Report - WP2 Need Analysis

KA220-SCH - Cooperation partnerships in school education (KA220-SCH)

Project number: **2024-1-NL01-KA220-SCH-000254064**

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1 Administrative Information

Project Title: Making maths more accessible using Game-based learning to create a more inclusive and less stressful environment in the learning of maths

Project Acronym: MathifyMe

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Coordinator Organisation: Stichting Hogeschool van Amsterdam (AUAS), Amsterdam, Netherlands

Partner Organisations:

- Satakunta University of Applied Sciences (SAMK), Finland
- Sveučilište Josipa Jurja Strossmayera u Osijeku (UNIOS), Croatia
- Università ta' Malta (UoM), Malta
- PROJETO SCHOLE LDA, Portugal

Associated Partners: Local schools and educational stakeholders in partner countries (FI, NL, HR, MT, PT)

Project Manager (in Finland, SAMK, responsible of WP2): Jenni Huhtasalo, SAMK
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2 Progress of Activities

The *MathifyMe* project is implemented under the Erasmus+ Programme (KA220-SCH – Cooperation Partnerships in School Education) between 2024 and 2027. The project aims to raise maths teachers' and students' awareness of the problem of maths anxiety (MA) and through that, enable more positive attitudes and ways of teaching and learning maths as well as lowering MA in the society. The main objective is to create a customisable digital learning game that maths teachers in primary and middle schools can use and adapt to increase awareness about MA and support students struggling with MA.

The project pursues three main objectives:

1. **Raise the awareness** about maths anxiety of primary/middle school teachers.
2. **Create and promote a customisable MathifyMe Digital Game** with learning analytics to support the teaching of maths and help reducing primary/middle school students' MA and increase their interest about the subject.
3. **Develop TPD** to equip and encourage primary/middle school teachers to adopt the MathifyMe Digital Game to support the teaching of maths.

To achieve these goals, the project combines a **multidisciplinary partnership** of five organisations across Finland, the Netherlands, Croatia, Malta, and Portugal. The consortium brings together expertise in STEM education, pedagogy, serious game design, mental well-being, and teacher training.

The project produces both **tangible results** – including the research report, the MathifyMe Digital Game, teacher professional development programme, and implementation video-guide – and **intangible results**, such as increasing teachers' awareness of MA, empowering them to diversify teaching practices as well as to use the MathifyMe Digital Game, and fostering more positive student attitudes towards mathematics.

Ultimately, *MathifyMe* contributes to the **Erasmus+ policy priorities** of:

- **Development of key competences**, by promoting mathematics as a key life competence by developing and implementing the customisable MathifyMe Digital Game – an innovative, analytics-integrated learning tool that supports and enhances traditional teaching methods, enables both formative and summative assessment, and is expected to improve students' performance in maths;
- **Supporting teachers and school leaders**, by enhancing primary and middle school teachers' professional development by increasing their awareness of the MA, supporting them in adapting instruction to meet diverse learning needs, and equipping them to use the MathifyMe Digital Game, thereby strengthening their capacity to innovate in teaching.

The project's results are expected to have a **sustainable impact** beyond its lifetime, with outputs made publicly available for schools, teacher education institutions, and training providers across Europe.

The project is organised into five work packages (WPs). This report concentrates on WP2, presenting the activities undertaken and the main results. Alongside these tasks, the consortium has progressed with WP1 (Project Management), WP5 (Dissemination), and begun collaboration with WP3 on Game Requirements. These parallel efforts have supported coordination, enhanced the visibility of the project, and ensured early alignment with upcoming phases. The outcomes of WP2 are shown in two key deliverables – a Needs Analysis Report and a Good Practices Brochure for Teachers – completed in autumn 2025. Together, these outputs will form the basis for developing the digital learning game and the teacher professional development programme in the subsequent work packages.

3 Objectives and Research Questions for WP2

The purpose of WP2 was to gain deeper knowledge and understanding of mathematics anxiety (MA) and its implications for students, teachers, and parents. More specifically, WP2 set out to explore how mathematics anxiety affects students' learning and experiences, to identify existing and potential strategies that teachers use to address it, and to examine the role of parents in supporting their children. In addition, WP2 aimed to provide a basis for developing a digital learning game that helps students manage mathematics anxiety, as well as to contribute to teachers' professional development in recognising and alleviating it.

The specific objectives of WP2 are:

- **SO2.1.** Identify the main aspects that characterise the phenomenon of MA as well as the good practices for preventing and lowering MA
- **SO2.2.** Identify the needs that should shape the design of the MathifyMe digital game
- **SO2.3.** Define requirements for the MathifyMe digital game

The research questions guiding this work focused on how students perceive mathematics anxiety and its impact on their learning, how teachers recognise and respond to signs of anxiety in their classrooms, how parents experience their children's struggles and provide support, and what pedagogical and technological solutions – including digital game-based approaches – could be effective in reducing mathematics anxiety and improving learning outcomes.

Research questions:

The following is a list of WP2 research questions, with the target group to which each question relates described at the beginning of the question. S = Students, T = Teachers and P = Parents.

1. S: How do students experience mathematics anxiety, and what impact does it have on their learning and attitudes toward mathematics?
2. S: How do students describe mathematics anxiety and its effects on their school experiences?
3. S: According to students, what factors contribute to increasing or decreasing mathematics anxiety?
4. T: How do teachers recognize and understand mathematics anxiety in their students?
5. T: What signs of mathematics anxiety do teachers observe in their students?
6. T: What methods do teachers use to reduce mathematics anxiety?
7. P: How do parents perceive their children's experiences of mathematics anxiety and its effects?
8. P: What kinds of support do parents provide to help alleviate mathematics anxiety?
9. T + (S+P): What pedagogical and technological approaches can be used to manage mathematics anxiety in education?
10. T+S: How do teachers and students assess the current strategies used to reduce mathematics anxiety?
11. T + (S+P): What features of a digital learning game could support the management of mathematics anxiety and mathematics learning?

4 Methodology

WP2 consisted of several phases and was carried out using a mixed-methods approach. The methodology document can be found in Appendix 1. The process began with a literature review, which mapped existing research on mathematics anxiety and examined what kinds of digital games have already been developed to help alleviate it. This was followed by a curriculum analysis, where the national mathematics curricula of the five participating countries were compared to identify similarities and differences in how mathematics education is structured. Building on the insights from these two phases, equestionnaires were developed and directed to three key groups – teachers, students, and parents – in order to capture their experiences, perceptions, and needs related to mathematics anxiety. To complement the questionnaire data and gain a deeper understanding of teachers' perspectives, both focus group and individual interviews were conducted. Together, these phases formed a comprehensive needs analysis, which provides the foundation for the game

design and teachers professional development program. The summary of results is presented in the following section.

5 Needs analysis in practise

WP2 was carried out in close collaboration with the entire project team, with the Finnish team from SAMK designing the needs analysis methodology (Appendix 1) and its practical implementation in various stages. The Finnish team also designed and implemented a summary of the literature review, curriculum analysis, and questions for equestionnaires conducted with teachers, students, and parents, as well as the framework and supporting questions for thematic interviews with teachers. The project teams from all five countries participated in the joint effort by organizing equestionnaires and teacher interviews with associated schools and analysing the data collected from their own countries at this stage.

