

**RbtsInMath: Developing Mathematics Achievement
through Using Robotics Applications in Flipped Learning**

Project number: 2022-1-PL01-KA220-HED-000086524

Robotic Applications in Mathematics Teaching Interview Report

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INTRODUCTION

This report was created as part of the project "Developing Mathematics Achievement through the Use of Robotics Applications in Flipped Learning." Its purpose was to gather insights from both pre-service teachers and teachers regarding the utilization of robotic applications in teaching mathematics. To achieve this, the report includes an analysis of interviews conducted with pre-service teachers and teachers concerning the integration of Robotic Applications in Mathematics Teaching.

The study was meticulously designed according to scientific principles, with the primary aim of eliciting the perspectives of pre-service teachers and teachers on the incorporation of robotic applications into mathematics education. The responses to the interview questions provided by the pre-service teachers and teachers were gathered via an online form containing four open-ended questions. This form was created using Google Forms and MSTeams platforms.

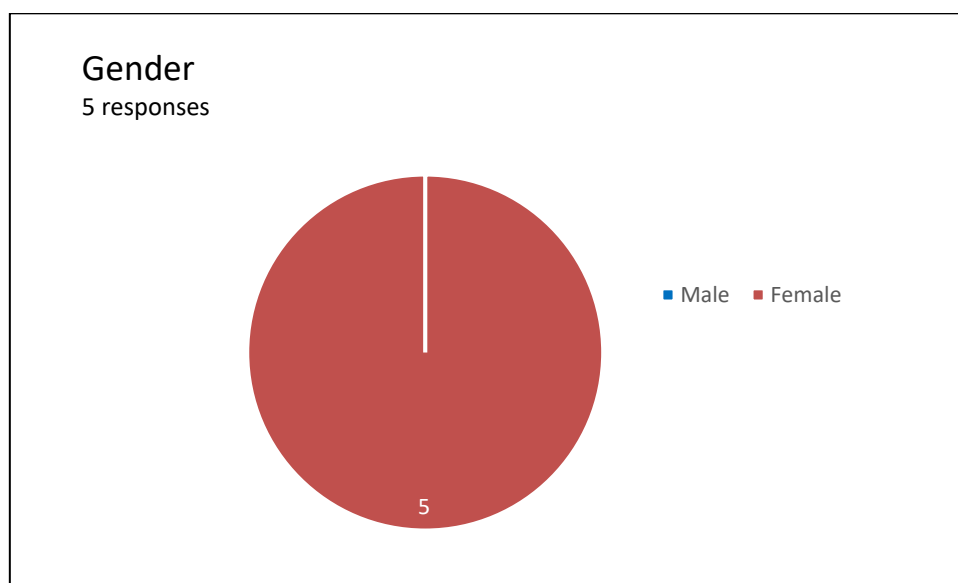
The interview questionnaire consisted of two main parts. Initially, participants were requested to provide information about their gender and status. Subsequently, participants were asked to share their insights and experiences regarding the implementation of robotic applications in mathematics teaching. The interviews were conducted over a period spanning from May 13th, 2023, to May 31st, 2023.



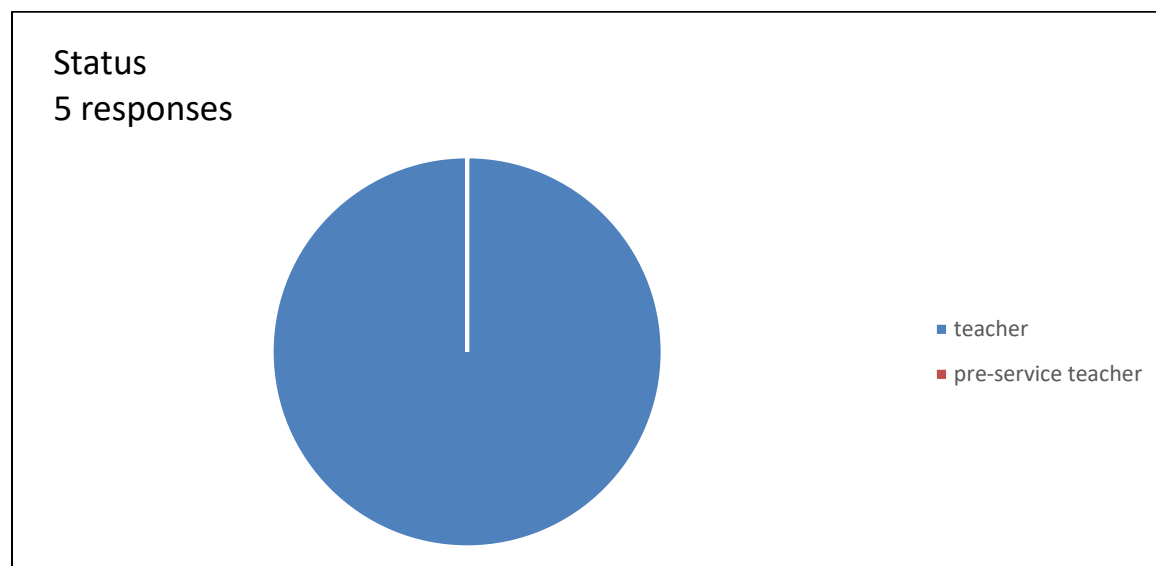
1. POLAND

1.1. Number of Participants and Profile

Interviews were held by University of Social Science from Poland, one of the project partners, with 5 participants. All of the participants were female.



