Short Research Article

Improving Students' Attitude towards Mathematics to enhance their achievement in Mathematics;An Action Research

Abstract

The success of students in the field of mathematics is inherently intertwined with their attitudes towards the subject. These attitudes play a pivotal role in determining students' levels of engagement and ultimately impact their achievements. This research study aims to augment the attitudes of fifth-grade students towards mathematics and concurrently enhance their performance in the subject. The study comprised a cohort of 27 participants, including 12 boys and 15 girls. Data collection involved the administration of a closed-ended, self-reported statement questionnaire employing a Likert scale, alongside an achievement test. The gathered data underwent analysis through a paired sample t-test, which subsequently revealed a noteworthy disparity between the pre-test mean score ($\bar{x}$ = 7.75) and the post -test mean score ($\bar{x}$ = 10). The statistical significance level of 0.00 ($P<0.05$) indicates a substantial improvement in both students' attitudes towards mathematics and their performance in the subject.

Keywords: Attitude, Enhancement, Mathematics Achievement

1.0 Introduction

Mathematics stands as the cornerstone of scientific disciplines and their associated fields of study, with its absence posing a significant impediment to progress in science and technology (Hafiz &Hina, 2016). The competencies acquired through the study of mathematics are universally recognized and find application across diverse facets of human existence (Asiedu-Addo&Yidana, 2004). Recognizing its paramount importance, mathematics has consistently been emphasized as a compulsory subject in Bhutanese schools. However, despite this emphasis, the academic performance of Bhutanese learners in mathematics remains notably lower than in other subjects. Many students demonstrate subpar proficiency in both fundamental and advanced academic skills, exhibit deficiencies in basic communication and analytical abilities, and, on average, require an additional year to attain the expected level of competence for their grade (REC, 2016). Bhutanese students who have firsthand

Comment [A1]: the abstract should contain the research objectives, methodology (type of research, research subjects, sampling, data collection instruments and tools, research procedures, and data analysis), as well as research results and findings.

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experience with mathematics education in Bhutan express skepticism regarding the subject, often finding it either uninteresting or challenging. Consequently, parents have come to accept and tolerate their children's underperformance in mathematics (Drukpa, 2015). An assessment of class VI students' mathematics achievement conducted by the National Education Assessment (2003), under the Ministry of Education (MoE), revealed disappointingly low performance levels. Subsequently, Ma and Xu (2004) underscored in their research that poor academic performance in mathematics is closely linked to a decline in attitudes toward the subject. Hemmings and Kay (2010) similarly identified a significant correlation between attitudes toward mathematics and academic achievement, suggesting that one's attitude toward mathematics can serve as a reliable predictor of one's mathematics performance.

This association between attitudes and achievement in mathematics is further substantiated by various researchers who have concurred those students' beliefs and attitudes toward mathematics exert a profound influence on their learning outcomes (Furinghetti&Pehkonen, 2000; Leder, Pehkonen, &Törner, 2002). Recent research in Songkla province, Thailand, also identified a positive relationship between students' attitudes toward learning mathematics and their academic achievements (Inkeeree1, Fauzeei, Othman, 2016). Consequently, it is evident that students' attitudes toward mathematics play a pivotal role in shaping their academic accomplishments.

2.0 Research Objectives

1. To Examine Students' Attitudes towards Mathematics Pre- and post-Interventions.
2. To develop and Implement Strategies Aimed at Enhancing Students' Attitudes towards Mathematics.
3. To Investigate the Relationship Between Students' Attitudes and their Academic Attainment in Mathematics.

3.0Reconnaissance

In order to execute this action research, the researchers adopted the steps proposed by Maxwell (2003), which involved situational analysis, competence and literature review. These three components provide an overview of the realities of the situations, the competences of the people involved, and link it with the review of literature.