The overall objective of the needs analysis was to generate deeper knowledge and understanding in relation to mathematics anxiety (MA) and its implications for teaching and learning through need analysis phase. Specifically, this needs analysis aimed to:

- Enhance understanding of the effects of mathematics anxiety on students' learning and experiences.
- Examine the strategies teachers currently use to address mathematics anxiety and identify additional practices that may be needed.
- Contribute to the development of a digital learning game that supports students in managing mathematics anxiety.
- Support teachers' professional development in recognising and preventing mathematics anxiety among their students.

Next, we will provide a general overview of the WP2 results, describing how the needs analysis was conducted and the key outcomes identified at each stage. The needs analysis process (Figure 1) was carried out through a comprehensive, mixed methods research approach, including literature review, curriculum analysis, teachers', students' and parents' equestionnaire, and teachers´ focus group and individual interviews.

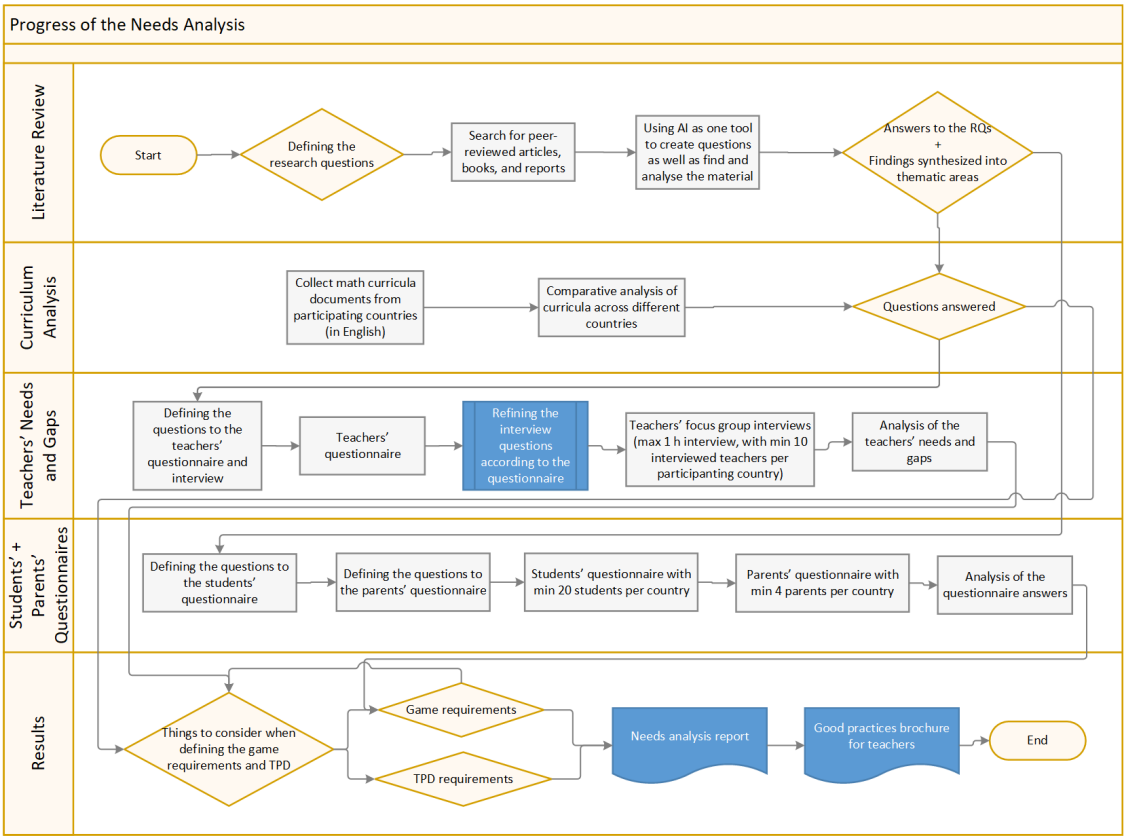

Figure 1. Progress of the needs analysis.

5.1 Literature Review

The literature review formed the first stage of the needs analysis and was carried out using international, peer-reviewed research published in English between 2015 and 2025. A total of 39 articles were analysed, focusing on mathematics anxiety (MA), its root causes, emotional and attitudinal dimensions, gender-related aspects, and existing educational games designed to reduce MA. The lists of analysed articles can be found in Appendix 2. Artificial intelligence tools (e.g., ChatGPT) were also piloted to support the formulation of research questions and the initial screening of relevant sources.

The literature review aimed to conceptualise mathematics anxiety (MA) from a research perspective in order to inform the subsequent stages of the project and to specify the pedagogical and design requirements of the *MathifyMe* digital game. To define math anxiety, the review examined the following key dimensions identified in prior research:

- Definition and Characteristics
- Causes and contributing factors
- Consequences and Impact
- Coping Strategies and Interventions

And when defining the requirements for the game, the following factors were sought in the literature:

- Game-Based Learning as a Tool for Anxiety Reduction
- Game Design Principles that Reduce Stress in Math Learners
- How Narratives, Storytelling, and Gamification Increase Confidence and Reduce Fear of Failure
- Positive Psychology Elements (Growth Mindset, Resilience-Building) in Games to Improve Math Self-Efficacy
- Accessibility and Personalization in Math Anxiety Games
- Key takeaways from the reviewed studies

The review confirmed that mathematics anxiety arises from a combination of personal, cognitive, and environmental factors. Gender differences were consistently reported, with female students experiencing higher levels of anxiety despite comparable performance outcomes. Self-efficacy emerged as one of the most critical predictors of mathematics anxiety, while external contributors included rigid instructional approaches, negative feedback, and parental pressure. Together, these insights provided a foundation for understanding the complexity of mathematics anxiety and for guiding the next phases of the project, particularly the development of a need-targeted digital learning game and a teacher professional development program.

As a conclusion of the literature review **the MathifyMe project's definition of Math Anxiety** was created. Accordingly, math anxiety can be defined as an emotional reaction characterized by feelings of fear, tension, and apprehension when engaging with mathematical tasks or situations. It involves cognitive, emotional, physiological, and behavioural responses that can impair mathematical performance, lead to avoidance of math-related activities, and affect academic and career trajectories, even among individuals with sufficient math skills.

5.2 Curriculum Analysis

The curriculum analysis examined the national mathematics curricula of all five participating countries and analysed them in light of the literature review and the project's research objectives. The focus was on identifying anxiety-inducing content areas (such as fractions, algebra, and geometry), examining pedagogical methods, and assessing opportunities for integrating innovative teaching tools, including digital games.

The comparative analysis revealed both similarities and differences in how mathematics is structured and taught across the partner countries (Table 1). Certain topics – particularly fractions, algebra, and geometry – were consistently identified as areas that tend to trigger higher levels of anxiety. While some curricula encourage innovative teaching practices and integration of digital tools, others remain more rigid, limiting opportunities to adopt game-based learning approaches.

All five countries have national curricula, but their level of specificity and flexibility varies. Finland and Croatia provide detailed grade-specific objectives; in Finland, a national framework sets clear goals while allowing local flexibility, while in Croatia traditional methods still dominate despite curricular encouragement for exploratory learning. The Netherlands grants schools greater autonomy in structuring instructional time and curricular implementation, whereas Malta and Portugal present more clearly defined structures, though private schools in Malta enjoy greater freedom.

