Enhancing Mathematics Proficiency among High School Students through Intervention Project

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ABSTRACT

Mathematical proficiency among high school students is a critical focus in education, particularly in communities with limited academic support, where low interest in the subject often impedes academic achievement. This study, conducted in the Central Melaka District, Malaysia, aimed to evaluate the impact of a six-month intensive mathematics intervention program that emphasized structured tuition and student-centered learning. A quantitative pre-test and post-test design was employed, involving 24 students from middle-income households who had previously underperformed in mathematics. Data were collected through structured questionnaires assessing program acceptance, mathematical understanding, problem-solving skills, learning aspirations, and attitude toward self-motivation, and were analyzed using descriptive statistics. The results revealed significant improvements in participants' mathematical comprehension, problem-solving abilities, and aspirations toward mathematics achievement. In addition, the program positively influenced students' attitudes, with marked improvements in their self-motivation to learn mathematics. These findings suggest that targeted intervention programs can play a pivotal role in supporting underperforming students and may serve as a scalable model for improving academic outcomes and fostering more positive attitudes toward mathematics learning. While the findings are encouraging, the small sample size may limit the generalizability of the results.

Keyword: mathematics education, secondary students, academic intervention, student motivation

INTRODUCTION

Mathematical proficiency among high school students is a critical focus in education, particularly in communities with limited academic support, where low interest in the subject often impedes academic achievement. In Malaysia, mathematics education at the secondary level builds upon six years of primary instruction and emphasizes conceptual understanding, problem-solving, and the application of mathematical reasoning in real-world contexts. The national curriculum, spanning Forms 1 to 5, encompasses key areas such as rational numbers, algebra, geometry, statistics, and probability, while also integrating values, 21st-century skills, and higher-order thinking (Ministry of Education Malaysia, 2023). The goal is to prepare students for national examinations and equip them with the competencies needed to face future academic and life challenges.

Despite these comprehensive policy frameworks, mathematics remains one of the most challenging subjects for Malaysian secondary students. The 2022 Programme for International Student Assessment (PISA) report by the Organisation for Economic Co-operation and Development (OECD) revealed that only 41% of Malaysian students achieved at least Level 2 proficiency in mathematics—substantially below the OECD average of 69% (OECD, 2023). This gap is particularly pronounced in socioeconomically disadvantaged communities, where students often lack access to additional academic support, structured learning environments, and enrichment opportunities.

This situation highlights the need for targeted, locally relevant interventions that bridge national education goals with the lived realities of students in under-resourced environments. In response to this challenge, an intensive

mathematics intervention program was implemented as part of a university social responsibility (USR) initiative, in collaboration with a non-profit organization. The program targeted secondary school students in underserved areas within the Central Melaka District, aiming to improve their mathematical performance through structured tuition and student-centered learning strategies.

Conducted over six months, the program focused on enhancing students' comprehension of mathematical concepts, problem-solving abilities, and motivation toward mathematics achievement. A structured questionnaire was used to collect data on four key areas: acceptance of the program, mathematical knowledge, problem-solving skills, and the development of aspirations and motivation toward learning mathematics. Pre- and post-intervention responses were compared using descriptive analysis to evaluate the effectiveness of the program and to derive recommendations for future improvements.

The structure of this paper is organized as follows. The next section provides background information and contextualizes the development of the intervention program, followed by a comprehensive review of relevant literature. This includes a review of prior studies related to mathematics achievement, with a focus on strategies for improving students' mathematical competencies and the effectiveness of remedial and community-based academic support programs. The methodology section then outlines the research design, participant selection, and data collection and analysis procedures. This is followed by a presentation and interpretation of the study's findings. The paper concludes with a discussion of the key insights, practical implications, limitations, and recommendations for future research and program implementation.

BACKGROUND OF INTERVENTION PROGRAM

This intervention program titled 'Community Engagement through Academic Enrichment' targets 24 students in four secondary schools in Melaka, the smallest state in Malaysia. It is a collaborative effort by a group of academicians from two faculties, namely Faculty of Accountancy and Faculty of Computer Science and Mathematics of Universiti Teknologi MARA and a non-profit organization, Global Peace Mission (GPM) Melaka. The project focuses on enhancing academic performance and instilling mathematical confidence through structured enrichment activities.