3.1 Background of the Study

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The researcher brings to this study an extensive teaching career spanning over 23 years, encompassing the instruction of various subjects including Mathematics, Social Studies, and Science. Throughout this pedagogical journey, a recurring observation has been the prevailing disinterest among a substantial portion of students towards mathematics, despite the subject's prominent status in

the educational landscape of Bhutan. This phenomenon has been particularly evident among fifth-grade students at Khoma Primary School in Lhuentse, where the researcher has been actively teaching over the past years. It is noteworthy that this observation has also been corroborated by fellow educators, suggesting that the issue transcends the confines of the researcher's individual experience.

This discernible lack of enthusiasm for mathematics is further substantiated by the Pupils' Performance Reports for 2019 and 2020, released by the Bhutan Council for School Examinations and Assessment (BCSEA). These reports indicate that student achievement in Mathematics, as assessed through the Bhutan Certificate of Secondary Education (BCSE) examination, consistently lags behind that in other subjects. Specifically, the BCSEA (2019) reported a mean score of 50.75% for Grade X students in mathematics, with a similar trend in 2020, where the mean score stood at 52.02% (BCSEA, 2020). Furthermore, the Bhutanese participation in the Program for International Student Assessment for Development (PISA-D) in 2019 yielded an alarming finding—the mathematical literacy of Bhutanese students was at a notably low level, with a mere 38.84% proficiency. This concerning trend can be attributed, at least in part, to the prevailing negative mindset towards learning mathematics and the correspondingly diminished interest in the subject.

Numerous scholarly investigations have explored the multifaceted determinants influencing students' achievement in mathematics. One recurrently identified factor of paramount significance is students' attitudes toward the subject (Chamberlin, 2010). Consequently, various research endeavors in different countries have sought to ascertain the extent of students' attitudes and to probe the intricate relationship between these attitudes and academic performance. However, the body of research on this subject presents a somewhat inconclusive landscape, with studies yielding both positive and negative associations between students' attitudes and their academic accomplishments (Zan& Martino, 2007). Notably, while there have been a limited number of studies conducted in Bhutan aimed at elucidating the causes of underachievement in mathematics, there exists a notable research gap with regard to understanding students' attitudes towards mathematics and the strategies employed to enhance their achievements in the subject. Thus, the present study endeavors to bridge this knowledge gap by focusing on the amelioration of students' attitudes and the enhancement of their mathematics achievements through the implementation of various strategies.

3.2 Competence

The researcher, in possession of a Master's degree in Leadership and Management conferred by Paro College of Education, possesses a robust academic background that significantly bolsters the capacity to undertake this research endeavor. Within the purview of this degree program, the researcher

engaged in a comprehensive Educational Research module, thus equipping themselves with essential research knowledge and skills. Furthermore, the researcher has actively participated in workshops specifically focused on Action Research, which have provided valuable insights and practical experience relevant to the current research initiative.

3.4 Literature Review

This literature review delves into pertinent research conducted both internationally and within Bhutan, with a particular focus on mathematics learning and students' attitudes toward mathematics. According to Nicko (2011), attitudes can be defined as the manifestation of positive or negative sentiments directed towards various entities, which may include physical objects, specific individuals, groups, government institutions, or other social entities. Meanwhile, Romberg and Wilson (1980) offer a more specific characterization of attitudes as an individual's predisposition towards entities within their environment, encompassing aspects such as mathematics, self-perception, school, teacher relationships, and more. These inclinations are closely linked to how students perceive these entities, and they become evident through the responses students provide in relation to them. Typically, these responses are collected on numerical scales, often in the form of questionnaires. These numerical scales gauge the intensity of students' emotional and cognitive reactions to the entity or position described in the statements. Drawing upon the insights of these scholars, it can be succinctly summarized that attitudes towards mathematics and the learning thereof can be understood as the positive or negative expressions and reactions exhibited by students towards mathematics and the process of learning it. These attitudes encompass cognitive, emotional, and behavioral dimensions.

