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RESEARCH ARTICLE

Reducing mathematics anxiety among Madrasah Ibtidaiyah students in Surabaya througha "FunMath Camp" program

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ABSTRACT

Mathematics remains a source of anxiety for most students. This is because of their mindset which thinks that mathematics is only about numbers, calculations, and complicated formulas. This kind of impression causes students to feel reluctant and have difficulty in learning mathematical concepts. To address this issue, an attractive program called "FunMath Camp" has been conducted to help students in managing their mathematics anxiety. The participants of the program are students from three Madrasah Ibtidaiyah in Surabaya, Indonesia. The program consists of six different activities, each designed to engage students and raise students' enjoyment in learning mathematics. Perception and discomfort tests were administered to the students before and after the main activities. The purpose of these tests is to gauge students' perception of mathematics and their level of discomfort when faced with mathematical situations. The result of the perception test shows that there are positive changes in the student's perception of mathematics. In addition, for the discomfort test, the post-test results shows that the level of discomfort among the students is reduced.

Keywords: Mathematics education; mathematics anxiety; Madrasah Ibtidaiyah; math camp; mathematics invention

1. Introduction

Mathematics anxiety, or fear of mathematics is a psychological condition in which individuals experience the feelings of fear, stress, or nervousness when presented with mathematical tasks or problems [1]. People with mathematics anxiety may avoid taking mathematics classes or performing even simple mathematical tasks because they fear that they will fail or make mistakes. Carl Friedrich Gauss, a great German mathematician, famously said that "Mathematics is the queen of the sciences" as it forms the foundation for many other subjects, such as accounting, physics, and chemistry [2]. Despite its importance, many students often experience mathematics anxiety. Mathematics anxiety was studied by analysing two methods to examine their effects on the level of mathematics anxiety and students' mathematics performance

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[3]. The first method, mathematics anxiety training, focused on the emotional aspects of students, while the second method, mathematics anxiety strategy training, focused on solving mathematical problems. Both methods had a positive impact on reducing mathematics anxiety levels, but only the second method influenced the improvement of students' mathematics performance. In 2021, Mathematics anxiety has a negative relationship with students' calculation performance in school [4]. Students with higher mathematics anxiety tend to perform poorly in calculations, which also affects their ability to absorb new mathematical knowledge. Research has shown that a high level of mathematics anxiety is associated with lower mathematics performance. This relationship was further supported in the thesis by Baker [5]. Later in 2022, a study on mathematics anxiety showed that it affected performance in general mathematics, including fraction skills [6].Mathematics anxiety not only affects school-aged children but also college students, especially those in Science, Technology, Engineering, and Mathematics (STEM) programs [7].

In this paper, mathematics invention refers to the exploration and discovery of mathematics through fun, creative, and engaging methods for students. Applying real-life situations can enhance understanding and help transform math anxiety into math enjoyment and math confidence.

Mathematics camps are often organized to boost students' interest in mathematics, manage their mathematics anxiety, and develop a positive perspective on mathematics. Persatuan Sains Matematik Malaysia (PERSAMA) introduced Mathematics Camp program in 1993 with the aims of promoting mathematics, increasing awareness on the importance of mathematics, encouraging greater participation in mathematics-based events or competititons raising the academic achievement of Malaysians students in mathematics [8]. In 2010, a team of scholars conducted a math camp with the theme "Mathematics is Alive", which covered three modules on different areas of mathematics which are abstract algebra, ethnomathematics, and cryptography. The goal of the program was to improve students' mathematical skills and knowledge and help them to appreciate the beauty and practical applications of mathematics [9]. In 2014, PERSAMA introduced a Mathematics camp module which consists of activities designed to help students to manage mathematics anxiety and increase their interest in the subject. This module includes many activities outside the classroom that relate mathematics to real-life scenarios [10]. Another camp was organized by Fleming et al. in 2015 with the aim of changing the negative attitude many students hold towards mathematics [11]. Mathematics camps, which are usually held outside school areas and outside school hours, engage students' senses, including their use of mental imagery. These mental imagery processes can have a positive impact on children's problem-solving skills and future high-level mathematics abilities [12]. Further supporting this, Commodari et al. found that higher imagery skills are proportional to higher academic performance, especially in mathematics [13].