Across countries, teaching methods are generally recommended rather than mandated, leaving teachers with considerable autonomy. Finland emphasizes pedagogical freedom and hands-on practices, Malta promotes a combination of exposition, discovery and exploratory approach to teaching, while Portugal and the Netherlands allow broad flexibility. In Croatia, the balance between exposition and exploration is encouraged, though classroom realities often favour more traditional approaches.

In terms of learning materials, alignment with the national curricula is consistent. Finland's materials are curriculum-aligned and diverse, Malta relies heavily on state-approved textbooks, while in Portugal and Croatia teachers supplement textbooks with handouts and digital resources. In the Netherlands, schools largely decide which textbooks and tools to adopt. Although digital tools and games are permitted in all contexts, integration varies: Finland and the Netherlands actively encourage gamification, Malta views games as supplementary, while in Croatia and Portugal game-based methods are seen as add-ons rather than core tools.

Mathematics anxiety itself is rarely addressed explicitly in curricula. Finland mentions it briefly, emphasizing the development of positive attitudes and self-image in mathematics. Elsewhere, MA is not systematically considered. Support for pedagogical innovation also differs: Finland provides teachers with freedom and institutional backing, Malta shows growing support, while Croatia and Portugal face challenges due to heavy content loads and time constraints. In the Netherlands, innovation is supported at the school level.

Overall, the comparative analysis indicates that while all partner countries support the use of digital tools in teaching, explicit consideration of mathematics anxiety remains limited. These findings provide important insights for the development of a digital learning game to mitigate mathematics anxiety. At the same time, they suggest that implementation strategies may need to be tailored to the specific curricular contexts of each country.

Table 1. Results of the curriculum analysis

Mathematics Curriculum Comparison	Finland	Netherlands	Croatia	Malta	Portugal
Curriculum Detail and Structure	National framework, clear goals, local flexibility	Greater school autonomy within national objectives	Highly detailed curriculum with defined outcomes per grade	Structured curriculum; variation by school type	Structured curriculum with implementation flexibility
Teaching Methods and Guidance	Pedagogical freedom, recommended practices, hands-on learning	High flexibility for teachers in methods	Balance of methods encouraged; traditional methods prevail	Some pedagogical recommendations	High flexibility; traditional methods common
Use of Teaching Materials	Aligned with curriculum, supports goals, varied formats	Materials align with objectives; school choice	Teachers supplement textbooks with various resources	Government-approved textbooks aligned with curriculum	Teachers supplement textbooks with various resources
Flexibility and Integration of Digital Tools and Gamification	Supports the use of digital tools, games, and innovation.	Flexible use of games, but integration is not prioritized without	Games encouraged; limited use and training in grades 7–12.	Games seen as supplementary tools; actual use varies.	Games perceived as supplementary; limited training for grades 7–12.
Consideration of Mathematics Anxiety (MA)	Limited mention, supports positive self-image and attitudes	Limited mention; verification needed	Not systematically addressed	A recent local study suggests growing awareness amongst teachers	Curriculum creators vs. teachers questioned
Teacher Motivation and Support for Innovation	Freedom to teach creatively and professionally	Innovation supported at school level	Encouraged innovation, but traditional practices dominate	Institutional support via guidelines and training	Encouraged innovation, but time/content limits
Curriculum Obligations	Mandatory national goals, implementation is locally flexible	Mandatory, with optional components in secondary education	Mandatory curriculum	Mandatory curriculum	Mandatory content; flexible scheduling

5.3 Teachers' eQuestionnaire and Focus Group Interviews

The teachers' equestionnaire (Appendix 3) was designed to explore how mathematics anxiety is recognised, experienced, and addressed in classroom settings from the teachers' perspective. The aim was to gather systematic information about teachers' observations of mathematics anxiety among their students, the strategies they currently use to support affected learners, and their views on the role of digital tools and games in reducing anxiety. In addition, the questionnaire sought to identify gaps in existing practices and highlight areas where teachers feel they need further support or resources. The following subsections present a general overview of the teachers' responses to the survey questions and the implementation of the focus group interviews. More detailed results and analyses will be published in separate scientific articles in 2026 and 2027.

5.3.1 Teachers' participation in the eQuestionnaire

A total of 129 teachers responded to the equestionnaire. Of these, 17 were from Finland, 49 from Croatia, 28 from Malta, 22 from the Netherlands, and 13 from Portugal. Teachers from all grades 1-9 participated in the equestionnaire. 10,9 % of teachers reported having less than five years of teaching experience. 15,5 % reported having worked as a teacher for 5-10 years, and 73,6 % had been teaching for more than 10 years. Just over half of the teachers, 57,4 %, said they only taught mathematics and related subjects. The rest, 42,6 % of respondents, said they taught multiple subjects, including mathematics.

5.3.2 Examples of teachers' responses regarding math anxiety

When teachers were asked what signs they notice in students who experience math anxiety, more than half indicated that they had observed most or all of the common indicators described in the questionnaire. When asked how math anxiety affects students, over 60 % of respondents said that students struggle to focus on tasks and that their test performance is lower than their actual skills. Over 40 % of teachers also reported that students experiencing math anxiety avoid participating in math lessons.

5.3.3 Examples of teachers' responses when asked about strategies used to alleviate math anxiety

The most important strategies used by teachers in situations where students experience math anxiety were positive encouragement and reducing assessment pressure. Almost 80 % of teachers reported using these strategies. Many teachers (over 50 %) also reported discussing their students' feelings about mathematics with them. Nearly 70 % of teachers reported that their school did not have a specific, school-wide support system or strategy for alleviating math anxiety. When teachers were asked what kind of support they felt they needed to cope with students experiencing math anxiety, nearly three out of four teachers wanted practical examples and tools for teaching. None of the teachers who responded said they did not need any support in this area.

5.3.4 Teachers' focus group and individual interviews

The focus group and individual interviews were conducted to gain a deeper and more nuanced understanding of teachers' experiences with mathematics anxiety in their everyday work. While the equestionnaires provided broad insights into observed signs of anxiety and common support strategies, the interviews allowed for a

more detailed exploration of teachers lived experiences, perceptions, and professional reflections. The aim was to examine how teachers identify mathematics anxiety, how it affects learning and classroom dynamics, and what kinds of support strategies are applied in practice. In addition, the interviews sought to capture teachers' views on the availability of school-level support and their perspectives on the potential of digital game-based learning as a tool for addressing mathematics anxiety. A total of 7 teachers from Finland, 7 from the Netherlands, 5 from Croatia, 2 from Malta, and 4 from Portugal participated in the focus group interviews. The qualitative analysis of the focus group interviews will be published with details in several scientific articles and the knowledge learned from them is used in defining the game requirements as well as in designing and developing the game.

5.4 Students' eQuestionnaire

The students' equestionnaire was designed to capture how learners themselves perceive mathematics and the emotions associated with learning it (Appendix 4). At no point in the questionnaire were students mentioned the term math anxiety; instead, their feelings and behaviours were asked about at a more general level using questions designed for that purpose. A total of 481 students responded to the questionnaire, of whom 133 were Finnish, 208 Croatian, 42 Maltese, 71 Dutch, and 27 Portuguese. The following chart (Figure 2) shows the grade levels of the students who responded to the questionnaire.