Mathematics Learning in Bhutan, as a mandatory subject within the Bhutanese school curriculum, assumes a position of paramount importance in shaping students' educational trajectories. However, research endeavors such as the National Education Assessment (NEA, 2003), "Education without Compromise" (2008), the Annual Status of Student Learning (ASSL, 2008, 2010 & 2011), and reports from the Royal Education Council (REC) have consistently unveiled a persistent issue – despite its obligatory nature, mathematics struggles to engage and motivate Bhutanese students effectively, resulting in pervasive underachievement in the subject. A recurring perception among Bhutanese children is that mathematics is an arduous or uninspiring discipline. This perception has, in turn, led many educated parents and even educators to resign themselves to the acceptance and tolerance of subpar mathematics performance (Dukpa, 2015).

Notably, The National Education Assessment (2003), a comprehensive study undertaken by the Ministry of Education (MoE) with technical assistance from the Australian Council for Educational

Research, disclosed the "disappointingly low" performance of grade six students in mathematics. Furthermore, the "Education without Compromise" document (2008) explicitly acknowledged concerns regarding perceived declines in educational standards, particularly in mathematics, English, and science. This has led to recommendations for reforms, including the reconfiguration of math curricula to prioritize fundamental numeracy skills and increased allocation of resources to rural and remote schools. However, these strategies yield limited impact. The findings from Bhutan's PISA-D National Report (2019) also underscored the suboptimal performance of Bhutanese students in Mathematics literacy compared to Science and Reading, calling for innovative approaches and strategies.

The nexus between students' attitudes toward mathematics and their performance in the subject has been explored extensively in literature. Attitude, classified as a cognitive and relatively stable component of affective science, encompasses belief, emotional response, and behavior (Golding et al., 2016). Knight (2005) disaggregated the attitude into three components and asserted its significance in relation to academic achievement. Numerous studies have found a direct and statistically significant correlation between students' attitudes towards mathematics and their performance. For instance, Mensa and Insurance (2013) conducted a study in Ghana and identified a significant positive correlation between students' attitudes and their academic performance. Similarly, Nicolaidou and Philippou (2003) established a significant relationship between attitude and achievement in mathematics. The Trends in International Mathematics and Science Survey (TIMSS) results from 2007 also indicate that students with more positive attitudes had higher average achievement in mathematics compared to their peers with less positive attitudes (Gonzales et al., 2008). This relationship has been further dissected by Zn and Martini (2007), who distinguished between positive and negative attitudes by defining a positive attitude as a favorable emotional disposition toward the subject, and conversely, a negative attitude as an unfavorable emotional disposition. A common consensus in the literature is that a positive attitude towards mathematics constitutes a pivotal factor for student success in the subject. Ma and Xu (2004) underscored this point in their study, indicating a direct link between poor mathematics achievement and a decline in mathematics attitudes. Furthermore, Lemmings and Kay (2010) corroborated these findings by discovering a substantial association between mathematics attitudes and achievement, implying that attitudes toward mathematics can. From the reviewed literature, it becomes apparent that previous research efforts in Bhutan have predominantly examined the factors contributing to low academic performance in mathematics. However, a notable research gap exists, as there has been a paucity of studies that specifically target the enhancement of students' attitudes toward mathematics and,

consequently, the improvement of their academic achievements in the subject. The current study endeavors to address this research lacuna by focusing on strategies designed to improve students' attitudes and, in turn, their mathematics performance as a reliable predictor of mathematics performance.

3.4 Overarching Research Question:

1. What is the impact of intervention strategies designed to improve the attitudes of Grade V students towards mathematics, and how do these attitudes relate to their academic performance in the subject?

3.4.1 Sub-Questions

1. How do the attitudes of Grade V students towards mathematics change before and after the implementation of intervention strategies?
2. What specific strategies can be developed and effectively implemented to enhance the attitudes of Grade V students towards mathematics?
3. To what extent is there a correlation between the attitudes of Grade V students towards mathematics and their academic achievement in the subject?

4.0 Significance of the Study

This action research endeavor, titled "Improving Students' Attitudes towards Mathematics to Enhance Their Achievement in Mathematics," carries profound significance with the following implications:

A. Improvement in Academic Performance:

The study holds the potential to substantially enhance students' academic performance by fostering positive attitudes towards mathematics. Such attitudes serve as a catalyst for students to overcome apprehensions and reservations associated with the subject, thereby promoting active engagement and facilitating improved academic outcomes.

