

The other challenge is related to the short time of application. During only 7 lessons of experiment, from which only 4 lessons were the implementation of Suggestopedia, it is hard to draw big conclusions. Despite that, the results can give us a general picture of the subject, while further researches can be conducted based on it.

Another challenge is the lack of big teaching experience. The role of the teacher in Suggestopedia, as it was mentioned in the Chapter 2.3.3, requires many skills. With the lack of teaching experience in general, it was even more challenging to apply Suggestopedia.

Moreover, the difference in the teaching subjects could have some effect on the results [31]. Equitable selection of subjects would give us better results, since for example, many

students consider Polynomials as an easier unite than the Equations. Unfortunately, this issue couldn't be affected by the researcher, who has been given specific teaching subject units and strict timetables from the school.

One more challenge can be associated with the big difference between the lessons of normal group and suggestopedic group. There was one month's break between the implementation of two methods, which is a pretty big timeframe for students. After this break, the students had to get used to a new teacher and especially to the new method.

Favorable risk to benefit ratio of the results also can be included into challenges, since the researcher and the teacher is the same person [31]. Due to limited resources, hiring another person and educating him/her to teach in Suggestopedia, was outside of the financial opportunities, so this challenge was considered in the stage of planning. This was the reason why the tests in the end of each section were chosen to be from the book Laskutaito. In this case, the teacher could not affect the difficulty of the given problems, and the results from both tests are reliable and valid.

Those were some general remarks which are completing the idea of how the methods were implemented.

5. CONCLUSIONS

We can see that the non-mathematical and social goals, which were set up in Chapter 2, have been reached. In students' opinion the atmosphere in classroom was nice. Students were interested in working with a different teaching method, they liked the diversity in the classroom and the chance of creativity that they were offered. They generated positive emotions during studying mathematics and they liked the more freedom. Those results are demonstrated in Chapter 4. Furthermore, a significant improvement has been done in students' presentation skills, in group work and in students' confidence.

By analyzing now, the mathematical skills, it can be seen from Chapter 4.1 that the students had the chance to work with more difficult and more demanding problems and they liked it. Unfortunately, the average of the class performance, according to the test results, had dropped. There are many factors that can explain that and maybe two of the most critical were the short time of implementation and the small sample size. Another important factor is the current grading system.

Our grading system currently is measuring the performance of the student in the test. Of course, other factors such as an active participation during the class is affecting the grade but the biggest impact on the grade of the semester has still the grade of the test(s). This can be seen once again from the way that students are entering higher education. In our current educational system there are entrance exams for universities or colleges. The performance of the students on that specific day has a significant importance in their future life. By judging the results of education by test scores, we shouldn't forget that the most important aspect of elementary education is raising students' motivation towards studying. Grade shouldn't be the driver for educational reforms.

The current grading system has completely different priorities from the ideas of Suggestopedia. Suggestopedic lesson is aiming in acquiring deep learning as well as emphasizes the importance of social skills. Comparing the results with a current grading system is unfair for suggestopedic lessons. For this reason, in the next chapter there is presented how a new grading system for meeting the newest needs can be designed.

Suggestopedic theme has a good prospective in research in education field. It opens many horizons and it questions again our ideas about what is a good education. The current thesis has been a useful experiment for the students, who changed their view points about what is a math lesson and which is the role of the teacher. For example, in Chapter 4.3 we saw that after the suggestopedic lessons they start greeting the teacher in the corridor with a smile in their faces, something that did not happen before.

This experimental part can encourage teachers trying new methods in their class. By questioning themselves and by bringing new features to the lesson, teachers can raise students' motivation. Furthermore, the whole school can consider this experimental part as a good opportunity to offer something new and useful to their students. Considering the needs of each school, there can be arranged special classes which can teach mathematics or other subjects using Suggestopedia for students who do not find anymore the old teaching method attractive.