GPM Melaka, a non-governmental organization (NGO) based in Tanjung Minyak, Melaka, was selected as a collaborative partner for this program. GPM Melaka is part of the Global Peace Mission Malaysia network, which actively promotes peace, unity, and community well-being. Among its key activities and initiatives are emergency relief efforts, educational programs, health campaigns, community engagement activities, and collaborative networking.

The intervention program was conducted through bi-weekly, three-hour sessions over a six-month period, from April to September 2025, focusing on mathematics. Each session was facilitated by a team comprising academic staff and Diploma in Accounting students from Universiti Teknologi MARA, Malacca Campus. The intervention module was developed by academics from the Faculty of Computer and Mathematical Sciences, with an emphasis on the Form 4 Mathematics syllabus and problem-solving techniques. Each session began with a topic summary, followed by a set of practice questions for students to solve. Participants were divided into small groups of four to five students, with each group assigned a dedicated facilitator or mentor to provide guidance and support throughout the session.

Participants of this intervention program received several valuable benefits. They were given free mathematics tutoring sessions and a Form 4 mathematics module aligned with the latest syllabus at no cost. Additionally, the learning experience was enhanced through small group discussions guided by qualified instructors and mentors, allowing for more focused and personal support.

The content covered a wide range of core topics including *Quadratic Functions and Equations in One Variable*, focusing on the relationship between quadratic functions and one-to-many mappings, the effects of coefficients on the graph, and solving quadratic equations based on real-life situations. Other key areas included *Number Bases* (conversion and arithmetic operations), *Logical Reasoning* (statements and arguments), and *Set Operations* (intersections, unions, complements, and combinations). The program also introduced *Graph Theory*

concepts such as multigraphs, weighted and unweight graphs, subgraphs, and trees. Additional topics addressed were *Linear Inequalities in Two Variables*, *Motion Graphs* (distance-time and speed-time graphs), and a comprehensive review of practice questions from Forms 1 to 4.

To better understand the challenges and possible solutions related to mathematical proficiency and community engagement, it is essential to review existing literature on this topic.

LITERATURE REVIEW

Efforts to improve mathematics education have increasingly focused on reducing performance disparities and strengthening student proficiency through targeted interventions. One of the most effective approaches involves tailoring instruction to address students' cognitive needs in specific areas such as algebra and problem-solving.

Alfayez (2022) emphasized that such targeted instruction particularly in algebra can significantly enhance learner engagement and achievement. Complementing this, Ojaleye & Awofala (2018) has previously revealed that blended and problem-based learning methods support deeper conceptual understanding and improved outcomes in secondary mathematics. These pedagogical innovations align with earlier findings from the RAND Corporation (2015), which highlight that personalized and adaptive learning approaches are particularly effective when integrated with data-driven decision-making and active community support. Together, these studies highlight the importance of evidence-based strategies that address both academic and non-academic factors in mathematics study.

To explore these issues in depth, this review is organized into three main parts: gap in mathematic learning around the world, how students' mathematic skills can be improved, and the role of community programs in supporting students.

Global gaps in Mathematics Achievement

Students from different parts of the world may not have the same opportunities to learn mathematics effectively. PISA shows that students from low-income and underserved communities often perform worse in mathematics than their peers (OECD, 2023). These results point to major gaps between countries, and even schools. In response, global organizations like United Nations Educational Science and Cultural Organization (UNESCO) have stressed the importance of inclusive teaching practices, methods that ensure all students, regardless of background, have access to quality education and the support they need to succeed in mathematics.

Malaysia's educational system continues to grapple with challenges in mathematics achievement. PISA 2022 reported that only 41% Malaysian 15-year-olds met Level 2 proficiency, compared to 69% across OECD nations (OECD, 2023). This performance gap reflects systemic shortfalls in conceptual understanding, problem-solving application, and instructional delivery. In a multilingual country like Malaysia, language proficiency also plays a significant role in mathematics achievement. Lopez (2023) elaborates that students with higher English proficiency tend to perform significantly better in mathematics. Given that mathematical instructions, problem statements and conceptual explanations are predominantly delivered in English, students with limited language proficiency face dual cognitive loads, comprehending the language as well as solving the mathematic problem.