The students' performance in handling mathematics anxiety can be related to teachers' performance in class. A study on mathematics teachers, based on their academic self-efficacy beliefs, academic amotivation, and attitudes, showed that these factors impact class management anxiety in general [14]. Besides, mathematics anxiety, which can also lead to poor performance in mathematics and studying in general, is related to technology. Digital addiction has an influence on students' academic performance [15].

Those camps have inspired a new program called "FunMath Camp 2023" which was held for Madrasah Ibtidaiyah students. Madrasah Ibtidaiyah (MI) is an Indonesian Islamic primary school, is a more modern Islamic educational institution with the content of the curriculum the same as education in Islamic boarding schools plus general sciences [16]. The reason MI was chosen is because majority of Islamic schools, especially those which are not located in urban areas, prioritize religious studies over general subjects, such as mathematics. The FunMath Camp program is designed to engage students and showcase the significance

of mathematics by connecting it to real-word situations and the environment. By providing a fun and engaging learning environment, the program aims to help students to overcome their mathematics anxiety, to improve their confidence level in solving mathematics problems, and to instill the importance of mathematics in real life.

2. Methods

This study was started by the selection of school participants and determination of the problems that constituted school challenges in improving students' mathematical abilities. The chosen primary school for the program was Madrasah Ibtidaiyah (MI), in Lakarsantri district, Surabaya, East Java, Indonesia. For this program, 50 students aged 9 to 11 from MI Islamiyah, MI Nurul Hidayah, and MI At-Taufiq have been chosen. The decision to select 50 students was made to align with the campsite capacity limitations, as well as the need to balance group arrangements, the duration of program, and the number of activities. All these students were selected by school teachers based on their mathematics performance, which was categorized into three levels: excellent, medium, and poor. Since the participants are underage, permission was obtained from their parents or guardians to ensure their safety and confidentiality during all planned and organized outdoor activities. These students were guided by 12 undergraduate students as facilitators, 8 university lecturers as trainers, accompanying teachers from each school, and some parents who joined the camp. Based on the results of observations and discussions with mathematics teachers and school principals, several problems were revealed including mathematics anxiety, confidence and motivation, development of a deeper understanding of the subject, opportunities, and resources.

First, mathematics anxiety can be a significant barrier to academic progress for many students, affecting their ability to learn and succeed in mathematics-related courses [17]. This fear is often expressed in the classroom, as students may exhibit avoidance behaviors, struggle to comprehend concepts, and have difficulty in solving mathematical problems. As a result, their academic performance may suffer, and they may develop negative attitudes towards the subject. In many schools, the focus of mathematics education often centers around teaching theoretical concepts and formulas without an explanation of the concepts linked with real-life situations. While this approach is essential for developing a strong foundation in mathematics, it can sometimes leave students feeling disconnected from the subject, as they cannot see direct uses or applications in life, leading to an anxiety of mathematics. The main causes of mathematics anxiety include tests and examinations, individuals, teachers, parents, peers, and the nature of mathematics [18]. Students are often not given ample opportunities to apply their knowledge to real-life situations, making it difficult for them to see the value of studying mathematics and view it as a tedious exercise rather than a practical tool for problem-solving.

Second, one of the biggest obstacles that students face when studying mathematics is lack of confidence and motivation. Many students perceive mathematics to be a difficult and complicated subject, which can undermine their willingness to engage with it [19]. This can be particularly challenging for students who may not have a strong foundation in mathematics or who lack the support they need to succeed. Building confidence and motivation in mathematics education requires a collaborative effort between educators, parents, students, and communities. By working together to create a supportive and engaging learning environment, we can help students to unlock their full potential in mathematics and prepare them for success in various fields.

Third, students often lack opportunities and resources to explore mathematics beyond what is taught in school. Traditional approaches to mathematics education can limit students' opportunities to engage meaningfully with the subject [20]. This can lead to disengagement and a lack of motivation as students are

not given the chance to apply mathematics to real-world problems or think creatively about mathematical concepts. Boaler emphasizes the importance of creating a classroom environment that encourages students to explore mathematics beyond the curriculum. Following this, teachers' use of digital technology in classrooms led to improvements in students' learning compared to traditional classroom methods [21]. In the following years, Karakose et al. and Papadakis et al. also emphasized the role of digital tools in enhancing the education system [22,23].