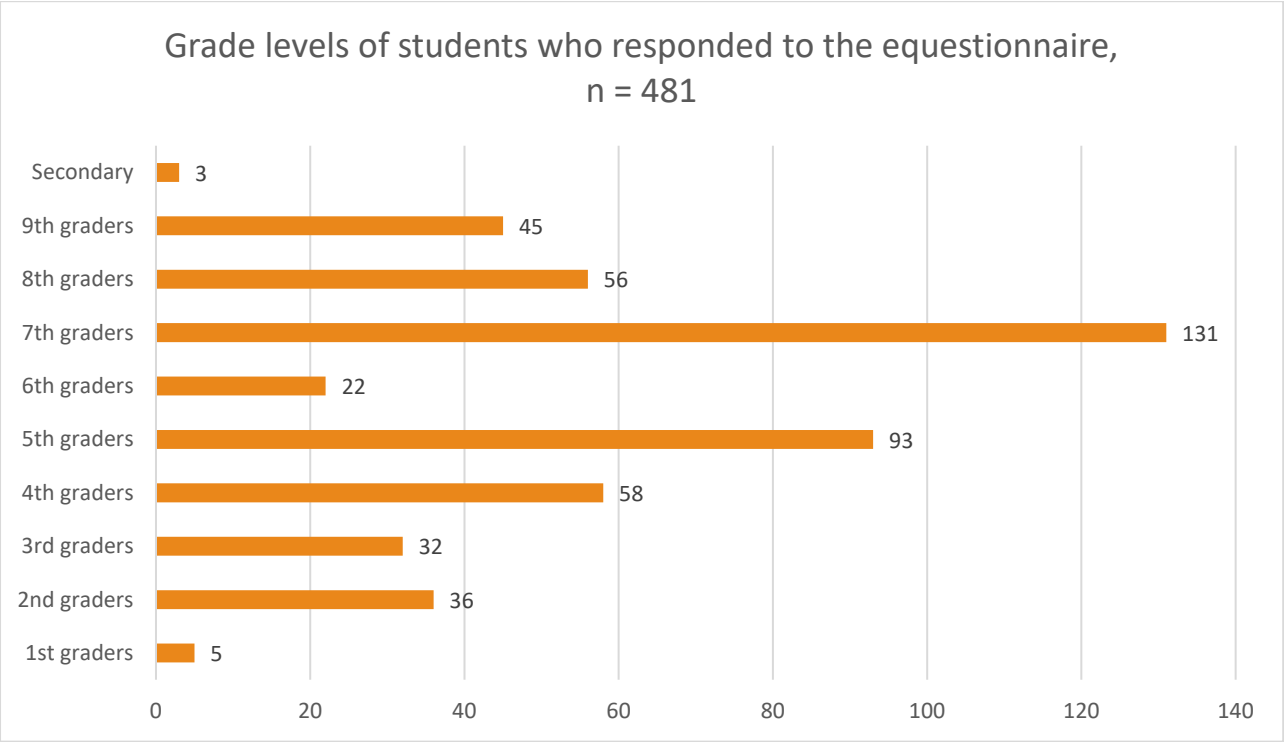

Figure 2. Grade levels of students who responded to the survey.

Most students indicated that they liked mathematics at least sometimes. The following table (Table 2) shows how the liking of mathematics changed by age group.

Table 2. Responses to the statement "I like mathematics" by age group.

Answer option	Grades 1-3 (n = 73)	Percentage	Grades 4-6 (n = 173)	Percentage	Grades 7-9 (n = 235)	Percentage
Yes!	38	52,1 %	44	25,4 %	56	23,8 %
Sometimes	24	32,9 %	83	48,0 %	105	44,7 %
I'm not sure	10	13,7 %	25	14,5 %	32	13,6 %
No, I don't like it	1	1,4 %	21	12,1 %	42	17,9 %

The following tables show how the responses were on different age groups when asked "When I see a math problem, I feel…" (Table 3: 1-3 graders), "When I have to solve a difficult math problem, I feel…" (Table 4: 4-6 graders) and "When I have to take a math test, I feel…" (Table 5: 7-9 graders).

Table 3. Answers of students from grades 1-3 when asked "When I see a math problem, I feel…"

When I see a math problem, I feel:	Answers (n=73)	Percentage
😊 Happy	24	32,9 %
😍 Excited	23	31,5 %
😐 Okay	34	46,6 %
🥱 Bored	8	11,0 %
😟 Nervous	7	9,6 %
😖 Frustrated	2	2,7 %

Table 4. Answers of students from grades 4-6 when asked "When I have to solve a difficult math problem, I feel…"

When I have to solve a difficult math problem, I feel:	Answers (n=173)	Percentage
😊 Happy	22	12,7 %
😈 Excited	23	13,3 %
💪 Confident	46	26,6 %
😐 Okay	54	31,2 %
🥱 Bored	17	9,8 %
😟 Nervous	29	16,8 %
😖 Frustrated	31	17,9 %
🤯 Anxious	21	12,1 %
🤷 Insecure	36	20,8 %

Table 5. Answers of students from grades 7-9 when asked "When I have to take a math test, I feel…"

When I have to take a math test, I feel…	Answers (n=234)	Percentage
😊 Confident	45	19,2 %
😈 Excited	14	6,0 %
😐 Okay	77	32,9 %
🥱 Bored	14	6,0 %
😟 Nervous	123	52,6 %
😖 Frustrated	35	15,0 %

Questions that were particularly important for this study were those that asked about students' attitudes toward playing digital games and whether they would like to play a game to learn mathematics. The following tables (Table 6 and Table 7) show the responses to these questions from different age groups.

Table 6. Students' answers to „Do you like playing digital games?“

Do you like playing digital games?	Grades 1-3 (n = 58)	Percentage	Grades 4-6 (n = 161)	Percentage	Grades 7-9 (n = 235)	Percentage
Yes, a lot	33	56,9 %	90	55,9 %	122	51,9 %
Yes, sometimes	24	41,4 %	67	41,6 %	99	42,1 %
No, I don’t	1	1,7 %	4	2,5 %	14	6,0 %

Table 7. Students' answers to „Would you play a game to learn math?“

Would you play a game to learn math?	Grades 1-3 (n = 58)	Percentage	Grades 4-6 (n = 161)	Percentage	Grades 7-9 (n = 235)	Percentage
Yes, a lot	35	60,3 %	81	50,3 %	101	43,0 %
Yes, sometimes	23	39,7 %	70	43,5 %	96	40,9 %
No, I don’t	0	0,0 %	10	6,2 %	38	16,2 %

The results of equestionnaire suggest that younger learners may experience a range of emotions when engaging with mathematics, but they may not use the specific term “anxiety” to describe their feelings. The terminology of the questionnaire was intentionally kept neutral to avoid priming, but this also illustrates the challenge of identifying mathematics anxiety among younger students, who may lack the vocabulary or self-awareness to articulate such experiences.