While these global challenges highlight the need for more equitable learning conditions, it is equally important to understand what assists students to develop strong mathematical skills in the classroom.

Improving Students' Mathematical Skills

Mathematics skills are not just about numbers. They also involve logical thinking and the ability to apply ideas to new situations. Research shows that focusing on topics like algebra and higher-level reasoning, using well-planned teaching strategies, assist students build confidence and perform better (Alfayez, 2022). Ojaleye and Awofala (2018) also found that students benefit more when teaching includes real-world problem-solving and a mix of online and in-class learning. These approaches allow students to work at their own pace and gain a deeper understanding of the subject.

A framework established by Kilpatrick et al. (2005) introduces five connected components of mathematical proficiency: conceptual understanding, procedural fluency, strategic competence. Adaptive reasoning, and productive disposition. These components serve as the bedrock for evaluating both teaching and learning in mathematics and are widely supported by educational theorists (Corrêa, 2021). Instructional strategy is also pivotal in determining mathematical outcomes. The benefit of inquiry-based, cooperative learning over rote memorization is emphasized by Samuelsson (2010). This view is further echoed by Helsa et al. (2024), advocating for student-centered methods that foster dialogue, exploration, and deep engagement, which are critical components for productive character and strategic competence. In addition, research also shows that being good at solving math problems is not just about getting the right answers. Tikhomirova et al. (2017) explains that true fluency means students can clearly explain how they solved the problem and why their steps make sense.

Although classroom instruction plays a significant role, many students benefit from additional learning opportunities outside school. The next paragraphs will discuss how community programs can support and extend mathematics learning.

Remedial and Community-based Learning Support

When students fall behind in math, support outside regular class time can make a big difference. Community-based programs, such as tutoring groups or weekend learning sessions, offer extra time and guidance for those who need it. These programs are more successful when they include fun, interactive elements like games, group work, and visual tools to explain math ideas. RAND Corporation (2015) reported that personalized learning programs, especially those supported by both schools and local communities, assist students improve over time and stay more engaged in their learning journey.

Educational outreach and public tutoring are becoming powerful tools in bridging gaps in formal education. Parker et al. (2019) revealed that students who participated in structured, community math support programs demonstrated improvement in both confidence and test scores. Similarly, a recent study by Nickow et al. (2024) found that consistent tutoring, when aligned with curriculum, leads to extraordinary learning outcomes. These community-based efforts provide critical support that complements school curricula and enhances the overall learning experience, particularly for students struggling with basic mathematical concepts,

In summary, prior studies revealed that mathematics learning is shaped by global inequalities, the quality of instructional strategies, and the availability of supportive programs outside the classroom. To improve mathematical proficiency among Form 4 students in a Malaysian school system, perhaps a multidimensional strategy is required, one that blends foundational skill development with better instruction and community participation. This study explores students' perceptions of the implemented intervention program, particularly in terms of program acceptance, knowledge of mathematics subject, problem-solving skills, and the development of aspirations toward learning mathematics.

METHODOLOGY

Research design

The original number of participants selected for the study was 20 students. However, during the intervention program, an additional 4 students voluntarily joined, increasing the total number of participants to 24. This 120% attendance rate serves as a positive indicator of the program's appeal and relevance to the target group. The participants were primarily selected from middle-income households earning between RM2,501 and RM5,000 and were identified based on their academic performance in mathematics during Form Three, specifically those who obtained scores below 50% or did not pass the subject.

This study employed a quantitative approach using pre-test and post-test research design. Data was collected using a structured questionnaire designed to assess the students' acceptance of the program, their knowledge of mathematics, problem-solving skills, and the development of aspirations toward learning mathematics. The data

collected were analyzed quantitatively using descriptive statistics. A comparative analysis of scores before and after the program was presented in graphical form to facilitate interpretation.

