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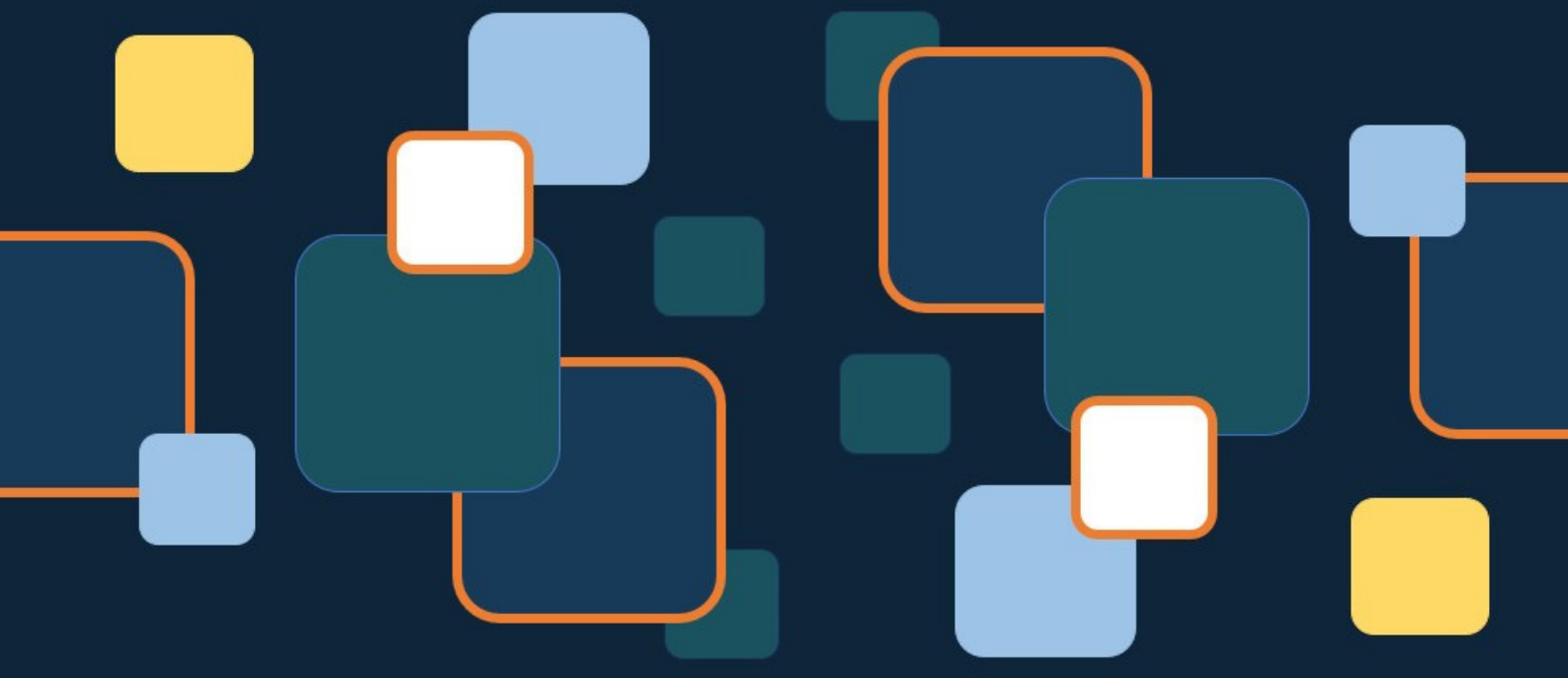


E = MD²:
EXCELLENCE IN MATH EDUCATION
THROUGH (E-) DEBATE AND DIVERSITY

ANALYSIS OF MATH TEACHING
METHODOLOGIES



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INTRODUCTION

Scientists have long used mathematics to describe the physical properties of the universe. Some scientists have even claimed that the universe itself is math, including human beings. When it comes to ordinary people, **we are aware of maths' ubiquity** in our everyday lives, yet **we very often fail to use it properly**. This happens every day in the classroom.