All of the participants participating in the interviews were teachers.



1.2. Summary of Results

Question – 1: What do you think about maths teaching in primary schools? What do you think is maths anxiety?

Participants generally describe math anxiety as the feeling of fear and anxiety, even a phobia, that students may experience in math class. In addition, participants also express math anxiety as the fear of failure and fear of wrong answers. One of the participants explained math anxiety as *“fear related to lack of knowledge. We are afraid of what we do not know and it is exactly the same with mathematics. Students who have problems understanding mathematics are afraid of the subject”*. Another participant claimed that in early-primary school classes, math anxiety doesn’t appear.

Question – 2: How can we release maths anxiety? Will the use of technology release maths anxiety while dealing with maths?

Participants suggested that math anxiety can be released with “learning by playing approach”. In addition, they stated that the use of technology in mathematics can help with eliminating math anxiety. One of the participants said the following about this subject: " Nowadays, technology is present and needed everywhere. In my opinion, the use of technology can help a student to tame the fear of mathematics. We all use modern technology on a daily basis and a well-adapted tool can contribute to broadening mathematical competence.”

Question – 3: How can we use robots to teach numbers and counting?

Participants stated that analytical and cause-and-effect thinking can be taught by using robots. It can also increase creativity and accuracy. In addition, the participants stated that using robots from the beginning of education can be helpful. . One of the participants said the following about this subject: *“Robots can be used to create personalised educational programmes that take into account the different skill levels and ages of children. In this way, robots can help tailor the level of difficulty and pace of learning to the individual needs of each learner”*. However, one of the participants didn’t know, how robots can be implemented to teach numbers and counting.

Question – 4: How can we use robots to teach measurement? How can we use robots to teach data processing?

Participants stated that and data processing and measurement can be taught by calculating the robot's paths. Robots can be used to measure distances, calculate dimensions and, for example, the perimeter of geometric figures. 3 participants didn't know, how to use robots, but they were willing to get to know.

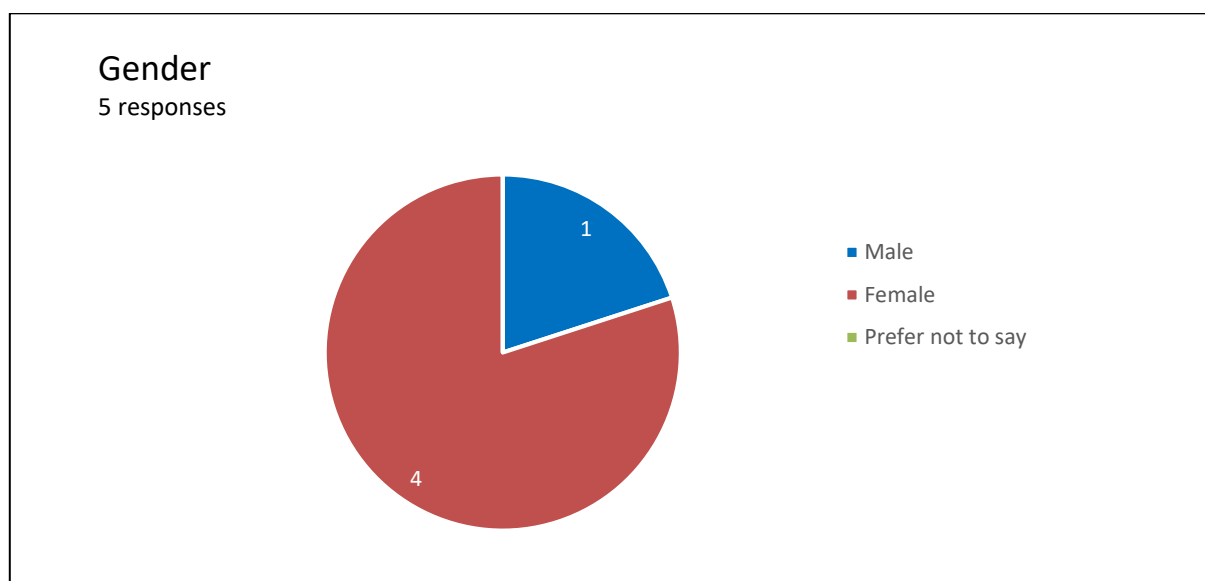
1.3. Conclusion

- Participants could understand the root of math anxiety and know the ways it can be released.
- Participants understood the role of technology in developing the mathematical skills of students.
- In general, participants can name the ways robots can be used in teaching math, but it was hard for them to give some practical examples.
- Teachers want to increase their knowledge in the subject.