The scientific community can consider Suggestopedia as a way for attracting people. As it has been discussed already in the introduction, the society has a dry image of mathematicians. That could maybe change by using Suggestopedia in teaching math. People would not be afraid of mathematics since they would see elements of their everyday life in the lesson.

Summarizing, it can be strained out that the Suggestopedic method has many perspectives. Students who have concentration difficulties can be helped a lot using Suggestopedia. Furthermore, this method can be very suitable for students who are hyperactive during the lesson, because through that method, they will be able to direct their energy for learning. Moreover, Suggestopedia with suggestological self-development might help in the fight against depression, even though it can't be considered as a treatment but as one helping factor. It is not sure if that method can become a general teaching method in all schools, but it is worth applying it in some schools, where the environment is suitable.

6. FUTURE RESEARCH

Future research is necessary in order to be able to make general conclusions about that method. The experiment must be repeated in a wider group, where the existence of a control and treatment group is necessary. Furthermore, the method should be applied for a longer period. It is also necessary to select the sample groups from different schools.

Another important aspect is that the group in which the experiment was held, was homogenic. The experiment needs to be repeated in multicultural environments. For this reason, international schools in Finland, could be a good target. Moreover, Finnish schools abroad could be an excellent choice. In those schools, the Finnish culture is mixed with the international and the curriculum matches with Finnish educational standards. Conducting a teaching experiment there, would give us a spherical image about that method. Teaching mathematics in Suggestopedia for a year would be ideal.

It would be interesting to conduct a research at international level. The experiment could be held at the same time in different European countries and maybe in the further future, in countries with completely different beliefs and values from the European ones, for example in South Arabia or North Korea. Making that would give us a clear idea about the method: where that method could be easily applied, on which stage of the application we might find some challenges, how to face them and what are the expected results.

It would be worth mentioning that this method is very promising, especially in application in Northern countries of Europe, where except of raising students' motivation and making math a pleasant subject, it could help us, educators and the whole society, to fight against depression and maybe even against suicides, since this method works through warm interpersonal relationships.

The grading system would be another interesting aspect to change. The grades fitted to follow the Gaussian distribution might not be the best way for grading the students. Lack of alignment is a major reason why students adopt a surface approach to learning. [14]

As a psychology student, quoted Ramsden: "I hate to say it, but what you have got to do is to have a list of "facts"; you write down the important points and memorize those, then you'll do all right in the test. ... If you can give a bit of factual information —so and so did that, and concluded that—for two sides of writing, then you'll get a good mark." [14, p. 8], which doesn't come across with the teacher's goals - the deep learning and understanding of the subject.

An interesting observation is made in J. Biggs article, where it is stated that the verbs used by the student can represent the level of the depth of the knowledge [14].

In the following table, we can see the grades given to the specific verbs:

Table 3: Evaluate how well the target acts indicated by the verbs are deployed in the context [14].

Curriculum Objectives
expressed as verbs students have to enact

A.	B.	C.	D.
The very best understanding that could reasonably be expected: Verbs such as hypothesise, apply to "far" domains, generate, relate to principle, etc.	*Highly satisfactory understanding:* Verbs such as explain, solve, understand main ideas, analyze, compare, etc.	*Quite satisfactory learning, with understanding at a declarative level:* Verbs such as elaborate, classify, cover topics a to n, etc.	*Understanding at a level that would warrant a pass:* Low level verbs. Also inadequate but salvageable attempts at higher levels