Research instrument

The research instrument used was a questionnaire developed using a four-point Likert scale (1 = Strongly Disagree to 4 = Strongly Agree). The questionnaire was divided into a few sections: one section for demographic information, general questions and four sections designed to measure changes in (1) mathematical concept knowledge (Knowledge), (2) problem-solving skills (Skills), (3) aspirations toward mathematics achievement (Aspiration), and (4) self-motivation and attitude (Attitude Change).

Knowledge in Mathematics

Having strong knowledge in mathematics is important for solving problems effectively (Fitria et al. 2025). This includes understanding basic concepts and knowing the steps or methods to solve problems. Students who have a solid grasp of these areas are more prepared to manage both simple and complex problems. In addition, skills like reading comprehension and background knowledge in science can help students make sense of word problems and real-life math situations. When knowledge from different subjects is connected, students are better able to apply what they have learned in new situations. Therefore, building a sturdy base of mathematical knowledge is key to improving problem-solving abilities.

Skills in Mathematics

Mathematical skills are supported by several important abilities. Cognitive skills, like thinking clearly and understanding language, help students work through problems. Spatial skills help them understand shapes, patterns, and how numbers relate to each other. Another important skill is metacognition, which means being able to plan, check, and improve how they solve problems (Abdullah et al. 2017). Good learning strategies, such as working in groups or solving real-life problems, can also improve problem-solving skills. Teaching methods and assessments that focus on active learning and critical thinking help students become more confident and skilled in solving math problems.

Aspiration in Learning Mathematics

Aspiration refers to a student's long-term goals or hopes for the future. It's about what they want to achieve. For example, a student aspires to study engineering at university, so they aim to do well in mathematics. Aspiration is an important factor that influences how well students learn and succeed in mathematics. Students with high self-efficacy and strong educational goals tend to be more motivated and achieve better results (Hidayatullah et al. 2023). Teaching methods that include hands-on projects, creative thinking, and gamified learning also help increase students' aspirations by making math more meaningful and engaging. While students from low socio-economic backgrounds may face challenges, those with strong aspirations and motivation can still succeed in advanced mathematics. Overall, supporting students' aspirations through motivation, positive goals, and effective teaching strategies can greatly improve their learning outcomes in mathematics.

Motivation in Developing Mathematical Proficiency

Motivation plays a key role in helping students succeed in mathematics. Students who are internally motivated tend to perform better than those who rely only on external rewards. When students are focused on completing the task itself, rather than doing it just for grades or praise, they are more likely to stay engaged and put in effort. A positive classroom environment, where teachers are supportive and confident, also helps build motivation over time (Wang et al. 2022). Success in early math tasks can lead to more motivation and better performance later, creating a positive learning cycle. Teachers can boost motivation by using strategies like games, rewards, and encouraging students to believe in their own abilities (Star et al. 2014). Motivation also works together with other skills like self-control and metacognitive thinking, making it an important factor in developing strong mathematical understanding and confidence.

FINDINGS AND DISCUSSION

Figure 1 below shows that a total of 24 students participated in this study. The respondents consisted of twenty female students and four male students, all aged sixteen. Most respondents (20 students) had never attended mathematics tuition classes elsewhere prior to this program. This fact highlights that this intervention program is a highly meaningful opportunity for them to receive quality supplementary learning support free of charge.