Lastly, without exposure to the wider world of mathematics, students may struggle to develop a deeper understanding of the subject, which can limit their ability to appreciate its inherent beauty and practical benefits. This lack of appreciation for mathematics can be particularly challenging, as it may prevent students from recognizing the important role that mathematics plays in our daily lives. From engineering and science to finance and economics, mathematics is a foundational subject that underpins many of the key fields and industries that drive our modern world.

After identifying the problem described, a set of solutions has been developed to address it through FunMath Camp program. The FunMath Camp was held for two days, from October 4th to October 5th, 2023. Since the program was intended for more than one school, the program was carried out at Taman Hutan Raya Jeruk which is located nearby the three schools. Besides its strategic location, the most important thing is that there are many facilities at the park that are related to mathematics. By implementing outside classroom activities, it could increase the enthusiasm of students in participating in the program and make the learning process more dynamic and entertaining.

Based on the activities planned for the camp, pre-test and post-test were designed to assess the impact of the camp. Each test consists of perception and discomfort tests. All participants were given 60 questions in total for perception and discomfort tests. Both perception and discomfort test questions were Likert scale questions. The perception test was rated on a four-level scale, from “strongly disagree” to “strongly agree”. Meanwhile discomfort test was rated on a three-level scale, which were “very confused”, “slightly confused”, and “not confused”. The test results were analyzed using Wilcoxon signed rank test. The Wilcoxon signed rank test is a statistical test used to determine whether there is a significant difference between two related samples of data, such as before and after treatment data [24].

3. Results and discussion

One effective way to address mathematics anxiety is to provide students with engaging and relevant activities that help them see the real-life applications of mathematical concepts. Students got the opportunity to participate in such activities through FunMath camp program. All the activities are designed to engage multiple senses, such as touch, thinking, and imagination, which not only help reduce mathematics anxiety but also improve mathematical performance and skills. By doing so, students can start to develop a deeper understanding of the subject and its practical applications, which can help to reduce their anxiety and build their confidence. Besides, outdoor activities related to nature can help students focus, engage, and improve problem-solving skills in mathematics, which can assist in managing their anxiety about the subject [25].

The two-day camp was divided into six activities, which includes: Motivational Lecture (ML), Mathematical Recreation (MtR), Math Hunt (MtH), Mathematics Performance (MtP), Mini Olympiad (MO), and Mathematics Invention (MtI). The program began with ice breaking, to help the participants get over their initial timidity on the first day. After playing a few games, the participants were split up into five groups, with members from three different schools in each group. The name of the group is taken from a

geometric shape, which are Cube, Cuboid, Cone, Cylinder, and Sphere. **Table 1** presents the results of each activity according to the group.

Table 1. Group rank.

Group	MtR	MtH	MtP	MtI	Overall Rank
Cube	5	5	3	2	4
Cuboid	3	3	1	5	3
Cone	1	1	2	3	1
Cylinder	2	2	4	1	2
Sphere	4	4	5	4	5

To raise awareness of the role of mathematics in daily life, a talk on "Mathematics in Daily Life" was delivered as the first activity. During the talk, students were given some exposure about mathematics and its application in their daily life. As a result, students were able to comprehend the value and applicability of studying mathematics. For instance, students could see how mathematical concepts are used in practical situations, such as calculating the area of a room or determining the interest on a loan. In another application, the students were introduced to the Fibonacci numbers and showed the existence of Fibonacci numbers in a pineapple. By emphasizing the practical applications of mathematics, the talk aims to increase students' interest and engagement in the subject. As a result, students can view mathematics as a valuable tool to solve real-world problems, rather than as an abstract concept studied only in the classroom.

In the mathematical recreation session, students were exposed to a range of games that utilize basic mathematical concepts which provided them a foundation in these concepts. There were three games for each group in this activity, involving counting, basic arithmetic operations like addition and subtraction, and geometric shapes. These games were designed to be fun and engaging, with the aim of encouraging students to develop an interest in mathematics and a desire to learn more. Through the use of games, students were able to develop a better understanding of the practical applications of mathematics and its relevance in their everyday lives. Moreover, it can help students to develop critical thinking and problem-solving skills as they seek solutions to the challenges presented in the games. The students also need to apply synergy skills with their team members to solve all the games. In addition, students can develop creative thinking and multifaceted problem-solving skills by applying mathematical ideas to real-world issues and challenges. These are transferable talents that can be applied to a variety of situations throughout life. Overall, the main objective of this session is to make mathematics to be more accessible and engaging for students by introducing them to basic mathematical concepts through fun and interactive games.