The most important educational period of our lives is between the ages of 4 and 15. During this period, pupils create learning mechanisms, build knowledge, and develop basic skills. However, the results of international knowledge and skills tests do not necessarily show that schools are helping pupils acquire and develop these basic skills. According to PISA 2018 results for **mathematical skills**, pupils from **Spain, Cyprus, Romania, and Croatia achieved a minimum level of** (level 2). **Northern Macedonian pupils did not reach this basic level**. Moreover, the results of national tests across Europe are beginning to show the devastating impact of the recent COVID -19 pandemic on school children's performance, especially the most vulnerable.

INTRODUCTION

he biggest cause for concern is for those disengaged or lower-performing pupils who, according to Schleicher (2019), will fade away to the margins of society without the right education. Many academic papers and global reports such as the Eurydice Network's report "Mathematics Education in Europe: Common Challenges and National Policies" point to the importance of learner motivation and engagement. In the light of this circumstances, the project "**E=MD2: Excellence in Maths education in inclusive classroom through e-Debate and Diversity**" was designed with the aim of raising the level of mathematical skills of European pupils, especially those with maths disabilities (dyscalculia, dysgraphia, mathematics anxiety...), by increasing motivation to learn and making their learning experience less passive.

This said, the E=MD2 project working team believes that pupils should be asked where the problems are in accessing or understanding mathematical content. A popular method to engage people in conversations is the **mathematical debate**. With this method **people participate in the exchange of ideas and viewpoints about learning maths**. The result is a better understanding of each other's experiences. In this context, the E=MD2 working team set out to ask pupils, teachers, and parents their opinions about teaching and learning mathematics.

INTRODUCTION

Between September and December 2022, the E=MD2 team conducted a series of surveys and online debates in different European countries. On the one hand, **177 teachers, 274 pupils and around 100 parents from Spain, Cyprus, Romania, Croatia, and Northern Macedonia** participated in an online survey where they described both the realities and challenges of learning and teaching mathematics. On the other, **parents (20) and teachers (20) from two schools in Romania and Northern Macedonia participated in an online debate to exchange experiences** to develop a better understanding of the challenge's pupils face at school and at home when engaging in mathematical activities. This was done in the hope of better supporting and motivating pupils to improve their performance. **This document is therefore a summary of the findings of both the surveys and the debates.**

Finally, as part of the mission to seek excellence in mathematics teaching in an inclusive classroom, a fundamental part of this process is to raise the profile of mathematics teachers. To this end, the E=MD2 team compiled a **collection of best practises in mathematics teaching so that they are incorporated into the new E=MD2 teaching method** and the interactive [e- MATH DEBATE platform](#) created both teachers and pupils (and parents).

ONLINE SURVEY CONCLUSIONS



$$V = \frac{4}{3} \pi r^3$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



TEACHERS

As the aim of the E=MD2 project is to find out where the problems lie in relation to the teaching and understanding of mathematical content. The first method to obtain data was an online survey in which more than 500 people participated, amongst them were teachers. For this group, the questions were designed to find out about **their reality** in the classroom and **their perceptions** of the curriculum, **their attitudes** towards pupils and the pupils' attitudes towards mathematics.

These are the most relevant findings:

Most teachers consider the topics of the mathematics curriculum they teach to be appropriate (64.73%). However, the vast majority of them claim that the **curriculum contains too much content (76.27%), which prevents them to spend time to attend the needs of pupils with learning difficulties (68.93%) and/or devoting time to gifted pupils (69.49%)**. More importantly, most teachers in the sample (79.66%) indicated that they felt it was necessary to have **more mathematics lessons per week**. This makes it clear that they work under great time pressure and a very compressed curriculum, which makes it difficult for them to deliver lessons in such a way that all pupils understand and can apply the knowledge

TEACHERS

In terms of their perception and that of their pupils, almost all the teachers interviewed agreed that mathematics is a difficult subject (76.84%) and that **pupils do not see the point of mathematics (71.19%)**. A surprising finding was also that even though the participants have **15 or more years of teaching experience, only a small proportion of them reported feeling competent to teach mathematics to pupils with learning difficulties (12.43% feel competent and 40.68% partially agree to feel competent)**.