5.5 Parents’ eQuestionnaire

The parents’ equestionnaire (Appendix 5) explored how families perceive their children’s experiences with mathematics anxiety and what forms of support the school provides for them and whether the parents are pleased with the support their child is given. A total of 530 responses were received to the parents’ equestionnaire, of which 128 were from Finland, 145 from Croatia, 111 from Malta, 103 from the Netherlands, and 43 from Portugal. Of the parents, 129 responded about their child in grades 1-3, 170 responded about their child in grades 4-6, and 224 responded about their child in grades 7-9. When parents were asked whether

their children had experienced difficulties in mathematics, 85 (16,1 %) parents responded that yes, my child has had significant difficulties with mathematics, 246 (46, 5 %) parents answered that their child had had some difficulties, and the remaining 198 (37,4 %) parents answered that their child had not had any difficulties with mathematics. When parents were asked whether they had noticed their children experiencing negative feelings when doing math problems or taking tests, 107 (20,2 %) parents said that negative feelings had been experienced often, 162 (30,6 %) parents said that these feelings had been experienced sometimes, 147 (27,7 %) parents had observed negative feelings only rarely, and 114 (21,5 %) parents had never observed them.

The following graph (Figure 3) shows the types of signs that parents report noticing in their children when they are having difficulties with mathematics.

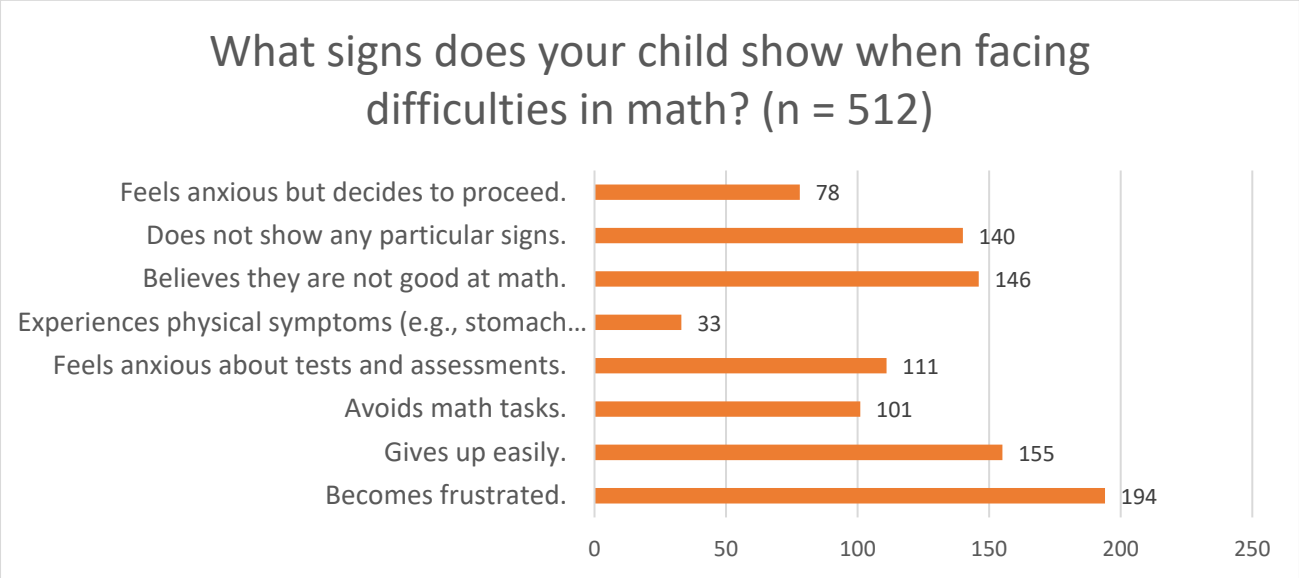

Figure 3. Parents' answers to question „What signs does your child show when facing difficulties in math?“

When parents were asked what kind of support strategies they use when supporting their child's math learning, almost half (49,2 %) of parents encourage their child to try again, and 70,5 % of parents help their children understand the task. Only 16,7 % of parents use digital learning tools or games to help their children, and only 10,6 % of parents reward their children for their achievements. 14,8 % of parents do not see the need for any special forms of support.

These findings highlight the central role of families in recognising and addressing mathematics anxiety. Parents' perspectives add valuable insight into the phenomenon and suggest that future interventions should involve families alongside educators, both in raising awareness and in applying supportive strategies.

5.6 Game Requirements

The game requirements were defined first by reviewing 18 peer-reviewed scientific articles and then analysing the equestionnaires of teachers, students and parents as well as the focus group interviews of teachers. All this was done from the perspective of what factors should be taken into account when designing a game whose primary goal is to alleviate math anxiety and, secondarily, to learn mathematics. The Dutch team was

largely responsible for defining the game requirements, but together with the Finnish team, they took into account the entire needs analysis. In practise, this has been a translation of needs analysis findings into clear game design requirements for the development phase.

6 Results of the qualitative analysis

The project *MathifyMe* generated a rich set of research findings and practical outcomes that directly address the issue of mathematics anxiety (MA) in primary and middle school contexts. Data were collected from teachers, students and parents through questionnaires, open-ended responses, through quantitative and qualitative analyses. Teachers' focus group interviews were also conducted. The results provide insights into the manifestations of MA, its effects on learning, and possible strategies for prevention and alleviation. They also guided the design of the **MathifyMe Digital Game** and the accompanying **teacher training programme**.

6.1 Students

Within Mathematic anxiety theme, the specific research questions concerning students were:

1. How do students perceive mathematics anxiety, and what impact does it have on their learning and attitudes towards mathematics?
2. How do students describe mathematics anxiety and its influence on their school experiences?
3. What factors, according to students, increase or decrease mathematics anxiety?

The following section outlines the overall results structured around these research questions:

6.1.1 RQ1: How do students experience mathematics anxiety, and what impact does it have on their learning and attitudes towards mathematics?

Emotional responses to mathematics

Students reported a wide range of feelings when confronted with mathematics tasks. While some expressed joy, enthusiasm, or a sense of success, others described boredom, frustration, or negative stress reactions. The presence of both positive and negative emotions suggests that mathematics evokes highly individual responses: for some, success and discovery bring motivation, while for others, difficult problems trigger avoidance or disengagement. The categories of *negative and anxiety-provoking emotions*, *boredom and lack of motivation*, and *joy and enthusiasm* show that students' perceptions of mathematics are complex and strongly tied to their immediate experiences with tasks.

Sources of enjoyment and challenge

Mathematics was considered fun when it was associated with well-being, success, and social interaction. Students particularly valued moments of enlightenment and problem-solving, playful activities such as competitions, and engaging reasoning tasks. At the same time, difficulties with calculations, word problems, and abstract numbers often made mathematics feel stressful or demotivating. Some students found challenge

itself exciting, while others saw it as a source of frustration, underscoring the dual role of difficulty in shaping attitudes toward learning.

Coping with difficulties and mistakes

When tasks were perceived as difficult, three main types of reactions were observed: persistence and problem-solving, emotional responses such as frustration or anger, and withdrawal or giving up. Similarly, when asked about mistakes, some students showed resilience by accepting errors as part of learning or using strategies like double-checking and perseverance. Others coped through emotional regulation (e.g., deep breathing, self-talk) or sought support from teachers, parents, or peers. Yet, a significant group reported bodily stress symptoms and quitting when overwhelmed. These findings indicate that mathematics anxiety manifests not only in emotions but also in behaviours that directly affect engagement and performance.