The next exciting activity was called “Math Hunt” based on the concept of a "treasure hunt," where participants searched for clues to find a hidden treasure. The Math Hunt games included mathematical puzzles and riddles. Participants in this game had to expend a significant amount of energy running around the park. Math problems with various mathematical concepts were presented at each checkpoint, requiring participants to answer them in order to receive the next clue. All concepts and theories of mathematics studied in the classroom can be expanded, imagined, and expressed using many senses during outdoor activities, which can help improve observation and reasoning skills in studying mathematics [26]. Each group had the opportunity to visit up to five checkpoints out of the six provided. At Checkpoint 0, the group needed to identify the angles in the gazebo in the park, distinguishing whether they were acute, obtuse, or right angles. At Checkpoint 1, the mathematical concepts involved focused on the conversion of units from centimeters to millimeters and understanding circumference. The group had to determine the circumference

of a tree in centimeters and then convert it to millimeters. Checkpoint 2 tasked the group with identifying 2-dimensional shapes from the playground in the park. At Checkpoint 3, participants were required to determine the sizes of walking stones in the park, classifying them as small, medium, or large. Checkpoint 4 challenged the group to identify a regular n-sided polygon from an object in the park. Finally, at Checkpoint 5, the group tackled problems related to height, where they needed to find the tallest and shortest members within their group. Each group could visit a checkpoint only once. The participants' faces showed their excitement as children and play became a single entity. By incorporating mathematical puzzles into the treasure hunt activity, this event not only provided an entertaining and engaging experience for participants but also helped to develop their mathematical thinking and problem-solving abilities. Moreover, it encourages participants to view mathematics as a fun and exciting subject beyond what they learn in the classroom.

On the second day, FunMath Camp was started with stage performance to build students' confidence and public speaking skills as they present their performances in front of the audience. Students' presentations took the form of math-based acting, songs, poetry, or rhymes. Through these performances, students can showcase their understanding of mathematical concepts and their ability to apply them in creative and innovative ways. The freedom given to the students in their performances can help them have fun and, at the same time, increase their motivation to develop an interest in mathematics and improve problem-solving skills, which are important skills needed to explore mathematics [27]. This can also help to make mathematics more accessible and engaging for their peers, as they see how mathematical concepts can be incorporated into various forms of art and expression. Moreover, this activity can foster a sense of teamwork and collaboration among students as they work together to create their performances. Overall, this event provided an opportunity for students to showcase their creativity and understanding of mathematical concepts in a fun and engaging way. It can promote a positive attitude towards mathematics and encourage students to explore and appreciate its applications in everyday life.

For the next activity, a mini-Olympiad was held for participants individually. In this competition, 20 multiple-choice questions were provided, ranging in difficulty from easy to challenging questions, to be answered in 60 minutes. The questions covered a wide range of mathematical topics, including arithmetic, algebra, geometry, and statistics, among others. The students must also be able to think critically and apply their mathematical knowledge to solve the quiz. The result showed that the top score is 75 from a MI Nurul Hidayah student, which means that the student answered 15 out of 20 questions correctly. In the meantime, for participants from MI Al-Islamiyah and MI At-Taufiq shared the same maximum score of 60 points. Even though the students were only able to answer 60% correctly, this score was a satisfactory score because the Olympiad questions were set for grade 5 students, but the schools sent grade 4 students to take part in this program. The detailed results of this activity can be seen at boxplot in **Figure 1**. Participating in this competition helped students develop their mathematical skills and knowledge. Overall, this competition provided an opportunity for students to showcase their mathematical abilities and compete against their peers in a fun and challenging environment.

The last activity of the FunMath Camp was mathematics invention. This inventive recreational activity allowed each group to use their creativity and imagination to design a 'dream school' using provided materials such as ice-cream sticks, cardboard, manila cards, glue, cello tape, and scissors. Participants were free to conceive, dream, and build their ideal school using their creativity and innovation. At the same time, they had to incorporate mathematical concepts into their design.

This activity not only promoted creativity, critical thinking, and teamwork, but it also helped students to gain a better understanding on the properties and relationships of basic mathematical objects. The students were able to see how mathematical concepts can be applied in a practical and enjoyable way, which can help to make the subject more interesting and relevant to their lives.