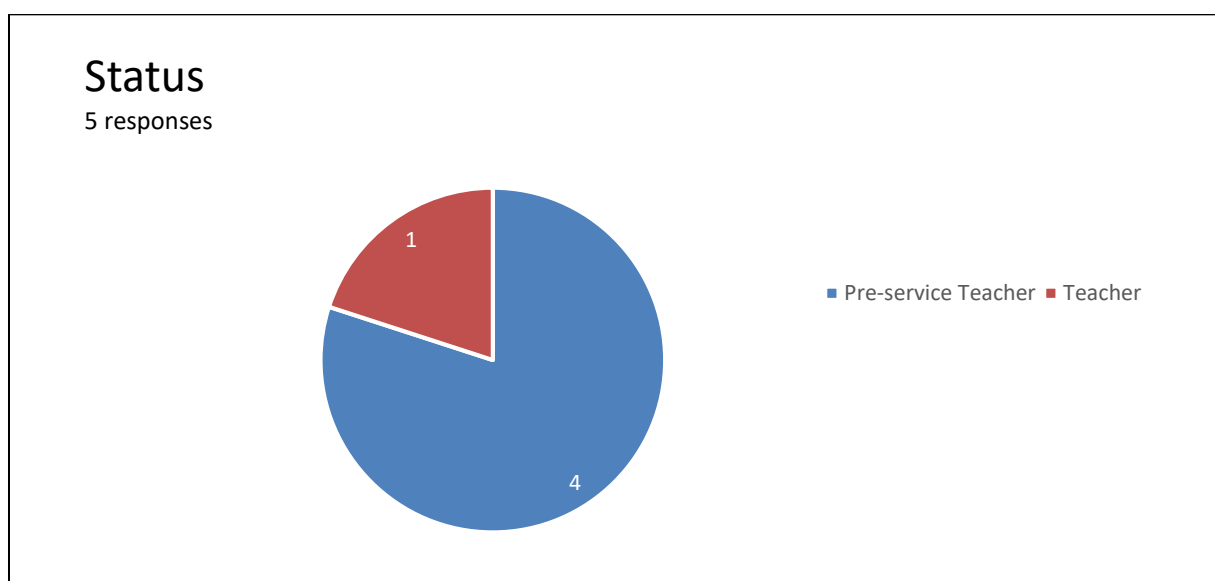
2. TURKEY

2.1. Number of Participants and Profile

Interviews were held by Çanakkale Onsekiz Mart University, one of the project partners, with 5 participants. 4 of the participants are female and 1 is male.



Only 1 of the participants participating in the interviews are teachers and 4 of them are pre-service teachers.



2.2. Summary of Results

Question – 1: What do you think about maths teaching in primary schools? What do you think is maths anxiety?

Participants generally describe math anxiety as the feeling of fear and anxiety that students may experience in math class. In addition, participants also express math anxiety as students' fear of failure. One of the participants explained math anxiety as *"a lack of belief or motivation that math is difficult and cannot be done"*. Another participant said about math anxiety: *"I think math anxiety creates a feeling that students will not learn anything."*

Question – 2: How can we release maths anxiety? Will the use of technology release maths anxiety while dealing with maths?

In order to eliminate math anxiety, the participants made suggestions to the students such as giving time, using reinforcement, using interesting activities, making motivating speeches, repeating the topic and telling stories. One of the participants expressed this situation as follows: *"The attitude of the teacher towards his students can remove the math anxiety. He should approach with reinforcements, integrate the subjects with interesting objects, stories, practices or activities according to the age level of the student."*

In addition, they stated that the use of technology in mathematics teaching could be the most effective method to eliminate mathematics anxiety in children. One of the participants said the following about this subject: *"Since mathematics is an abstract subject-intensive course, technology-supported software, applications, videos, interactive content that can appeal to as many senses as possible can be presented."*

Question – 3: How can we use robots to teach numbers and counting?

Participants stated that using robots would make teaching numbers and counting more fun and interesting. However, they also stated that there is a need for software developer or expert support in this regard. In fact, this situation reveals the need for training on the use of robotic applications.

In addition, the participants stated that numbers and counting could be taught as a result of coding the robot about numbers and observing the robot by the student. In these activities, they emphasized the importance of interaction, giving feedback, and the use of remarkable

elements such as music and light. One participant said the following about this subject: "We can interact, give feedback, combine with music. Pressing 1 can use red light, pressing 2 yellow light, etc. At this time, it can be written which number is greater than the other."

Question – 4: How can we use to teach measurement? How can we use robots to teach data processing?

Participants stated that measurement and data processing can be taught by making coding and transferring them to the robot. They stated that this application would facilitate teaching measurement and data processing. In addition, they said that the use of digital tools such as Kahoot and Wordwall will contribute to this process.

2.3. Conclusion

Participants generally define mathematics anxiety as the fear of failure and anxiety that students may experience in mathematics lessons.