Support systems and classroom conditions

Students highlighted the importance of adult support, peer help, and a calm classroom environment. They noted that clearer instructions, varied activities, and a balance between easy and challenging tasks would help them feel more comfortable in mathematics lessons. Requests for both reduced workload and more engaging activities suggest that anxiety may stem from a mismatch between perceived ability and task demands.

Implications for learning and attitudes

Overall, the analysis shows that students' perceptions of mathematics anxiety are closely linked to both emotional and contextual factors. While moments of success foster motivation and positive attitudes, negative emotions and stress can lead to withdrawal, reduced persistence, and avoidance of mathematics. Supportive environments, timely help, and well-structured tasks appear crucial in shaping whether students experience mathematics as motivating or anxiety-inducing.

Summary

Based on dataset gathered from different countries, mathematics anxiety among students appears as a multifaceted phenomenon. It is expressed through physical and emotional reactions (frustration, sadness, nervousness), avoidance behaviours, and reduced persistence. At the same time, many students experience joy and motivation when they succeed or understand new concepts. Mathematics anxiety therefore shapes both attitudes and learning experiences – supporting motivation through success on the one hand and hindering progress through frustration and fear on the other.

6.1.2 RQ2: How do students describe mathematics anxiety and its influence on their school experiences?

Although students rarely used the explicit word *"anxiety"*, their descriptions reveal that mathematics anxiety is a real and multifaceted experience in their school lives. They described it through a mixture of emotional, physical, and behavioural responses, which together shape how they perceive and engage with mathematics.

Students often linked mathematics to negative emotions. Feelings of frustration, sadness, anger, and nervousness were commonly reported, particularly when faced with difficult or unfamiliar tasks. These emotions were sometimes accompanied by bodily stress reactions such as tension, discomfort, or nervous agitation, indicating that anxiety is experienced not only as a cognitive burden but also as a physical one.

This emotional and physical strain frequently translated into behavioural responses that affected classroom participation. Some students described withdrawing completely or giving up on tasks, for instance by erasing their work or passively waiting for the teacher's help. Others reported difficulty concentrating or an active tendency to avoid mathematics tasks. Such behaviours show how anxiety undermines engagement and prevents students from fully participating in learning activities.

The impact on attitudes and classroom climate was equally pronounced. While a few students reported that challenging problems could feel motivating, for many others the same tasks provoked negative emotions that lowered their confidence and reduced their willingness to try. Fear of making mistakes emerged as a central theme. To cope, students relied on strategies such as deep breathing, positive self-talk, or double-checking their answers. Some also sought support from teachers, peers, or parents, and where such support was available, they described feeling calmer and more capable of continuing. Positive experiences – such as solving problems successfully or taking part in playful competitions – were mentioned as important counterbalances, fostering moments of enjoyment and contributing to a more positive image of mathematics.

In summary, students describe mathematics anxiety as a combination of emotional stress, physical symptoms, avoidance behaviours, and lowered confidence. These experiences strongly shape their daily lives at school, often reducing motivation and engagement, especially in evaluative situations. At the same time, the accounts highlight that supportive environments and constructive coping strategies can help students reframe difficulties as opportunities for growth and build more resilient attitudes toward learning mathematics.

6.1.3 RQ3: What factors, according to students, increase or decrease mathematics anxiety?

The following sections describe the findings that correspond to the third research question.

Factors that increase mathematics anxiety

- **Task difficulty and complexity:** Students often linked negative emotions to hard or confusing problems, especially word problems, geometry, and calculations with large or abstract numbers.
- **Fear of mistakes and evaluation:** Several described stress and sadness when they feared being wrong, or when asked to perform in front of peers (e.g., "I erased everything and waited for the teacher to say the answer").
- **Bodily and emotional reactions:** Anger, sadness, nervousness, and physical stress symptoms (e.g., stomach-aches, tension) were common when facing challenges.
- **Lack of clarity or overwhelming workload:** Students noted that unclear instructions and too many tasks could trigger frustration and demotivation.

Factors that decrease mathematics anxiety

- **Experiences of success and enlightenment:** Students reported feeling happy and motivated when they solved problems, learned something new, or saw their own progress.
- **Supportive environment:** Teacher encouragement and step-by-step-support, parental help, and peer collaboration were seen as important in reducing stress. Even a single instance of supportive feedback was enough to transform nervousness into confidence.
- **Variety and engaging activities:** Competitions, playful tasks, and hands-on approaches made mathematics feel fun rather than threatening.
- **Calm and stress-free conditions:** A distraction-free classroom, clear tasks, and adequate time reduced pressure. Students explicitly mentioned wanting "pressure-free gameplay" or calm lessons.
- **Game-like or digital elements:** When students imagined digital games, they emphasized progress at their own pace, positive feedback, and motivating elements. These were described as features that could make mathematics less stressful and more enjoyable.

6.2 Teachers

Within Mathematic anxiety theme, the specific research questions concerning **teachers** were:

4. How do teachers identify and understand mathematics anxiety in their students?
5. What signs of mathematics anxiety do teachers observe among their learners?
6. What strategies do teachers apply to reduce mathematics anxiety in the classroom?

The following section outlines the overall results structured around these research questions:

6.2.1 RQ4: How do teachers recognise and understand mathematics anxiety in their students?

Indicators and manifestations of mathematics anxiety
Across all contexts, teachers consistently describe mathematics anxiety as a multidimensional experience. They identify it through:

- **Emotional signs:** fear, panic, sadness, nervousness, frustration, low confidence.
- **Cognitive signs:** blanking, memory impairment, constant need for reassurance ("Am I doing it right?"), self-labelling as *"bad at maths."*
- **Behavioural signs:** avoidance of tasks, freezing in exams, reluctance to answer, withdrawn or slowed behaviour, refusing to start.
- **Physical signs:** sweating, stomach pain, headaches, shaking, even somatic illnesses or fits.

These symptoms are observed not only in struggling students but also in high-achievers, who may experience anxiety from pressure, perfectionism, or competition. Teachers also stress that the problem often begins **early in primary school** with negative experiences and foundational gaps.

Teachers' interpretations of causes and triggers
Teachers link mathematics anxiety to several interrelated causes:

- **Early experiences:** discouragement, weak mastery of basic arithmetic, early failure, and learned helplessness.
- **Family and social context:** parental pressure, lack of emotional support, inherited negative attitudes ("I was never good at maths"), and gender stereotypes.
- **School structures:** surprise tests, evaluative culture, time pressure, rigid curricula, and grouping by ability.
- **Social comparison:** anxiety is heightened by peer judgement when speaking in class or performing in public.

Impact on learning and participation

Teachers understand that anxiety undermines learning by blocking concentration and preventing students from showing their true knowledge. It results in:

- Difficulties starting tasks or completing them
- Reduced persistence and participation
- Lower performance on tests despite preparation
- Long-term negative self-concepts and disengagement from mathematics.

Strategies teachers use to identify and mitigate MA

Teachers rely mainly on intuition and close observation, supported by adaptive classroom practices. Reported strategies include:

- **Pedagogical approaches:** scaffolding, prompting, step-by-step questioning, low-stakes testing, oral questioning, humour, group work, cross-subject integration, and linking tasks to real-life contexts.
- **Creating safety:** reassurance, encouraging mistakes as part of learning, building confidence through easy tasks first, and offering choices in how tasks are done.
- **Individualisation:** one-to-one guidance, small groups, differentiated tasks, repetition to build confidence.
- **Emotional support:** calming breaks, patient repetition, positive reinforcement, and fostering inclusion.

