MATHEMATICS CAN BE MEANINGFUL, EASY AND FUN

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Paths to Math

Abstract The negative attitudes are easily growing among children when mothers are telling to their daughters they were not good at mathematics or when newspapers' cartoonist is drawing jokes about bad mathematics memories at school. It seems that the structure of mathematics lessons have not changed during the last decades. Schools seem to put too much attention to mechanical practice and mathematics teaching is too far from student interest and life. By diversifying teaching methods and using technology like adults are using it in everyday life, we can get students engaged to mathematics and change their attitudes positive towards mathematics.

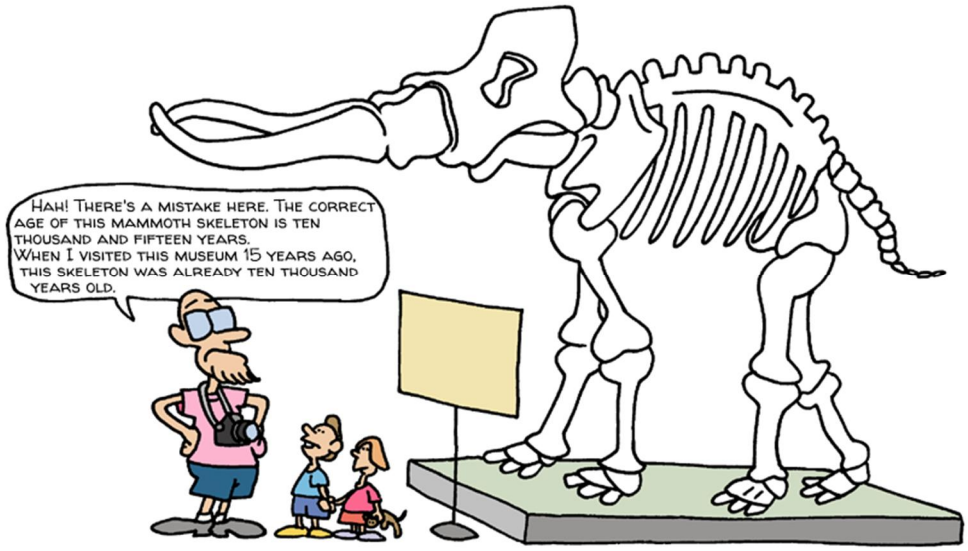
1 Attitudes and stereotypes are mathematics' worst enemy

Have you ever met a person who would proudly tell you that she/he cannot read or write? Is this a strange question? But you have maybe met a person who has told you that he/she cannot mathematics, because also his/her mother did not understand mathematics? I have heard many times from adults all kind of explanations why mathematics is impossible for them to learn or understand – and it is also clear that they don't even bother!

How do people remember mathematics at school? Probably they remember them sitting all alone in rows and the teacher was solving an equation on blackboard and then it was their turn to repeat it – over and over again. It was often hard for them to see the connection to real life and they started to lose their motivation.

Where from the negative attitude towards mathematics originates? Family member's attitudes play very important role and we may easily say something negative without understanding its impact to our children. Jo Boaler (2015) writes that the messages we give students can change their performance in mathematics dramatically. Students' ideas about their ability and potential seems to be extremely important, more than previously have been understood.

Sometimes newspapers are presenting mathematics in their cartoons with humor that is not favorable for mathematics learning. Cartoons can also be supporting the importance of understanding mathematics (number sense) with humoristic way.



Drawing 1. Artist drawing from the module Pre-Algebra, chapter Estimation from www.pathstomath.com

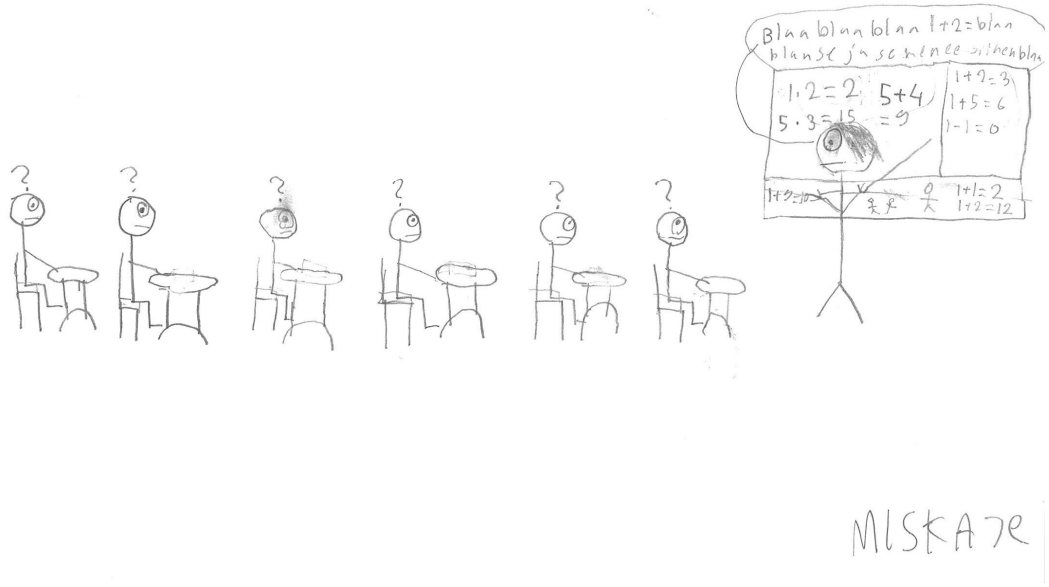
Children are facing with whole bunch of negative attitudes towards mathematics around their life, even from family, friends, newspapers and so on. It is not a wonder that every other students would rather take out the trash than do mathematics? Students often see mathematics boring, irrelevant or even frightening. When teachers get new students in their mathematics class, they also meet the attitudes of mathematics learning. We have to consider that the problem is not with mathematics itself but part of it can be on the way it is taught.