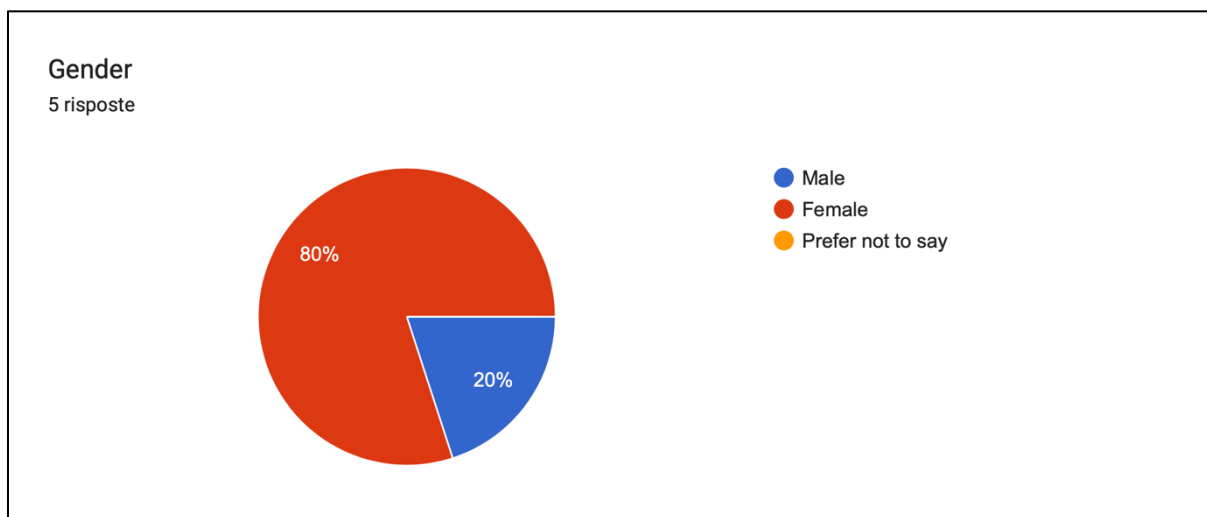
Participants made suggestions such as giving time to students, using reinforcement, using interesting activities, making motivating speeches, repeating the subject and telling stories in order to eliminate math anxiety in students. They also stated that the use of technology in mathematics teaching could be the most effective method in relieving mathematics anxiety in children.

In addition, they also stated that numbers and counting could be taught in a more fun way as a result of coding the robots about numbers and observing the robot by the student. However, the participants also stated that they needed expert support because they did not have enough knowledge about robotic applications. Participants also stated that robotic applications can be used in measurement and data processing. They stated that robotic applications will make it easier to teach these subjects.

3. ITALY

3.1. Number of Participants and Profile

Interviews were held by Scuola di Robotica , one of the project partners, with 5 participants. 4 of the participants are female and 1 is male.



2 of the participants participating in the interviews are teachers and 3 of them are pre-service teachers.

3.2. Summary of Results

Question – 1: What do you think about maths teaching in primary schools? What do you think is maths anxiety?

Math anxiety is a common issue that negatively affects students' learning and can create emotional barriers to understanding mathematical concepts. Factors contributing to math anxiety include insecurity about mathematical abilities, fear of mistakes or failure, social pressure, and past negative experiences. Math teaching in primary schools plays a crucial role in establishing a strong foundation for students' mathematical understanding and skills. It is essential to introduce math concepts in an engaging, accessible, and developmentally appropriate manner to address math anxiety and promote effective learning. By creating a supportive and positive learning environment, educators can help students overcome math anxiety and build confidence in their math abilities.

Question – 2: How can we release maths anxiety? Will the use of technology release maths anxiety while dealing with maths?

To alleviate math anxiety, the use of technology, including robots, can be beneficial in several ways. Here's a synthesis of the answers:

Interactive Learning: Technology, including robots, can offer interactive platforms that make learning math more engaging and enjoyable. These tools present math concepts in visual and interactive ways, allowing students to explore and practice at their own pace.

Personalized Learning: Technology enables personalized learning experiences by adapting to students' individual needs and learning styles. Through online platforms and educational software, students can receive targeted exercises, feedback, and additional resources tailored to their specific areas of struggle, boosting their confidence and helping them overcome math anxiety.

Gamification: Technology, including robots, can gamify math lessons, making the learning process enjoyable and less intimidating. Math games and interactive challenges create a positive and competitive atmosphere, encouraging active participation and problem-solving in a fun and relaxed manner.

Gradual Implementation: Incorporating technology into math teaching may seem daunting, but starting with simple and user-friendly digital tools and gradually integrating them into teaching practices can ease the process. Seeking professional development opportunities and collaborating with tech-savvy colleagues can provide support and guidance.

Comprehensive Approach: While technology can be valuable, it is important to recognize that it alone cannot eliminate math anxiety. It should be integrated into a comprehensive approach that includes supportive teaching strategies, a positive classroom environment, and individualized attention to address students' unique needs.

In terms of using robots to teach numbers, robots can serve as engaging and interactive tools for teaching math concepts. They can provide hands-on experiences, assist with demonstrations, and facilitate problem-solving activities. By incorporating robots into math lessons, students can develop a deeper understanding of numbers and mathematical concepts through active and immersive learning experiences.

Question – 3: How can we use robots to teach numbers and counting?