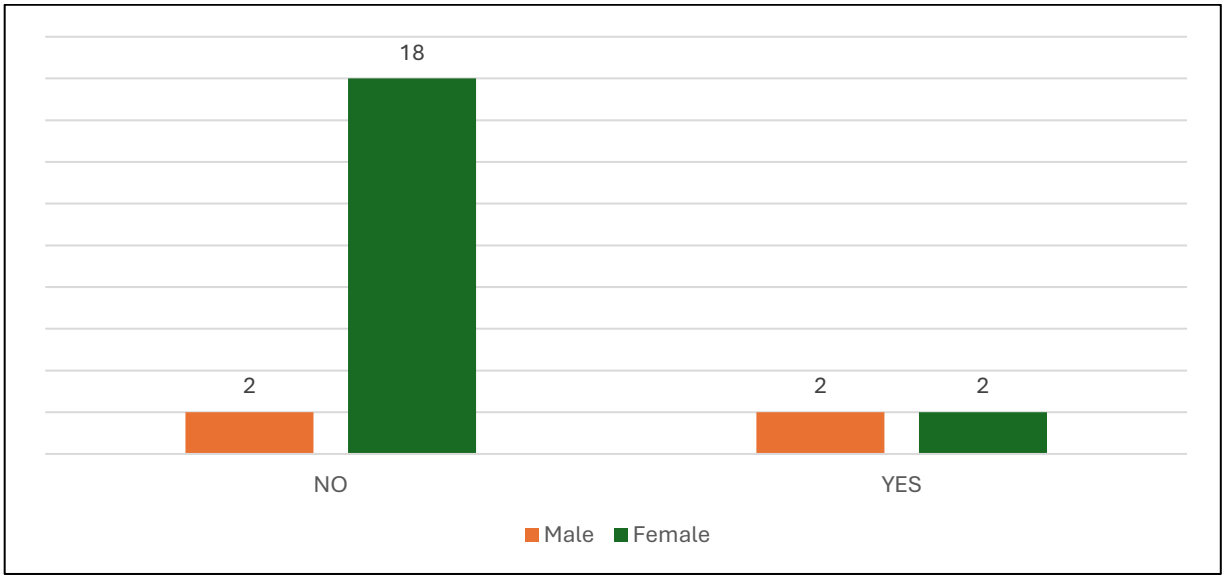

Figure 1: Demographic of Respondents

The first two items in Table 1 assess the perceived relevance of the intervention program from the students' perspective. The item *"The program is appropriate for learning needs"* recorded a high average score of 3.79, indicating strong agreement among students that the program content was well-aligned with their academic requirements. This suggests that the program successfully addressed specific gaps or challenges faced by the participants in their mathematics learning. Similarly, the item *"The program supports examination preparation"* received an average score of 3.67, further reinforcing the program's effectiveness in helping students prepare for assessments. Implying that the program not only provided conceptual understanding but also practical support relevant to exam contexts. Together, these scores affirm that the program was both relevant and impactful in supporting students' academic goals in mathematics.

Table 1: Average Scores for Each Evaluation Item

Item	Average Score
The program is appropriate for learning needs	3.79
The program supports examination preparation	3.67
Understanding of mathematical concepts *before* the program	2.38
Understanding of mathematical concepts *after* the program	3.79
Problem-solving skills *before* the program	1.96
Problem-solving skills *after* the program	3.58
Confidence in achieving excellent results *before* the program	1.88
Confidence in achieving excellent results *after* the program	3.33
Motivation to learn mathematics *before* the program	2.25
Motivation to learn mathematics *after* the program	3.75

Changes in Mathematical Concept Knowledge (Knowledge)

Respondents' knowledge of mathematical concepts showed a significant improvement, with the average score increasing from 2.38 to 3.79. This score is close to the maximum value of 4, indicating that respondents strongly agreed on the effectiveness of the program in enhancing their understanding. Figure 2 presents a comparison of respondents' knowledge levels before and after the program. The blue line, representing pre-program knowledge, shows considerable variation, ranging from scores of 1 to 4. Most respondents were at Level 2 (58%) and Level 3 (21%), while only 13% reached Level 4. This reflects inconsistent knowledge levels, with most students falling into the moderate or lower categories.

In contrast, the orange line representing post-program knowledge demonstrates a clear positive shift. A total of 79% of respondents reached Level 4, while 21% were at Level 3. This pattern provides strong evidence that the program successfully improved all participants' understanding of mathematical concepts.