Overall understanding

Teachers identify mathematics anxiety through observable emotional, cognitive, behavioural, and physical signs. They interpret it as rooted in early experiences, family dynamics, systemic pressures, and assessment cultures, and understand its significant impact on participation and achievement. While they employ creative and supportive strategies to mitigate anxiety, they consistently stress their need for institutional support, professional development, and structural change.

6.2.2 RQ5: What signs of mathematics anxiety do teachers observe among their learners?

Based on data collected through interviews and questionnaires across all participating countries, teachers consistently report **emotional, cognitive, behavioural, and physical signs** of mathematics anxiety:

Emotional signs

- Fear, panic, nervousness, sadness, anger, frustration.
- Low confidence, self-devaluation, and negative self-talk (*"I can't do maths"*).
- Visible stress before or during assessments, sometimes near tears.
- Fear of making mistakes in front of peers; embarrassment or avoidance of public participation

Cognitive signs

- Blanking out or memory impairment in tests ("I didn't know what I was doing, I panicked").
- Constant reassurance-seeking, even for simple tasks (*"Am I doing it right?"*).
- Difficulty initiating or progressing with tasks despite knowing the content.
- Overchecking or perfectionism (repeatedly erasing or redoing tasks).

Behavioural signs

- Freezing or becoming unresponsive during exams or oral questioning.
- Withdrawing, working very slowly, or refusing to participate.
- Task avoidance, giving up quickly, or erasing work and waiting for teacher answers.
- Reduced classroom participation or passive engagement.
- Lack of interest or motivation towards mathematics
- Deliberate disruptive behavior to avoid tasks or to be sent out of class

Physical signs

- Sweating, shaking, fidgeting, headaches, stomach aches.
- Some teachers even reported extreme cases: students feigning illness, or in rare cases fits triggered by test situations.
- Test papers marked by physical traces of stress (excessive erasing, torn pages).

Summary

Teachers observe mathematics anxiety through a **constellation of signs**: emotional distress, cognitive blocks, avoidance behaviours, and physical symptoms. These indicators are not limited to struggling learners – they also appear in high-achievers, especially in assessment situations or under social pressure. Symptoms were most often observed during tests, when new concepts were introduced, or in public classroom settings where students feared being judged by peers.

6.2.3 RQ6: What strategies do teachers apply to reduce mathematics anxiety in the classroom?

Teachers across the datasets consistently emphasised that reducing mathematics anxiety requires a combination **of emotional support, pedagogical flexibility, and an inclusive classroom climate.** Their practices are often shaped by intuition and personal experience rather than formal training, yet several common strategies emerge.

One of the most widely reported approaches is **scaffolding and step-by-step support**. Teachers deliberately begin with easier tasks, sometimes almost identical to examples just explained, so that students can experience immediate success. This success, they explain, helps to build confidence and reduce feelings of helplessness. From there, tasks are gradually increased in difficulty, ensuring that students do not feel overwhelmed. Scaffolding is supported by prompting, small hints, or structured drill work that strengthens mastery and allows students to progress at their own pace.

Teachers also underline the importance of **emotional safety in the classroom**. They consciously normalise mistakes, telling students that errors are part of the learning process and encouraging them to try, talk, and even fail without fear. Positive reinforcement, reassuring language, and humour are often used to ease tension. For example, teachers describe moments where making students laugh or offering a quiet word of encouragement helped them to relax and re-engage with the task. Some also allow students to take short breaks, such as walking or drinking water, when emotions threaten to overwhelm them.

Anxiety is further addressed through **individualised support and inclusion**. Teachers note that some students require personal guidance to get started on tasks, and in large classes these learners can easily be overlooked. To address this, they provide one-to-one help or organise small groups where students can work in a calmer environment. In some schools, collaboration with special education teachers or learning support educators is possible, but this depends heavily on resources. Offering choice in how tasks are approached or in the learning environment also gives students a sense of agency and reduces pressure.

Another key strategy is **reducing the pressure of assessment**. Many teachers adopt low-stakes testing or oral questioning without making grading explicit. This allows them to assess understanding while avoiding the anxiety associated with formal exams. They also avoid practices such as grouping students by ability, which teachers believe can intensify the fear of failure. Instead, they focus on fostering a supportive atmosphere where every child feels capable of learning at their own level.

Finally, teachers make use of **engagement-oriented approaches**. Real-world contexts, cross-subject projects, and hands-on activities are used to make mathematics feel meaningful and less intimidating. Playful elements, such as puzzles, board games, digital platforms, or teacher-created games, provide opportunities for practice in a relaxed setting. Teachers observe that these activities lower stress, enhance motivation, and encourage participation, particularly among students who would otherwise avoid mathematics tasks.

In summary, teachers describe a repertoire of strategies that aim to reduce mathematics anxiety by **balancing academic support with emotional reassurance**. They build confidence through structured success, create safe spaces where mistakes are accepted, provide targeted individual help, and adapt assessment to reduce pressure. Engagement through play and real-world relevance further supports students' willingness to

participate. Importantly, these strategies are often developed by teachers themselves, filling the gap left by the absence of formal protocols or systemic training on mathematics anxiety.

6.3 Parents

Within Mathematic anxiety theme, the specific research questions concerning **parents** were:

7. How do parents perceive their children's experiences of mathematics anxiety and its effects?
8. What kinds of support do parents provide to help alleviate mathematics anxiety?

6.3.1 RQ7: How do parents perceive their children's experiences of mathematics anxiety and its effects?

Parents' views on mathematics anxiety reveal a spectrum of recognition, scepticism, emotional involvement, and expectations toward schools and teachers. Their responses underline how mathematics anxiety is experienced not only by children but also by families, shaping motivation, confidence, and home–school dynamics. While the general patterns were similar across countries, parents´ emphasis varied slightly: some focused on systemic school issues, whereas others stressed emotional well-being and early support.

Recognition and critical attitudes

Some parents question the concept of mathematics anxiety itself, expressing scepticism about whether difficulties should be described as "anxiety" or whether the term risks reinforcing negative beliefs in children. These parents often attribute struggles to teaching methods, curricular complexity, or poor study habits rather than innate anxiety. At the same time, many acknowledge that feelings of inadequacy and inferiority can emerge very early, making recognition and **early prevention** crucial. Parents also highlight **individual learning differences**, noting that children learn at different paces and that additional needs, such as autism, may intensify difficulties.

Effects on learning and emotional life

The majority of parents describe mathematics anxiety as having a direct and often negative effect on their child's learning. Reported impacts include avoidance of homework, loss of concentration, reduced self-confidence, and reluctance to attend school. Several parents link mathematics anxiety to daily stress and sadness, with some explicitly reporting that their child has "lost self-esteem" or feels discouraged about the future of their learning in mathematics. Importantly, parents also describe their **own emotional involvement**, noting frustration, guilt, or helplessness when unable to help with mathematics tasks. In some cases, anxiety was described as a "shared burden," where the child's stress spread to the parent.