2 Is it possible to change the attitude towards mathematics?

To find out pupils' attitudes and beliefs to mathematics learning in the beginning of the school year, I have asked them to draw a picture how they feel and see mathematics lessons. Typically I get pictures in which a pupil draws him/herself sitting alone in the desk, pupils are in rows and the teacher is a big figure in front of the blackboard, teaching (Drawing 2). There were also pictures, where pupils used a lot of black color, signs of sweating and anxiety towards mathematics. Those pictures proved very strongly that there is a huge need to make changes in mathematics content, activities and communication.

Differences in collective emotional atmosphere in mathematics lesson were found among different classrooms based on Finnish fifth grade drawings (Laine et al., 2015).

Now we can read similar results from PISA 2012: While a considerable proportion of 15-year-olds reported feelings of helplessness and emotional stress when dealing with mathematics, girls were consistently more likely than boys to report feelings of anxiety towards mathematics (OECD, 2015).



Drawing 2. Student and his/her classmates are sitting alone, in rows and the teacher is teaching.

Drawing 3. The student feels anxiety towards mathematics.

3 Structure of mathematics lesson – does it have to be constant?

What do you think that is the most used structure in a mathematics class? Are there many different methods to teach and learn mathematics? Are we still using the century old teaching methods? Does a mathematics class still follow the same pattern all around the world?

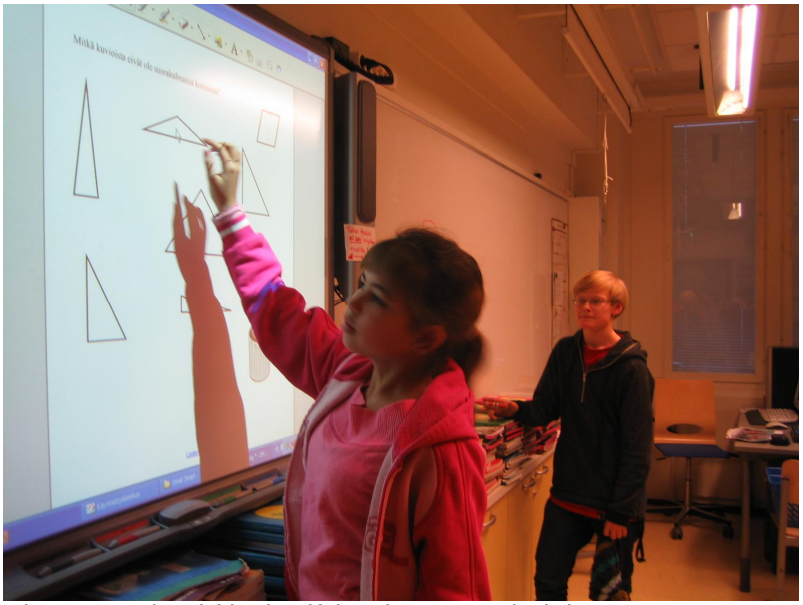
I'm participating in a research (Lexicon, The International Classroom Lexicon Project) where researchers are comparing mathematical vocabulary used in mathematics lessons. Part of research is to analyze 8th grade lessons (video) from nine different countries. My personal observations are that lessons are very similar and teacher-centered in all those countries which mean that there is a big demand for the change of mathematics education in comprehensive school.