Applying something like that in the class would require a well decided plan. In the beginning of the school season a teacher need to explain to the students how exactly works their grading system so they can have clear goals. Furthermore, it is important to check that this grading system is coming across with the curriculum. In the following figure a hierarchy of verbs that may be used is represented:
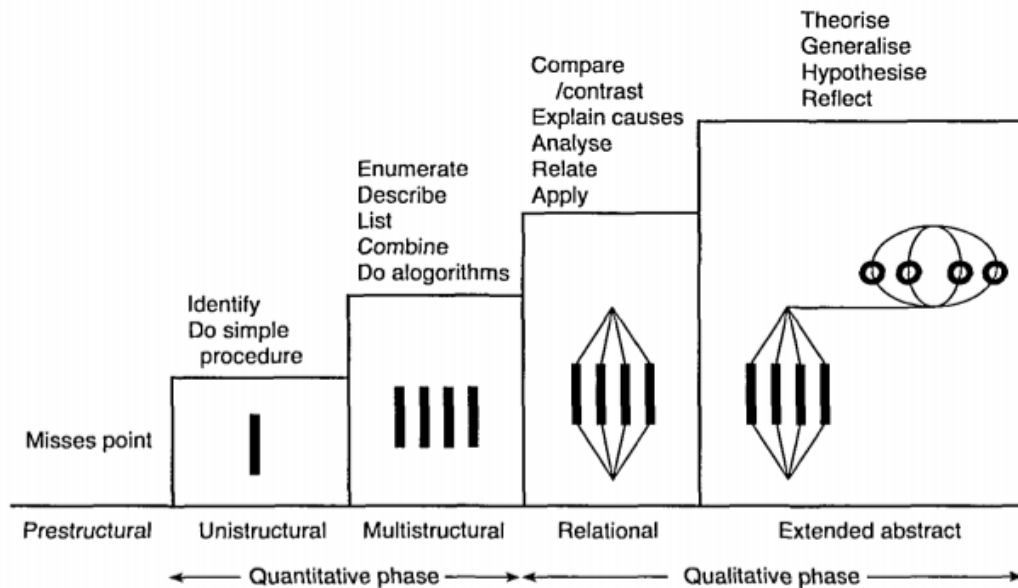
Figure 21: A hierarchy of verbs [14].

As it can be seen in the Figure 21 above, the level of abstractness is represented with sticks. The more complicated the figure is, the more abstract is the thinking. This grade

system method could compete with the traditional grade system that we currently have in school.

An example of what could be the structure of that test is presented below in Table 4. The test could be divided into the groups according to the difficulty of the problems that each group contains. According to the difficulty of each group there can be a coefficient so the final grade of the test will be calculated considering the given coefficients. [14]

An important note is that, the test should be made in that way that passing it wouldn't be extremely difficult but getting a high score would reserve nice challenges. The same idea can be applied to homework. Then student's motivation will be raised and deeper learning would be achieved. The following table is presenting this structure with more details. [14]

Table 4: *Some different assessment tasks and the kinds of learning assessed [14].*

Assessment mode	Tasks
Extended prose, essay-type: Essay exam Open book Assignment to take home	Rote, question spotting, speed structuring As for exam, but less memory, coverage Read widely, interrelate, organize, apply, copy
Objective test: Multiple choice Ordered outcome	Recognition, strategy, comprehension, coverage Hierarchies of understanding
Performance assessment: Practice Seminar, presentation Critical incidents Project Reflective journal Case study, problems Portfolio	Skills needed in real life Communication skills Reflection, application, sense of relevance Application, research skills Reflection, application, sense of relevance Application, professional skills Reflection, creativity, unintended outcomes
Rapid assessments (large class): Concept maps Venn diagrams Three minutes essay Gobbets Short answer Letter-to-a-friend Cloze	Coverage, relationships Relationships Level of understanding, sense of relevance Realizing the importance of significant detail Recall units of information, coverage Holistic understanding, application, reflection Comprehension of main ideas

As it is illustrated in Table 4, on the right column of the table are listed some verbs that can be used during the different level tests, while the left column lists the corresponding to that task level of test. The variety of the tasks brings the growth of different skills. This

variety also combines very well with the basic idea of Suggestopedia. We can state out that developing this kind of grading system and using it generally in school or with suggestopedic method could lead to very interesting results.