Incorporating robots into math education offers numerous benefits for teaching numbers and counting. Here's a synthesis of the provided answers:

1. **Interactive Counting:** Robots can be programmed to interact with students, guiding them through counting exercises and displaying numbers. This interactive experience enhances engagement and enjoyment in the learning process.
2. **Math Games and Challenges:** Robots can facilitate math-related games that involve numbers and counting. They can initiate games focused on number sequences, addition, or subtraction, providing feedback and rewards to motivate students.
3. **Hands-on Exploration:** Robots offer a hands-on platform for students to explore math concepts concretely. Through manipulatives and activities, students can develop a deep understanding of numbers, shapes, and measurement.
4. **Programming and Data Processing:** Robots provide opportunities for students to practice programming and coding skills while working with data. Students can program robots to process data, perform calculations, and generate statistical analyses, fostering a deeper understanding of both programming and data concepts.
5. **Personalized Feedback:** Robots can offer personalized feedback to students during counting exercises. They can recognize and respond to students' answers, providing encouragement, corrections, or additional challenges based on individual progress.

Overall, incorporating robots into math lessons enhances interactivity, engagement, and hands-on learning. It enables students to practice counting skills, play math games, explore concepts concretely, develop programming abilities, and receive personalized feedback to support their learning journey.

Question – 4: How can we use to teach measurement? How can we use robots to teach data processing?

When using robots to teach measurement, there are several approaches suggested by the five participants:

1. **Data Collection:** Robots can be programmed to collect data from various sources, such as environmental sensors. This allows students to work with real-time data and understand different data types.
2. **Virtual Simulations:** Robots can be utilized in virtual environments to simulate measurement scenarios. Students can program or control virtual robots to measure objects or distances, providing hands-on practice without the need for physical objects.
3. **Real-Life Connections:** Making connections between math and real-life situations is emphasized as it helps students see the practical relevance of mathematical concepts. By applying math to everyday scenarios, students can develop problem-solving skills.
4. **Data Analysis:** Robots can assist in analyzing data by performing calculations and generating graphs and charts. Students can work with the robot to interpret the data and understand patterns and trends.
5. **Visual Representation:** Robots with LED displays can visually present data in an appealing manner. This visual representation helps students observe and interpret information more easily, enhancing their understanding of patterns and trends.

In summary, the use of robots in teaching measurement offers opportunities for data collection, virtual simulations, real-life connections, data analysis, and visual representation. These approaches foster a hands-on and practical learning experience for students, enabling them to apply mathematical concepts in meaningful ways. By working with robots, students can develop problem-solving skills, interpret data, and make connections between math and the real world. The incorporation of robots in measurement instruction provides a dynamic and engaging approach that enhances students' understanding of measurement concepts and their applications.

3.3. Conclusion

In conclusion, math anxiety is a common issue that can hinder students' learning and understanding of mathematical concepts. However, the use of technology, including robots, can play a significant role in alleviating math anxiety and promoting effective math education.

Technology offers interactive learning platforms that make math engaging and enjoyable for students. Personalized learning experiences through technology adapt to students' individual needs and learning styles, boosting their confidence and helping them overcome math anxiety. Gamifying math lessons and gradually integrating technology into teaching practices can also enhance students' engagement and reduce anxiety.

Robots can be powerful tools for teaching numbers and counting. They can interact with students, guide them through counting exercises, and facilitate math-related games. By providing hands-on exploration and incorporating programming and data processing, robots enhance students' understanding of math concepts. The visual representation of data through robots can help students observe patterns and trends more easily.

When teaching measurement, robots can be programmed to collect real-time data, simulate measurement scenarios, and provide connections to real-life situations. They assist in analyzing data, performing calculations, and generating visual representations that aid students in interpreting information effectively.

In summary, the integration of technology and robots into math education offers various benefits, such as increased engagement, personalized learning experiences, hands-on exploration, and visual representation. By utilizing these tools, educators can create a supportive learning environment that addresses math anxiety, fosters student confidence, and promotes effective math learning.

4. LATVIA

4.1. Number of Participants and Profile

Interviews were held at University of Latvia, one of the project partners, with 7 participants.

All 7 participants are female (see Figure 1).

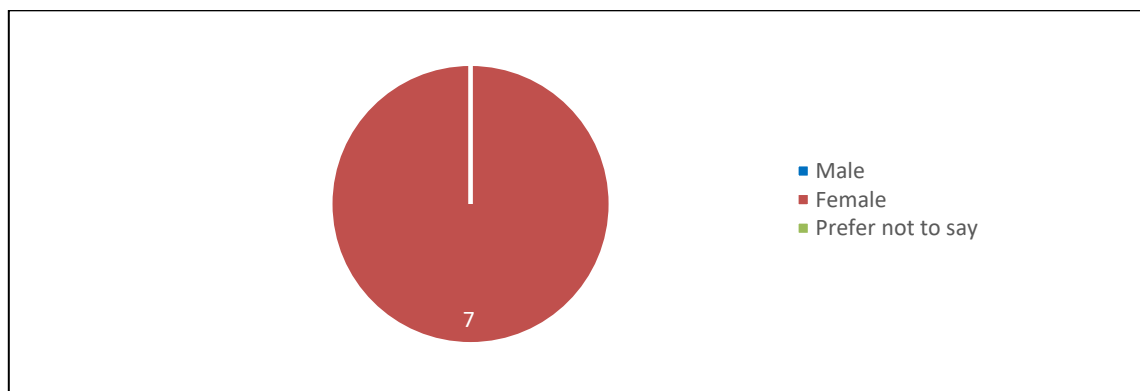


Figure 1 Gender of respondents.