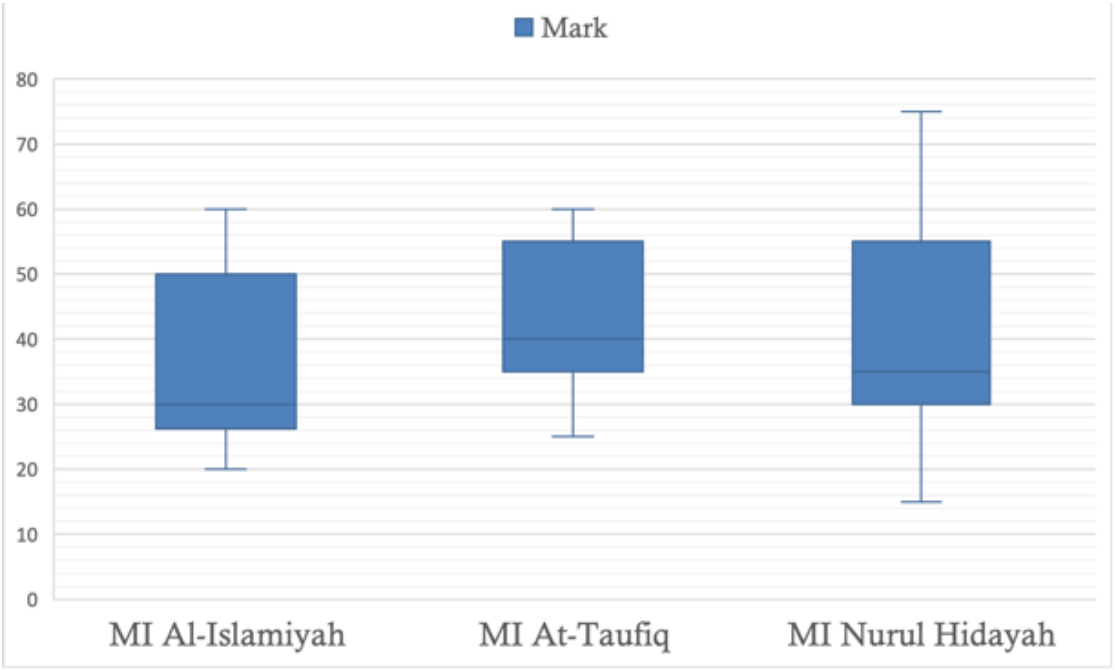

Figure 1. Mini-olympiad result.

There was a clear sense of competition among the participants as each session was given points in order to identify the best group among the five. The recapitulation of the group rank can be seen in **Table 1**.

In addition to the six main activities, perception and discomfort tests were carried out to the participants. The perception test aims to discover students' perceptions of mathematics, while the discomfort test aims to find out students' level of discomfort when faced with situations related to mathematics. The questions on perception test are divided into two parts, i.e., 20 positive perception questions whose answers tend to be "agree" or "strongly agree" and 15 negative questions whose answers tend to be "strongly disagree" or "disagree". Meanwhile the number of discomfort test questions is 25. The sample of questions can be seen in **Table 2**.

Table 2. Sample of questions.

No.	Perception		Discomfort
	Positive	Negative	
1	Mathematics is numbers.	Mathematics is a religion.	You count your change after purchasing goods.
2	Mathematics is fun.	Mathematics is boring.	You want to sum 976 and 777 without using a calculator.
3	I like Mathematics.	I don’t like Mathematics.	You are asked to remember the phone numbers of three of your friends.
4	Mathematics is useful.	Mathematics is useless.	Your friend asks you a difficult math problem.

The results of the perception test and discomfort test can be seen in **Figure 2** and **Figure 3** respectively. **Figure 2** shows that there is an increase in the percentage of “strongly agree” choices for positive questions and “strongly disagree” choices for negative questions.