Despite everything, it is clear that teachers do what they can with what they have. **Almost all (98.03%) considered peer-to-peer learning to be a useful strategy** and acknowledged that teaching is a great way to learn (96.61%). Making this an opportunity for both gifted pupils and pupils with learning difficulties to interact, help and be helped.

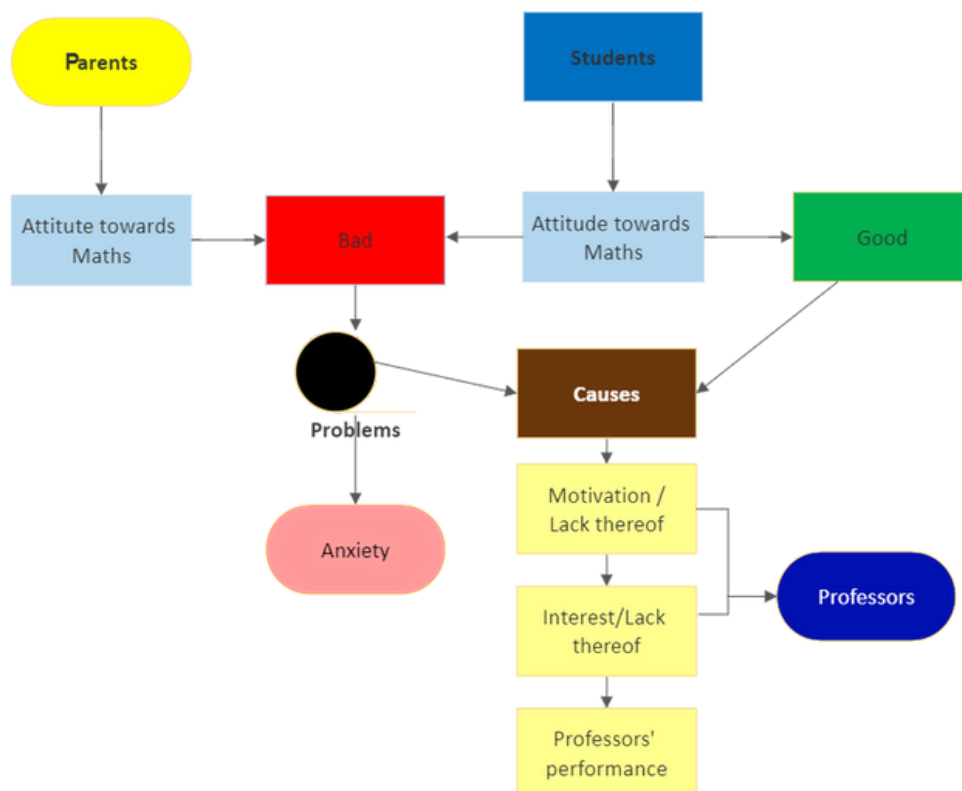
From this survey we can see that teachers are aware of the problems in teaching mathematics but **have no time to help their pupils and no opportunity to improve their skills** which only makes it possible for these problems to perpetuate.

$$X = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



PUPILS

Before the survey, the working team of the E=MD2 project had the following hypothesis. The idea was that a pupil's negative attitude towards mathematics was strongly influenced, on the one hand, by a teacher's poor performance and, on the other hand, by parents. When both attitudes and influences were negative, this led to "maths anxiety". To the surprise of the working team, the results of the survey have many more nuances than originally assumed.



PUPILS

Unexpectedly, of the 274 respondents, most pupils declared that **they love or like maths (23.72% love and 48.9% like maths)**, and only 10.58% of pupils said they disliked maths altogether. This rather positive tendency is also shown when pupils were asked if it would be "nice if there were no maths lessons" (58.42% disagreed). **However, the survey also shows a strong lack of interest in maths among pupils.** For example, pupils neither find it **interesting (50%)** nor do they find it **useful at all (27.01%)**. It is obvious that there is a **50:50** split between the two sides.