All seven participants participating in the interviews are prospective teachers and part time students as well (see Figure 2).

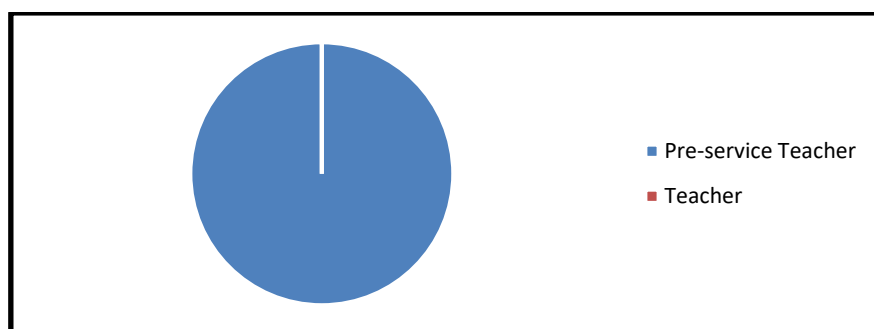


Figure 2 Status of respondents

4.2. Summary of Results

Question – 1: What do you think about maths teaching in primary schools? What do you think is maths anxiety?

Respondents point out that there are differences between learning mathematics in preschool and primary school. The new curriculum is being implemented in pre-school, but it is not really being used in primary school. For example, in pre-school, a lot of attention is paid to *giving children time to think, you can make mistakes in maths, there are no wrong answers, but in*

school maths does not take this into account. Children have difficulty switching from pre-school to primary school.

Respondents feel that mathematics teaching in primary school is very unclear, there are big gaps, and there is no system in curriculum planning. The following example describes the poorly thought-out implementation of mathematics education: *in mathematics, a 20-minute video from Tavaklase is shown, which makes children lose interest, which makes them less willing to learn mathematics.*

Respondents point out several typical features of mathematics teaching in primary school, such as *the greater use of books and workbooks in primary school mathematics. Opportunities to promote motivation should also be considered. There are also implications for the COVID period for pupils' skill levels.*

Respondents have difficulty answering the question *What do you think is maths anxiety*. In general, respondents are not familiar with maths anxiety and therefore cannot express an opinion about it. Although encouraged, respondents try to describe maths anxiety as *I can't do maths, I don't know how to do it; Maybe it is related to dyscalculia? If there is bilingualism - children understand but cannot answer - then children become anxious.*

Question – 2: How can we release maths anxiety? Will the use of technology release maths anxiety while dealing with maths?

Respondents believe that the teacher plays an important role in reducing anxiety in mathematics: *the teacher's attitude can reduce anxiety. But it will not be the case that the teacher can do everything.*

It is also important to change the approach to teaching mathematics in primary school. More emphasis should be placed on practical activities, on the individual growth of each pupil, on the implementation of learning activities in mathematics content learning: *the approach should be different - smaller groups, usually focusing on those who learn quickly and well, while the other children do not keep up.*

Respondents believe that cooperation between teachers and parents is needed to reduce math anxiety. Parents should be encouraged to support the pupil instead of taking on the role

of teacher: *Parents also have a responsibility, but they do not have to be the teacher, they can only support.*

Respondents highlight the positive impact of technology in reducing mathematics anxiety and give various examples of positive experiences where a positive correlation between technology and anxiety reduction can be clearly observed. For example, in a private school using robotics, technology: *We have robotics - the children love it, making things with their hands, they are excited, they see the use. So for the children, maths is the top subject in the class.*

However, respondents point out that it is important for the teacher to assess, choose and offer students the opportunity to work with technology: *the teacher looks at what the children need, technology helps to change attention, switch, e.g. different programmes, interactive whiteboards.*

Question – 3: How can we use robots to teach numbers and counting?

Respondents had difficulty answering the question *How can we use robots to teach numbers and counting?*, and were unable to answer the question. Participants do not have an answer to this question due to lack of knowledge, skills, experience.

However, respondents indicate that there is a need for support materials, resources to give insights on how to use robotics to teach students numbers and counting: *We need ideas.*

Question – 4: How can we use to teach measurement? How can we use robots to teach data processing?

Respondents emphasise that learning measurement skills is usually organised in a practical way, using appropriate measuring tools: *I like practical measuring tools myself, e.g. you can measure more easily with a phone than with a tape measure.*

However, the learning of measurement also needs to incorporate the opportunities offered by today's technology, e.g. *Nowadays is the age of technology, we need to move with the times. But the ruler should not be taken away, forgotten; if robots are used, it attracts children more, it is like a game, it is not like a classical lesson. It definitely appeals to children.*

Respondents highlighted several benefits of using robotics for maths learning, such as: *if children work on their own, they code the task themselves, the teacher is not dominant;*

imagine you make a 3D triangle or square in the air, it is definitely more interesting....; the word maths sounds complicated....if you don't use it, then children are happy to work.