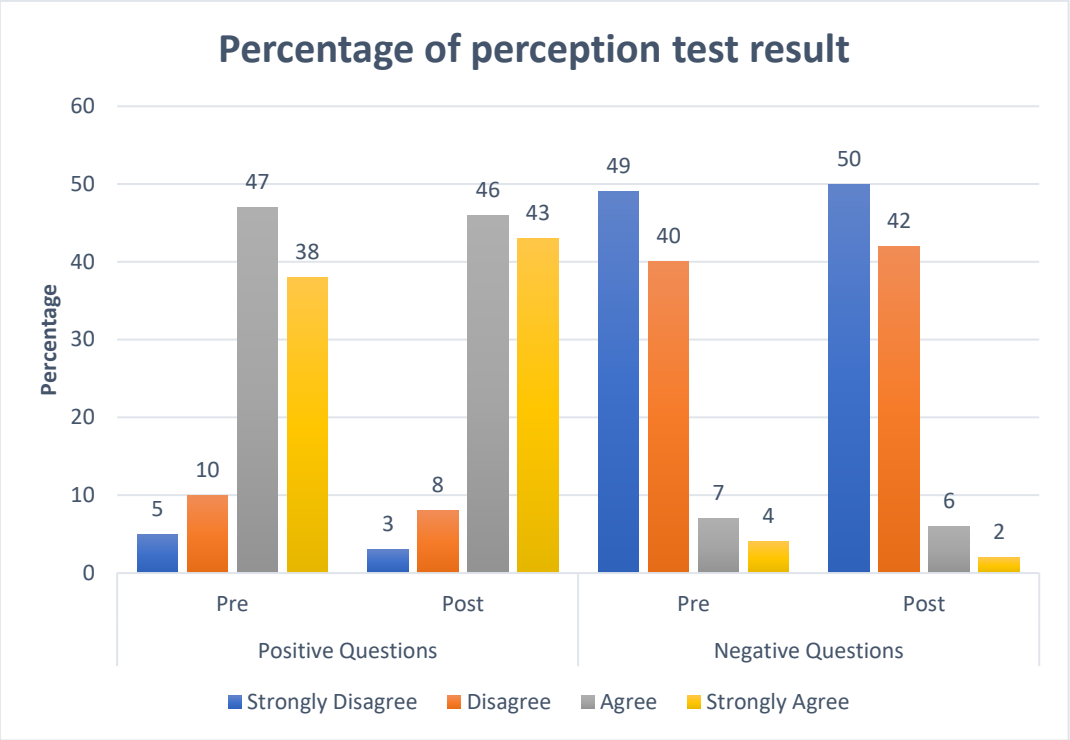

Figure 2. Percentage of perception test result.

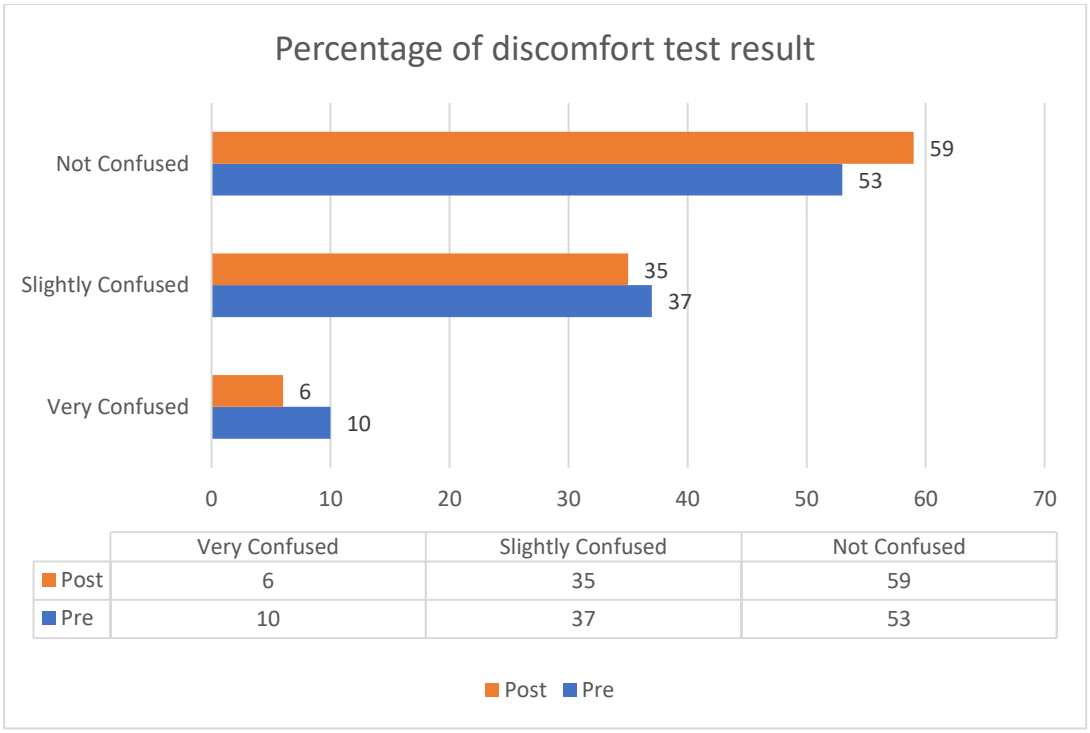

Figure 3. Percentage of discomfort test result.