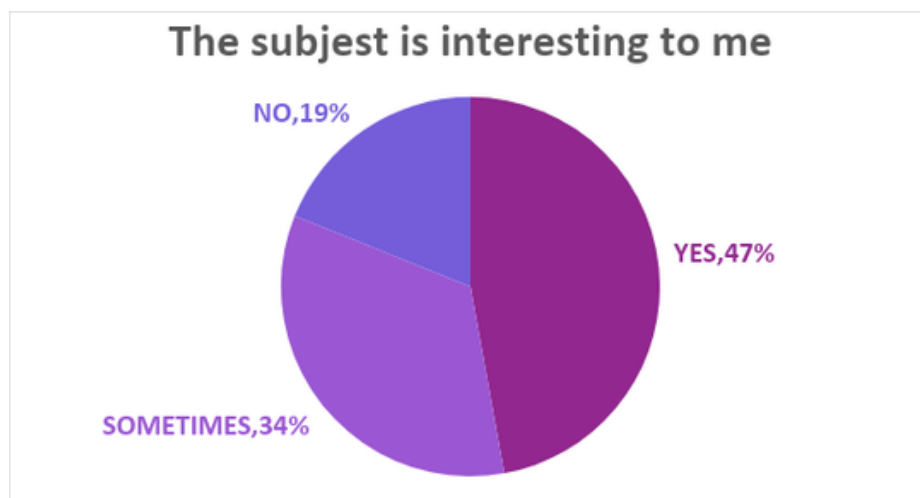


Image 5. General pupil's opinion about the subject Maths

As far as maths anxiety, **21.79%** of the pupils **agreed** with the statement "**Maths makes me nervous and confused**" and the other 36.43% answered "sometimes". This negative feeling is also reflected in the fact that **77%** of the pupils surveyed answered "**yes**" or "**sometimes**" to the following statement: "**After the written exam, I feel that I made a lot of mistakes even in the tasks I knew**".

PUPILS

We must also **not neglect the role of teachers in mathematics education**, as they have a great influence on the working environment. For example, between **40 % and 50 % of all respondents feel that they have a relaxed working atmosphere**, and that discipline is the main reason for this. Only 15% of pupils do not feel relaxed about the working atmosphere and discipline in class. It is obvious that the presence of discipline in the classroom clearly correlates with the seniority of teachers.

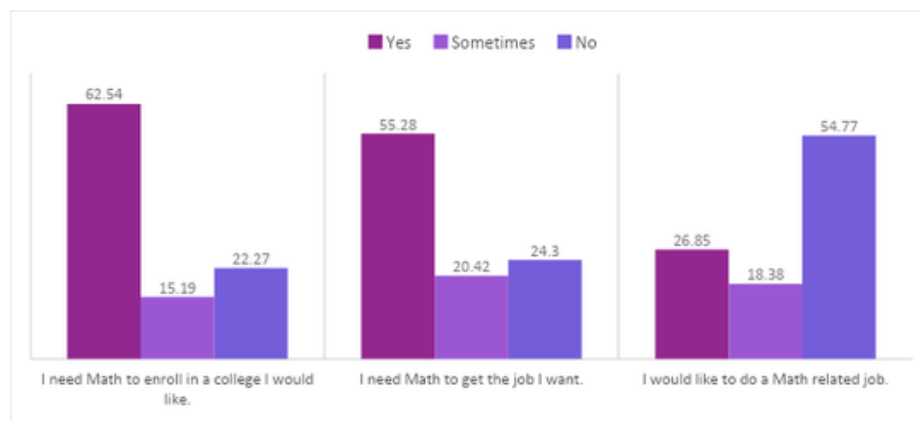


Image 9. General opinion of pupils on the need for Maths in later life

Now, even though mathematics is perceived by teachers as a difficult subject, they invest time in finding interesting teaching methods to familiarise pupils with the material. One of these methods is peer-to-peer work. To this point, **37.46%** of the pupils surveyed agreed with the statement, "**I love when my peers explain tasks to me, so I learn better**" and **45%** of the pupils said that **they enjoy explaining maths problems to their classmates and believe that they learn better that way.**

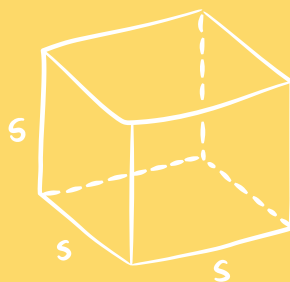
PUPILS

As expected, pupils learn better in pairs and through discussions and through their participation in the teaching process.