However, once again, respondents continue to express concerns about the lack of proficiency in incorporating and meaningfully using robotics in mathematics learning in primary school, e.g. *But I don't really know what to do with the robots.*

4.3. Conclusion

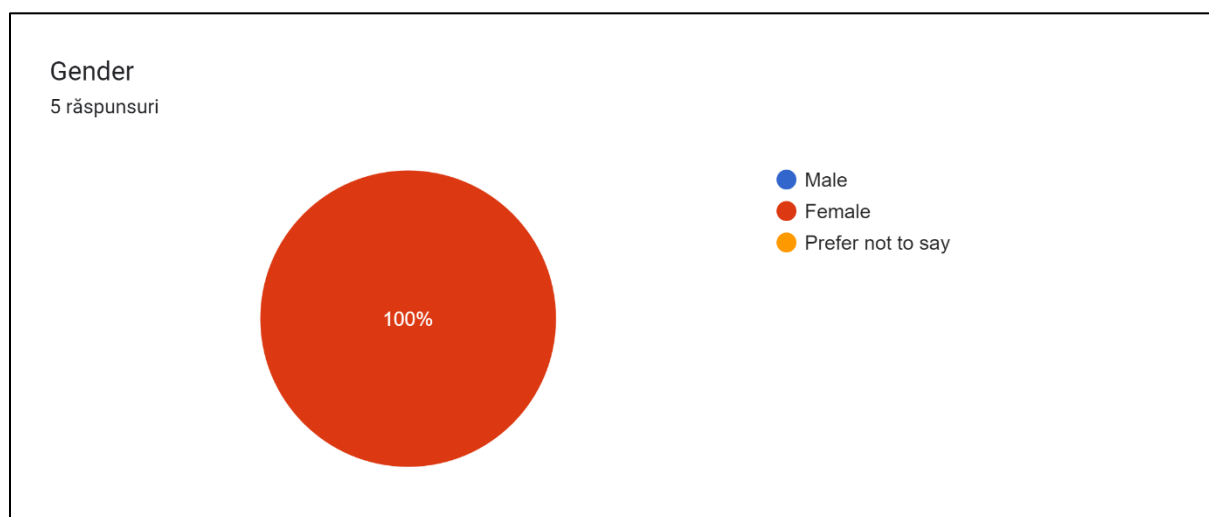
Prospective teachers need to be given the opportunity to develop their understanding of the following concepts: robotics, anxiety, the correlation between robotics and anxiety reduction.

Prospective teachers need to be offered practical materials on how to learn numbers, measurements using robotics, and prospective teachers need to be given the opportunity to develop relevant resources for teaching mathematics.

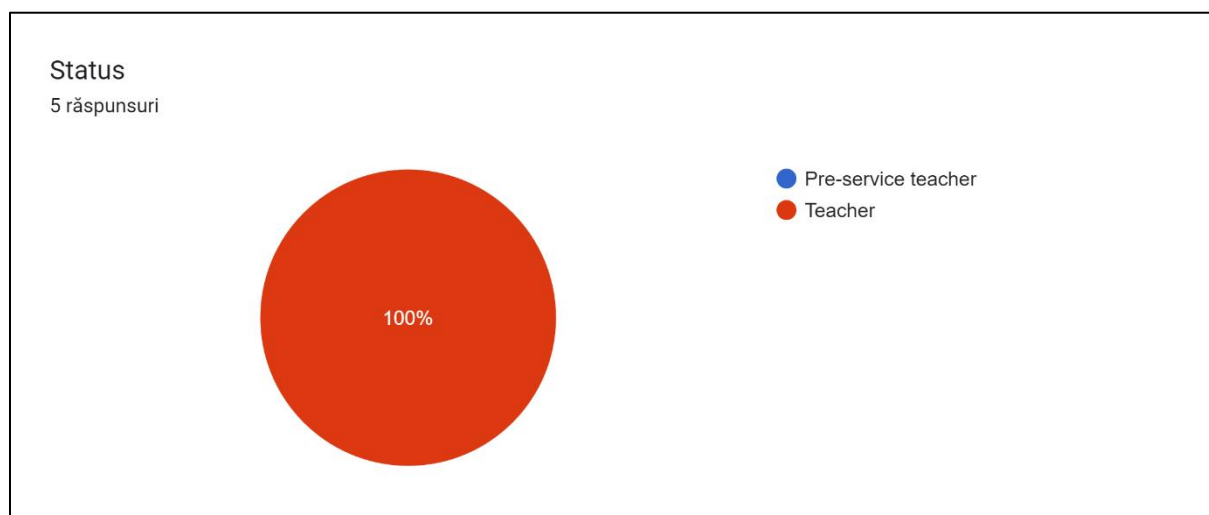
5. ROMANIA

5.1. Number of Participants and Profile

Interviews were held by Lucian Blaga University of Sibiu, one of the project partners, with 5 participants.



All participants participating in the interviews are teachers.



5.2. Summary of Results

Question – 1: What do you think about maths teaching in primary schools? What do you think is maths anxiety?

Participants generally describe the factors that lead to anxiety in the primary grades as the fear of expressing themselves and the fear of making mistakes. One participant writes that: *"Math anxiety can manifest as a negative emotional response, such as nervousness, helplessness, or a feeling of being overwhelmed, when faced with mathematical tasks or situations."* They describe the importance of teaching mathematics in primary school: *"From the age of six can help build a solid foundation for later development of mathematical skills, which can be beneficial in everyday life and careers."*

Question – 2: How can we release maths anxiety? Will the use of technology release maths anxiety while dealing with maths?