Support and alleviation

Many parents emphasize that **success, encouragement, and structured support** are key in reducing mathematics anxiety. Experiences of success, breaking tasks into smaller steps, or providing additional lessons and special education support were highlighted as effective strategies. Parents consistently note that practice and repetition build confidence, while positive reinforcement, group work, and engaging activities create protective buffers against anxiety.

The role of schools and teaching quality

Parents frequently link mathematics anxiety to **teaching practices, curriculum design, and school organisation**. They stress that the quality of instruction, the methods used by teachers, and the scope of the syllabus are central in shaping whether students experience mathematics as approachable or intimidating. Criticisms include overly vast syllabi, lack of sufficient practice time, inconsistent substitute teaching, and insufficient teacher capacity to recognize and address struggling learners. At the same time, parents acknowledge that effective teaching can help children overcome anxiety and build confidence.

Peer influence and social dynamics

Although mentioned less frequently, several parents draw attention to the role of **peer comparison and classroom climate**. Children are reported to measure themselves against peers, sometimes feeling inadequate or judged. Such social pressures can worsen insecurity and reinforce anxiety, even for students who perform well in other subjects.

Positive experiences

A notable share of parents report **no experiences of mathematics anxiety** in their families. These parents describe their children as confident, hardworking, and even enthusiastic about mathematics, with some noting that their child enjoys the subject and excels in it. These accounts illustrate that mathematics anxiety is not universal and that for some families mathematics is a source of pride rather than stress.

Summary

Parents' perceptions of mathematics anxiety range from scepticism to deep concern, but overall, they recognize its potential to affect both children's learning and family dynamics. They identify its impact in lowered confidence, avoidance of tasks, and emotional strain, while also acknowledging their own struggles to provide adequate support at home. Parents stress the importance of **early recognition, individualized support, engaging teaching practices, and experiences of success** as key to alleviating anxiety. At the same time, they express strong expectations toward schools: teaching quality, curriculum design, and systemic support are seen as decisive in either mitigating or exacerbating mathematics anxiety.

These findings suggest that mathematics anxiety is not only an educational issue but also an emotional and relational one, shaping the parent-child dynamic and family wellbeing. These perspectives highlight the importance of cooperation between families and schools, as well as the need for systemic awareness and reform to address mathematics anxiety effectively.

6.3.2 RQ8: What kinds of support do parents provide to help alleviate mathematics anxiety?

Parents describe a variety of ways in which they try to support their children in coping with mathematics anxiety. Much of this support is shaped by emotional reassurance, practical help, and efforts to create positive learning habits at home.

A first form of support is **emotional encouragement and reassurance**. Parents report that they try to boost their children's confidence by reminding them that effort is noticed and valued, by offering encouragement

after mistakes, and by maintaining a positive attitude toward learning. Some emphasize the importance of helping children regulate their emotions, for example by teaching coping strategies such as self-regulation, relaxation, or adopting a calm mindset before approaching mathematics tasks. In these accounts, parents see their role as helping children believe in their own ability to succeed and normalizing the idea that difficulties are part of learning.

Another major form of support involves **practical and academic help**. Parents describe assisting with homework, arranging extra practice, or seeking external tutoring when they feel unable to provide the necessary guidance themselves. Several parents highlight that consistent practice at home, including breaking down problems into smaller steps, can help children feel more secure and less anxious. Others note that they arrange private lessons or encourage participation in math clubs to give children more structured opportunities for success.

Parents also emphasize the value of **creating a safe and individualized environment**. Some report adapting the study environment to reduce pressure, encouraging children to take tasks one at a time, or ensuring that mathematics practice at home happens in a calm, non-stressful setting. This reflects parents' understanding that the conditions under which children study are as important as the number of hours spent.

A smaller but important theme is **seeking collaboration with schools and teachers**. Parents note that they attempt to maintain dialogue with teachers or expect the school to play a stronger role in providing additional lessons and individualized attention. In some cases, parents point out that they themselves cannot provide sufficient help because of limited mathematical knowledge, which increases their reliance on professional or school-based support.

However, several parents also described emotional strain in trying to help their children, expressing feelings of frustration, guilt, or helplessness when their support did not seem to ease the child's anxiety. This highlights that supporting a child with mathematics anxiety can itself be emotionally demanding for parents.

Summary

In summary, parents provide support to alleviate mathematics anxiety through a combination of **emotional reassurance, structured practice, tutoring or extra lessons, and the creation of calm and individualized learning environments at home**. A few parents also noted that access to external tutoring or additional lessons depends on family resources, pointing to inequalities in how support for mathematic anxiety can be provided at home. While many make significant efforts to compensate for challenges, their responses also reveal that they often feel the limits of their own capacity, leading them to call for stronger collaboration with schools and teachers.

7 Dissemination Activities of WP2

Work package 2 of the MathifyMe project has been very extensive. This has led to a much larger amount of results and data being collected than planned. Since there is so much good research data, it has been decided that the results of the analyses will be published extensively in scientific articles. Two articles have been already published:

1. Breaking the cycle: addressing mathematics anxiety in education with game-based learning – published in the CSS Research Forum publication of three Finnish Universities of Applied Sciences
2. Needs Analysis to Define a Digital Learning Game Aimed at Coping with Mathematics Anxiety – published and presented in the ECGBL conference

During the fall 2025 the "We research" article will be published at the RoboAI website at SAMK. The article "Designing Player Experience Goals to Support Learners in a Digital Game about Mathematics Anxiety „ is already written and it will be submitted to the CSS Research Forum held in Kokkola, Finland in April 2026.

In addition to these there will be several (3-6) different scientific articles written by the end of 2026 as all the data can be analysed from different points of view. One of the results of WP2 was the publication of a brochure for teachers on math anxiety, how to recognize it, and how to alleviate it.

8 Final conclusions of WP2

Work Package 2 has provided a comprehensive and evidence-based understanding of mathematics anxiety (MA) among students, teachers, and parents across the five partner countries. The findings confirm that MA is a complex, multifactorial phenomenon that manifests emotionally, cognitively, behaviourally, and physically, and that it affects learners of all ages and ability levels. It often begins early in schooling and is sustained by factors such as fear of failure, rigid teaching practices, negative feedback, and lack of confidence.

Teachers play a crucial role in recognising and addressing MA, yet many rely on intuition rather than formal guidance. Their main strategies – scaffolding, reassurance, individualisation, and low-stakes assessment – are effective but require stronger institutional support and professional development. Students' responses show that supportive learning environments, encouragement, and engaging activities significantly reduce anxiety, while excessive workload, unclear instructions, and evaluative pressure increase it. Parents, meanwhile, emphasise the importance of emotional support, structured practice, and collaboration with schools, though many feel ill-equipped to assist effectively.

The results of WP2 highlight the need for systemic attention to mathematics anxiety in both curriculum design and teacher education. They form a robust foundation for the next stages of the project: the development of the MathifyMe Digital Game and the related teacher professional development programme. These tools should prioritise positive feedback, self-paced learning, and playful engagement to help students experience mathematics with confidence and enjoyment. Ultimately, WP2 underscores that reducing mathematics anxiety requires a holistic approach – combining pedagogical innovation, emotional support, and cross-sector collaboration – to make mathematics a more inclusive and empowering experience for all learners.