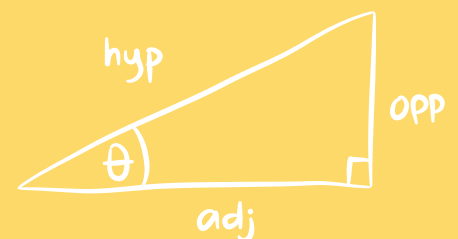
As the survey shows, mathematics is seen by teachers as a difficult subject, so they **seek the help of those pupils that have an interest for maths** and who have no difficulty in understanding it. These are **the ones who act as teachers and help other pupils** understand the material. **However, there is still a lot of confusion and anxiety towards maths** when pupils must **deal with mathematical problems by themselves**, for example in an exam. This results in a lack of motivation, which translates into a general disinterest in mathematics among almost half of pupils across Europe. Furthermore, these **results do not consider the fact that, according to research, 2 or 3 pupils in each class have learning difficulties** (Butterworth, B. & Kovas, Y., 2013). **Pupils that do not receive much needed personal attention from teachers due to their already packed curriculum and the class time constraints.**



$$V = \frac{4}{3} \pi r^3$$



$$V = s^3$$



$$\sin(\theta) = \frac{\text{opp}}{\text{hyp}}$$

PARENTS

As for parents, the general opinion is that Maths is difficult and that pupils are not motivated enough. In fact, from the 169 respondents, **61.57% admitted that their child has problems with mathematics.** The reasons given by parents are motivation and lack of understanding of the subject. Specifically, **40% of pupils are not motivated and almost 31% do not understand the subject** according to the parents.

When asked if **their attitude towards mathematics could influence their child's attitude, opinions are divided almost 50:50** between those who believe this and those who do not. However, the perception is with Croatian parents who state that their attitude has no influence on that of their child, while Romanian, Macedonian and Spanish parents have the opposite opinion.

When asked about the things that could help their child be more motivated to learn maths, the answer was basically that maths should be more interesting, **that there should be more "gamification" in math classes.** Moreover, that it was important for pupils to see a connection with daily life and the need for maths. This opinion was also expressed in the online debates with teachers. The conclusions drawn from this debate are discussed in the following section of this document.

ONLINE DEBATES FOR THE EXCHANGE OF EXPERIENCES



$$V = \frac{4}{3} \pi r^3$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



ONLINE DEBATES FOR THE EXCHANGE OF EXPERIENCES

As mentioned earlier, the E= MD2 work team set out to gain a better understanding of the challenge's pupils face at school and at home when engaging in mathematical activities. To this end, **2 online debates were organised to share experiences.**

On 3 November 2022, a group of **teachers (10) and parents (10)** from the country of **North Macedonia** met for an online debate. The debate was moderated by staff from the school **OOU "ILINDEN"** Kriva Palanka. On 12 November 2022, the same debate took place, this time at the secondary school **"Ion Agârbiceanu" in Alba Iulia in Romania. Here too, 10 mathematics teachers and 10 parents** took part in the debate at both debates, parents and school staff discussed the possible way in which they could support and motivate pupils to improve their performance.