From a statistical perspective, there are three categories data tested, to find out whether there are changes before and after the camp is carried out. This test is classified as a non-parametric statistical method because the data comprises categorical responses from Likert scale questions. Non-parametric tests do not require assumptions about the data distribution [24]. Since the data size of this study is small and the data

involves paired data, specifically pre-test and post-test, the Wilcoxon signed rank test is an appropriate approach for analyzing the data with the significance level of 5%.

The analysis results for the positive perception and discomfort test obtained Asym. Sig of 0.001 and 0.000, which are less than 0.05. Hence, it can be concluded that the FunMath Camp can significantly change students' perceptions and levels of discomfort towards mathematics. Slightly different from the negative perception test, the analysis results yielded Asym. Sig of 0.448 which shows that there is no significant change before and after the camp. This result can also be seen from **Figure 2**, there is a change between the pre- and post-tests, but it is only about 2%. One possible reason for this result is that the mathematics camp was too short, lasting only two days. Changing negative perceptions about mathematics takes time, and students may need more practice and support. A longer camp with more activities could help them feel more confident and improve their attitude toward mathematics. To effectively improve this negative perception, activities should not only focus on enhancing students' interest in mathematics and helping them appreciate its beauty in real life but also include activities that cater to each student's abilities and weaknesses to support their improvement. This approach can increase students' confidence in learning mathematics, which can lead to a shift in their negative perception of the subject. Additionally, other factors could have influenced the findings. For example, the novelty effect of the camp may have temporarily increased students' enthusiasm and excitement as they participated in outdoor activities, different from the usual classroom setting, rather than indicating a lasting change in attitude. Furthermore, different facilitators and trainers have their own ways of interacting with students, as this is part of their individual personality. Differences in facilitator engagement may have impacted student experiences, as varying teaching styles and interactions could influence individual outcomes.

Other than statistical results, feedback from parents and teachers also provided valuable insights about the camp. The accompanying school teachers and parents who joined the camp expressed their support for organizing similar camps in the future or extending the duration. They observed that students enjoyed the experience, as it allowed them to learn while also engaging in fun activities.

4. Conclusion

In summary, the statistical analysis using the Wilcoxon signed rank test with a 5% significance level indicates a significant improvement in positive perceptions and reduced discomfort among students who attended the FunMath Camp. However, no significant change was observed in negative perceptions. While the camp positively influenced attitudes toward mathematics, its impact on negative perceptions was limited, with only a 2% change in pre and post-test scores. By conducting six fun and engaging activities that involve mathematical concepts, the FunMath camp program helped students learn how to manage their mathematics anxiety. Another goal of the program is to broaden students' views of mathematics beyond the classroom and into the real world. By demonstrating the significance of mathematics in their daily lives, students felt more at ease with mathematics and less fearful of it.

The limitations of this study are divided into a few points: the number of respondents (students), the duration of the camps, and the collections of results from this camp. First, the number of respondents. Only 50 students were selected to join, and these students were divided into three levels. In addition, the participants of this study were exclusively drawn from Islamic schools, which may limit the generalizability of the findings to other types of schools within the Indonesian education system. Islamic schools in Indonesia often have specific cultural and religious practices that may not be presented in public schools. As a result, there were limited variations in student responses before and after the camp, as well as in their mathematics anxiety levels.

As a suggestion, expanding the number of participants from different regions and educational backgrounds in Indonesia can help explore how factors such as local culture, curriculum differences, and past learning experiences influence mathematics anxiety. Future research could also examine the impact of longer math camp durations on Indonesian students' problem-solving skills and anxiety levels, particularly in relation to the national curriculum. Tracking students' progress after the camp, including their performance in national exams such as the Ujian Sekolah or National Assessment would provide insights into its long-term effects. Additionally, interviews with students, parents, and teachers could offer a deeper understanding of students' learning experiences within the Indonesian education system. These studies can contribute to the development of more effective math intervention programs tailored to the specific needs of Indonesian students.

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Conflict of interest

No conflict of interest was reported by all authors.

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