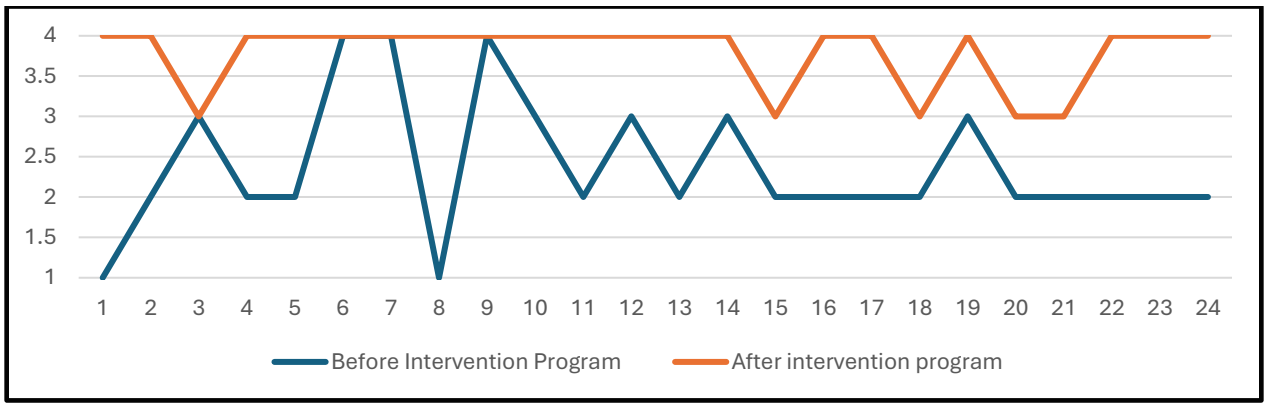

Figure 2: Respondents' Response on their Level of Knowledge on Mathematical Concepts.

Changes in Mathematical Problem-Solving Skills (Skills)

Respondents' problem-solving skills in mathematics were initially at a low level, with an average score of 1.96. However, following the implementation of the program, there was a significant improvement, with the average score rising to 3.58. Figure 3 illustrates the comparison of respondents' problem-solving skills before and after the program. Prior to the intervention, their skills ranged from low to moderate levels, specifically between Levels 1 and 3, with the majority at Level 2 (54%) and Level 1 (25%). This indicates that many participants faced difficulties in solving mathematical problems before attending the program.

After the program was conducted, a clear improvement was observed. A total of ten respondents (42%) agreed, and fourteen respondents (58%) strongly agreed that the program helped enhance their mathematical problem-solving skills. This demonstrates that the approach used in the program had a positive impact on developing their problem-solving abilities.

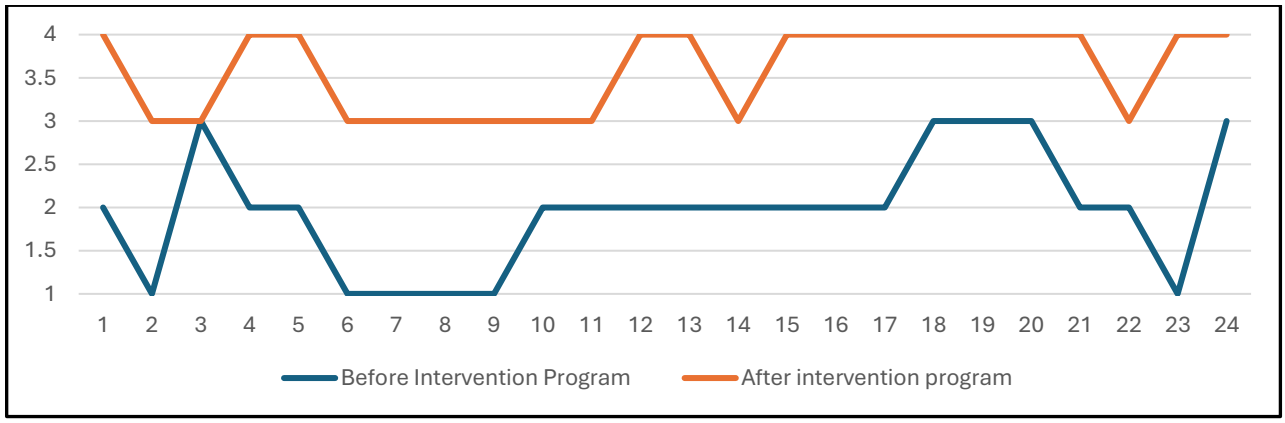

Figure 3: Participants' Response on Level of Mathematical Problem-Solving Skills

Changes in Aspirations Toward Mathematics Achievement (Aspiration)

Figure 4 illustrates the changes in respondents' aspirations regarding their performance in mathematics. Before participating in the program, seven respondents (29%) agreed and 14 (58%) strongly agreed that their confidence level was low. Only three respondents (13%) expressed a different view.