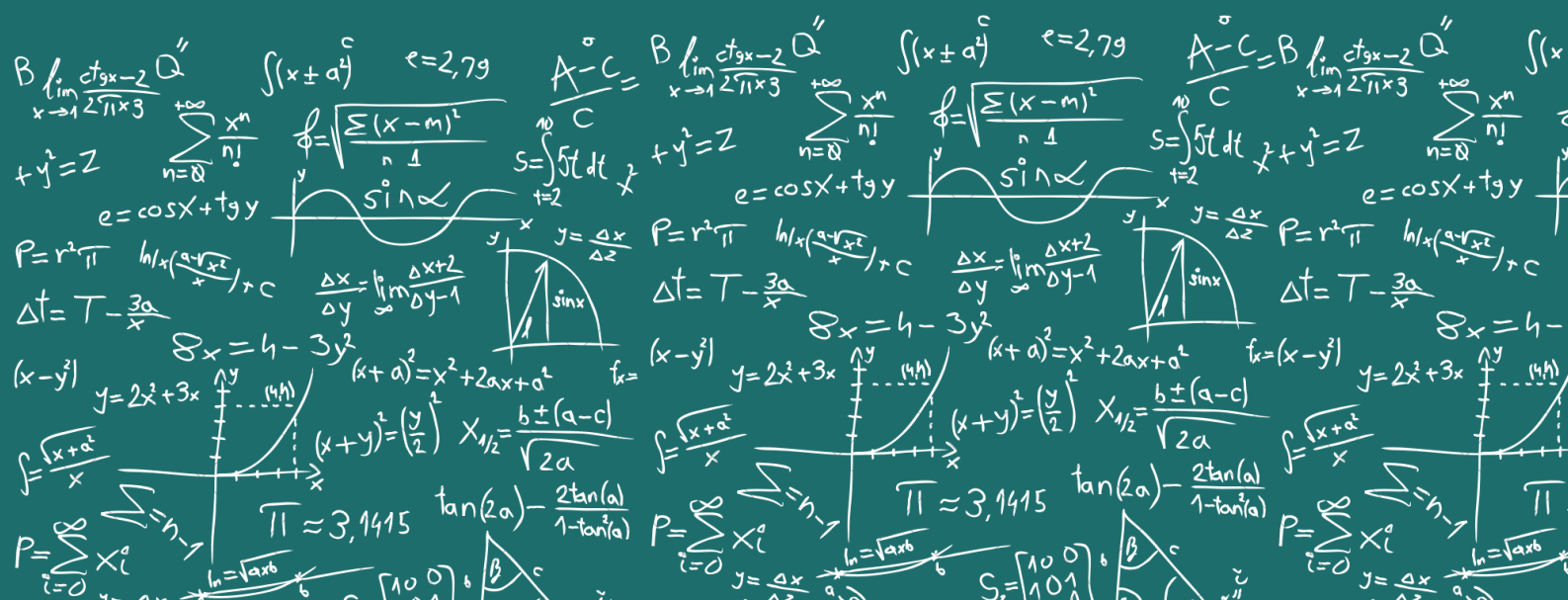
The conclusions drawn in Northern Macedonia and in Romania are as follows:

Although mathematics primarily teaches pupils how to think, gives them self-confidence and opens up many possibilities for the future, **the extremely dense curriculum** (very theoretical in Romania) does not allow teachers to **make the lessons practical**. Furthermore, the number of mathematics lessons per week **does not allow** teachers to work with pupils who have **higher abilities** or **special educational needs**.

ONLINE DEBATES FOR THE EXCHANGE OF EXPERIENCES

According to parents and teachers, the **lack of interest** in mathematics **becomes apparent as pupils get older**, because in the beginning they love mathematics. Consequently, **as mathematics becomes more complex, they are less independent and less confident in their abilities**. This problem becomes evident when they do homework and need answers to their questions. This often leads to frustration when parents try to help them and misguide them.

The general request from parents to teachers is **to make mathematics more tangible for pupils**, i.e. pupils do not understand the usefulness of mathematics because it is so abstract. Therefore, they want **more practical exercises that can translate and be useful to everyday life**.





CONTACT INFORMATION



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AND STUDENT**



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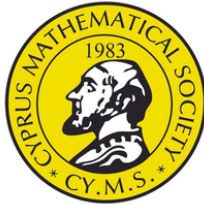
PARTNERS

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