4 Different learning environment in mathematics learning

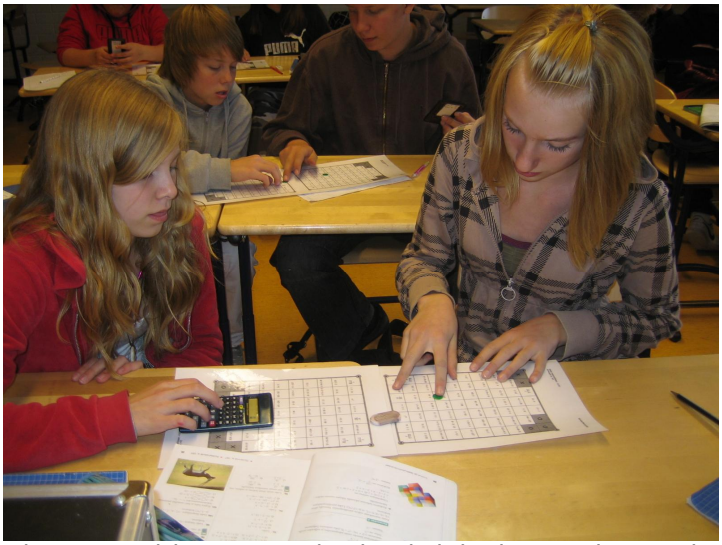
During the years we, in Paths to Mathematics, have tried to find balance between four pedagogical areas: 1) Interdisciplinary Mathematics, 2) Learning by Doing, 3) Social Learning, and 4) Practice. This kind of material contains among others more text for students to read. It is important to use technical tools when possible. Most students have mobile phones, which are great in many learning situations. Blended learning generally means a combination of technology and teacher-led instruction in the classroom. For example students can estimate familiar neighborhood distances and check them from Google Maps.

Instead of disconnected single tasks *Interdisciplinary Mathematics* includes larger theme sections like climate, shopping, household, nutrition and health. In wider thematic entity we can broaden the understanding of the usefulness of mathematics in students' everyday life. *Learning by Doing* comes true in situations like constructions of models, action tasks, classification, comparing and combining, investigation and modeling. *Social Learning* includes situations like action tasks in groups, board games, and card and dice games. Earlier and sometimes even today schools put too much attention to mechanical practice. Individual questions, applications, quizzes and tests are important, but if that is building the main learning environment, the mathematics is too far from students' interest and life.

Picture 1. In this Interdisciplinary Mathematics, students are working in groups and collecting data.

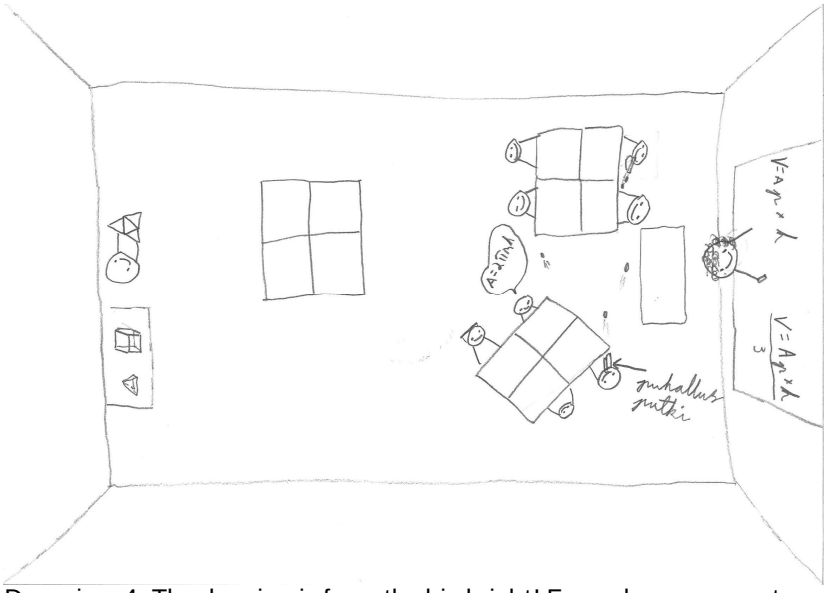


Picture 2. The girl is classifying the geometrical shapes.



Picture 3. Girls are strengthening their basic operations on the board game.

Picture 4. In this activity students are investigating dependency between two variables. After teaching the same students for three years, I asked them again to draw a picture of typical mathematics lesson. The change was huge every time. They had memories from different learning situations, they were working together and you could see the interest and motivation on their faces.



Drawing 4. The drawing is from the bird sight! Formulas are correct.

Drawing 5. Student remembers different action tasks. All classmates are smiling.

Today boys spend more time to play video games than girls. PISA (OECD, 2015) shows that playing moderate video games is not associated with poorer performance at school and may even help students acquire useful skill, such as spatial judgement and the ability to navigate through web-based material.

Picture 5. Girls are solving interactive tasks.

A report by the Organization for Economic Co-operation and Development (OECD) (Chowdhry, 2015) wrote that test results from 31 countries "show no appreciable improvements in student achievement in reading, mathematics or science in the countries that had invested heavily in ICT for education".

The schools need high quality eLearning material. One reason for OECD results could be that what the most of the market is offering to the schools today is the same content as the previous books but copied to the net and sold as an e-learning material. It is widely talked about the need of personalized material but most of the mathematics materials sold to the schools are still mechanical problems, because they are easy to copy and program to electronic devices.

In my mind our main keys for success in mathematics education have been:

- to analyze what is the conception of knowledge
- to move from behaviorism forward socio-constructivism in teaching and learning mathematics
- to improve mathematics teaching through alternative ways of teaching
- to implement everything we have noticed to improve the understanding and engagement of mathematics also in technology surroundings

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Further reading

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