However, following the implementation of the program, all respondents (100%) gave positive feedback, stating that they now felt confident in achieving better results in upcoming mathematics tests. Moreover, a significant increase of 1.45 points in the average score further confirms that the program had a positive impact on respondents' aspirations toward academic success in mathematics.

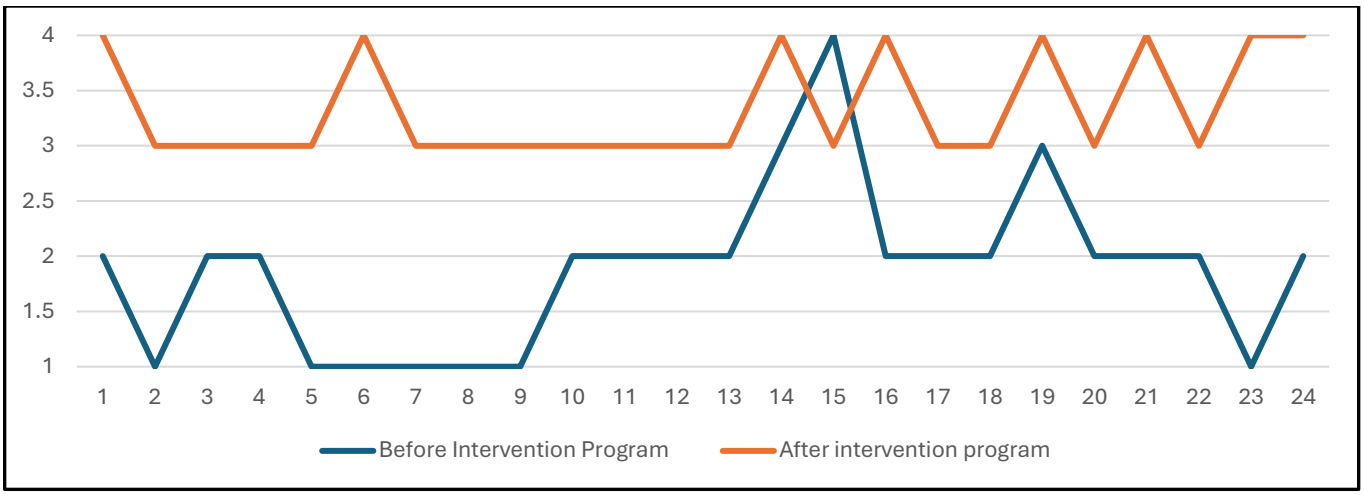

Figure 4: Participants' Response on Level of Aspirations toward Mathematics Achievement

Change in Attitude Toward Self-Motivation (Attitude Change)

Figure 5 illustrates the change in respondents' attitudes, specifically in terms of self-motivation. Before the program was conducted, most respondents (96%) were at a moderate level of motivation, ranging between scale 2 and 3. Only one respondent (4%) reported an extremely low level of motivation (scale 1).

However, after the program was implemented, a significant improvement was observed. A total of six respondents (25%) agreed, and 18 respondents (75%) strongly agreed that their motivation to learn mathematics had increased. Notably, no respondents reported low motivation levels after the program. This demonstrates that the program successfully fostered a positive attitude and strengthened the respondents' intrinsic motivation toward learning mathematics.