To this question, participants highlighted that students can be freed from math anxiety by creating experiences that make them curious, adopting different strategies and approaches to help individuals develop a positive attitude towards math, and approaching math in a playful and creative way: by using games and other playful activities. Participants highlighted the place of technology in reducing anxiety.

One participant writes that: "I think the use of technology is a good alternative when dealing with mathematics because it allows students to be creative." Another participant highlights the important types of technologies that can be applied: "Visualisation and multimedia, which visual aids can make mathematical ideas more tangible and easier to understand, reducing the perceived difficulty and anxiety associated with the subject. Gamification with educational math games or gamified platforms can motivate students to practice and apply their math skills in a stress-free environment, helping to alleviate anxiety."

The participant writes the role of the teacher in reducing anxiety that depending on how the teachers relate to this discipline and the type of educational activities, the children will take over the attitude and be stimulated to get actively involved, to discover, and to try.

Question – 3: How can we use robots to teach numbers and counting?

When asked how robots can be applied to mathematics participants wrote that robots could teach basic counting skills in a fun and engaging way. By presenting children with visual and auditory, robots help them understand concepts related to counting and numbers. They can also provide children with instant feedback, allowing them to correct any mistakes they make along the way.

They also wrote that we could use robots to create games, in groups, for students to associate digital material with numbers. But it was also emphasised that they should be used in conjunction with human guidance and support. Teachers play a crucial role in facilitating meaningful interactions between students and robots, ensuring that learning experiences are aligned with curriculum goals and individual student needs.

Question – 4: How can we use to teach measurement? How can we use robots to teach data processing?

For the application of robots to the measurement and processing of data, the participants had different ideas by directly involving the children in the measurement process and integrating the results into various exercises. In data processing, the robots will help the students to analyse the data and the students to extract the data from the observations. Students can also be invited to program their own robots to collect data about various aspects of their environment, they can be taught to program robots to organize the collected data into a table or graph.

5.3. Conclusion

Based on this survey it was understood that there is a problem of anxiety, what are the factors that lead to anxiety, what is the role of the teacher to reduce anxiety and what are the most current tools the teacher can use. The role of using technologies to reduce anxiety and in particular technology that is simple and accessible for children to use, such as robots, would be a positive and practical solution to use in teaching mathematics in primary education and to reduce those fears and barriers to understanding mathematical concepts.

CONCLUSION

The survey conducted in this study has provided valuable insights into a significant issue that often plagues the realm of education: anxiety. Delving deeper into this concern, the survey aimed to unravel the underlying factors that contribute to anxiety, explore the pivotal role of teachers in alleviating anxiety, and investigate the latest tools available to educators for this purpose. Furthermore, the study recognized the potential of technology, particularly user-friendly and accessible options like robots, in mitigating anxiety among young learners and enhancing the teaching of mathematics in primary education.

One of the key revelations of the survey was the existence of an anxiety problem within the educational landscape. Students often experience apprehension and unease, particularly when grappling with challenging subjects such as mathematics. These feelings can be exacerbated by various factors, ranging from the fear of failure and performance pressure to the complexity of mathematical concepts themselves. Understanding these underlying factors is crucial in devising effective strategies to address anxiety and create a conducive learning environment.

A fundamental aspect highlighted in the survey is the role of educators in curbing anxiety. Teachers serve as not only disseminators of knowledge but also as mentors and guides who shape students' attitudes and perceptions towards learning. By fostering a supportive, encouraging, and inclusive classroom atmosphere, teachers can significantly reduce anxiety levels among students. Building strong teacher-student relationships, offering personalized guidance, and promoting a growth mindset are some strategies that emerged as potent tools in the quest to alleviate anxiety.

In the ever-evolving landscape of education, technology emerges as a promising ally in combating anxiety. The survey recognizes the potential of technology to serve as a bridge between traditional teaching methodologies and modern learning preferences. Specifically, the use of robots as a technological tool holds tremendous promise. Robots, with their simplicity and accessibility, provide a novel and engaging way to interact with and comprehend complex subjects such as mathematics. Their non-judgmental nature and

interactive capabilities create a comfortable and non-threatening environment for students to explore and master mathematical concepts.

Embracing technology, particularly robots, can revolutionize the teaching of mathematics in primary education. By integrating these innovative tools into the curriculum, educators can transform the way students approach math, transitioning from apprehension to enthusiasm. The visual and interactive elements offered by robots can demystify abstract concepts, making them more tangible and comprehensible for young learners. This not only enhances their understanding but also cultivates a sense of confidence and achievement, ultimately reducing the barriers to learning.

In conclusion, the survey sheds light on the pervasive issue of anxiety in education and underscores the multifaceted approach required to address it. By comprehending the factors that contribute to anxiety, acknowledging the pivotal role of teachers, and harnessing the potential of technology, particularly robots, educators can pave the way for a more inclusive, engaging, and anxiety-free learning experience. As the educational landscape continues to evolve, embracing innovative solutions becomes imperative, and the integration of technology holds the promise of reshaping the future of education for the better.



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