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APPENDIX A: QUESTIONNAIRE

Kysely

1. **Oli mukava olla oppitunnilla.**

| Mukava | 5 | 4 | 3 | 2 | 1 | epämukava |

2. **Tykkäsin enemmän neljästä viimeisestä tunnista kuin kolmesta edeltävästä.**

| Paljon | 5 | 4 | 3 | 2 | 1 | vähän |

3. **Tykkäsin päässälaskuista.**

| Paljon | 5 | 4 | 3 | 2 | 1 | vähän |

4. **Tykkäsin passiivi- konsertista.**

| Paljon | 5 | 4 | 3 | 2 | 1 | vähän |

5. **Tykkäsin monipuolisista kotitehtävistä. (esim. viimeisen tunnin esitys)**

| Paljon | 5 | 4 | 3 | 2 | 1 | vähän |

6. **Mielelläni jatkan matematiikkaa opiskelemista tällä menetelmällä.**

| Paljon | 5 | 4 | 3 | 2 | 1 | vähän |

7. **Kirjoittaa neljä hyvää asiaa ja neljä parannettavaa asiaa näistä neljästä oppitunnista.**

Figure 22: The questionnaire.

B: First test

18 Taitotesti

Nimi: _____   Ryhmä: _____

1. Sievennä.

   a) $3x + 2 + 7x + 9 =$

   b) $x^2 + 8 + (7x^2 - 8) =$

   c) $-4x^2 - 5x + 1 + (3x^2 - 9x - 7) =$

2. Sievennä.

   a) $9x - (8x + 2) =$

   b) $-5x^2 - (-3x^2 - 8) =$

   c) $x^2 + 7x - (9x^2 - 7x + 5) =$

3. Muodosta ja sievennä polynomien $-2x^2 - 7x + 9$ ja $3x^2 - 7x + 8$

   a) summa

   b) erotus.

4. Sievennä lauseke $(8x^2 + 4x - 7) - (7x^2 - 6x) + 7$ ja laske sen arvo, kun $x = 6$.

Figure 23: *The first test that was given to the students.*

C: CLASSROOM EXERCISES FOR THE FIRST SUGGESTOPEDIC LESSON

Name:

1. Solve the equations.

a.   9x= 36

b.   5x-3= 8

c.   6y+1= 4y

d.   3z+5= 7+ 5z

2. Solve the equations.
a.   k-12= 97   b) m+11= 0   c) 5δ- 4γ-3 = 6δ -4γ

3. *Research if x= -2 is the root of the equation.*

a.   -7x+ 3 = 0   b) 4x- 2x= -2x

4. Form and solve the equations.

a.   The addition of 6 and x gives the same result as the addition of 22 and x.

b. When the number x is subtracted by the number 4, it gives the same result as two times the number x.

5. Solve the equations.

a. $17x = -17$ b) $x - 4 = -4 + x$

D: Homework for the first suggestopedic lesson

Solve the equations and using the answers for making a painting.

a) 7x -1= 55   b) 9y+ 2= 38   c) 5z= 3z+14   d) 3k = -3k+30

e) 8l+1= 5x-5   f) 6m-14= m+1   g) x+x= -200   h) -3x+(-x)= -6

Put your answers in a random order below and with the help of them create a painting. You can use color pencils.

-

E: SECOND TEST

39 Taitotesti

Nimi: _____   Ryhmä: _____

1. Ratkaise yhtälö.

   a) $4x - 13 = 15$ b) $6x = x + 15$

   c) $3(x - 2) = 12$ d) $\frac{x}{7} = 5$

2. Ratkaise yhtälö.

   a) $12x - (5x - 2) = 23$ b) $3x + \frac{x}{3} = 20$

3. Muodosta ja ratkaise yhtälö.

   a) Kun luvusta x vähennetään luku 6 ja erotus kerrotaan luvulla 5, saadaan luku -40.

   b) Luvun x kolmasosan ja neljäsosan erotus on 2.

4. Kuvio on neliö. Laske sivun pituus.

   $2x + 7$

   $4x - 15$

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Figure 24: *The second test that was given to the students.*