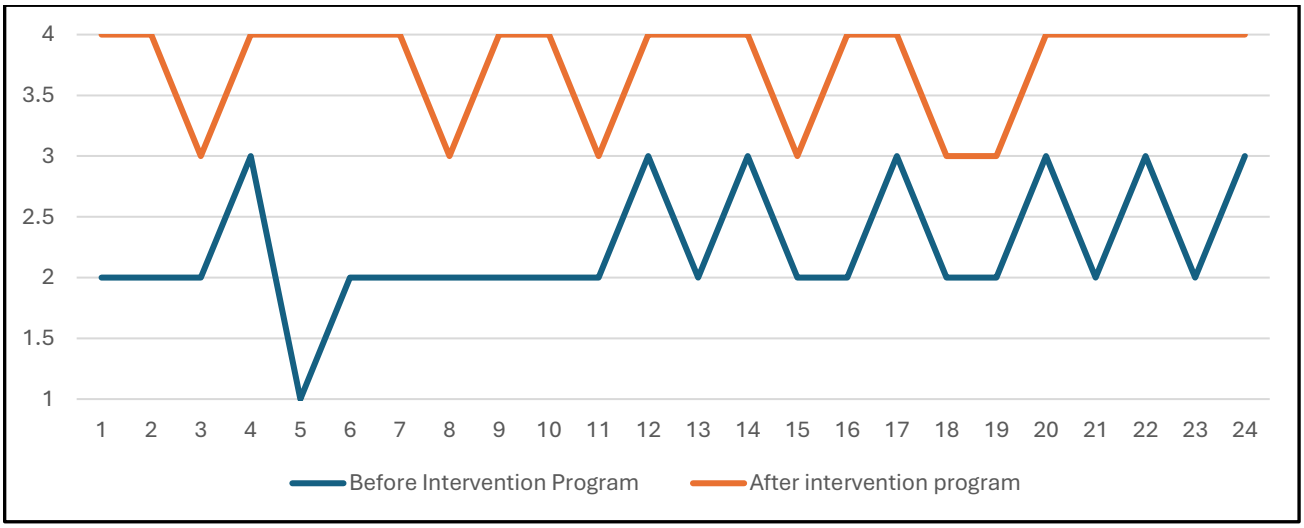

Figure 5: Response on Students' Motivation Level to Learn Mathematics

Overall, the findings indicate that the program positively influenced students, particularly by improving their mathematical knowledge, problem-solving abilities, aspirations, and motivation. Nonetheless, several significant challenges emerged. The most prominent was difficulty in understanding certain mathematical concepts, reflected by an average score of 3.42. Students also faced issues with time management (average score: 3.12) and reported insufficient teacher guidance (average score: 2.88). These results highlight the need for more robust conceptual support, better time management strategies, and increased instructional engagement to further enhance student performance. A summary of the key challenges and corresponding recommendations is presented in Table 2 below.

Table 2: Summary of Challenges and Recommendations for Program Improvement

Challenges Identified	Recommendations by Respondents
Difficulty managing time effectively	Extend the duration of the program to allow more in-depth learning and reduce time pressure.
Lack of sufficient teacher guidance during sessions	Increase instructional support and ensure more frequent teacher-student interaction.
Need for stronger conceptual understanding of mathematical content	Incorporate more interactive and visual learning strategies, such as guided practice and real-life examples.
Limited comfort and focus in current learning environment	Conduct sessions in more conducive, distraction-free spaces to enhance student engagement and comfort.
Passive or traditional learning methods reduce engagement	Include interactive activities such as games, quizzes, and hands-on tasks to make learning more engaging and effective.
Limited reach of the program to other struggling students	Expand the program to include more at-risk students, particularly those from low-performing groups or underserved schools.

CONCLUSION

This study demonstrates that a structured, community-based intervention program can significantly enhance students' proficiency in mathematics, especially among underserved populations. By providing free, syllabus-aligned tuition supported by university mentors, the program successfully addressed critical gaps in knowledge, problem-solving skills, self-confidence, and motivation.

The program's overall effectiveness highlights the importance of multidimensional strategies that combine academic enrichment, mentorship, and student-cantered pedagogy. However, the findings also underscore the need for better conceptual support, improved time management practices, and stronger instructional guidance.

As such, future implementations should consider extending the program duration, expanding participant outreach, and incorporating more interactive learning tools to further optimize engagement and effectiveness. This intervention model holds promising potential as a replicable framework to reduce educational inequality and nurture long-term mathematical success among high school students.

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