B. Augmentation of Motivation:

Positive attitudes toward mathematics are closely linked to heightened motivation among students, which, in turn, can translate into increased diligence and determination in their pursuit of mathematical knowledge. This heightened motivation has the propensity to instill a sense of purpose and tenacity, ultimately leading to greater academic accomplishments.

C. Enhancement of Problem-Solving Skills:

A favorable disposition towards mathematics equips students with the confidence and creativity necessary to approach mathematical problems with greater efficacy. Consequently, this can facilitate

the development of more robust problem-solving skills, which have far-reaching applications beyond the mathematics classroom.

D. Improved Self-Esteem:

Success in mathematics holds the potential to bolster students' self-esteem and bolster their self-perception regarding their own abilities. This, in turn, can result in heightened self-confidence and increased participation and enthusiasm in other academic domains, thereby contributing to holistic academic growth.

E. Long-term Advantages:

Nurturing positive attitudes towards mathematics during the formative years carries the promise of yielding enduring benefits. It lays the foundation for a sustained interest in the subject throughout one's educational journey and may lead to the pursuit of careers rooted in mathematics or STEM (Science, Technology, Engineering, and Mathematics) fields. Thus, the study's implications extend beyond immediate academic gains, encompassing the potential to shape lifelong learning trajectories and career choices.

5.0 Methodology

This study employed a quantitative research approach as its methodological framework to systematically gather and analyze data. Specifically, the research design encompassed the administration of pretests and posttests for the selected sample group. The primary objective was to conduct a comparative analysis of students' attitudes towards mathematics and their corresponding achievements in the subject, both prior to and following the implementation of prescribed intervention strategies.

To gauge students' performance in mathematics, a subject achievement test was administered. Concurrently, to delve into the realm of students' attitudes towards mathematics, a survey questionnaire was utilized as the data collection instrument. It is important to note that the teacher-researcher, in alignment with the research objectives, meticulously crafted and employed self-developed instruments for both the subject achievement test and the survey questionnaire. These instruments were thoughtfully tailored to ensure their alignment with the specific research context and objectives, thereby enhancing their efficacy in data collection and analysis.

5.1 Sample

The researcher employed a convenience sampling method for participant selection, a method characterized by its selection of readily accessible and willing participants (Teddlie& Yu, 2007, p. 78). The study's total sample consisted of 27 students, with a gender distribution of 12 boys and 15 girls, all of whom were enrolled at Khoma Primary School in Lhuentse.

5.2 Reliability

To assess the reliability of both the achievement test and the survey questionnaire, a pilot test was conducted with a distinct group of students within the same research school. In evaluating the internal consistency of the subject achievement test, the Kuder-Richardson formula (KR-20) was applied. The outcome of this analysis yielded a reliability coefficient score of 0.81, indicative of the reliability of the test items. It is worth noting that the Kuder and Richardson Formula 20, in this context, serves as a robust metric for evaluating the internal consistency of measurements involving dichotomous choices, where each question is scored as either correct (1) or incorrect (0). This assessment ensures that the measurement instruments utilized in the study are reliable in their capacity to yield consistent results.

6.0 Implementation of Interventions

The research study involved the systematic implementation of various interventions aimed at improving students' attitudes towards mathematics and enhancing their mathematics performance. These interventions are delineated as follows:

1. Cultivation of a Growth Mindset:The researcher undertook initiatives to instill in students the concept of a growth mindset, emphasizing that mathematical proficiency is not an immutable attribute but rather a quality that can evolve and expand with the right mindset, patience, and perseverance. Students were encouraged to recognize that they possess the capacity to excel in mathematics through the cultivation of a growth-oriented attitude. Moreover, students were provided with a platform to compose affirmations that served to reassure and motivate them in their journey to acquire mathematical proficiency.

2. Utilization of Collaborative Learning Strategies:To address the challenges faced by students in comprehending mathematical concepts and skills, the researcher harnessed various collaborative learning strategies during instruction. Students were occasionally grouped into teams and presented with abstract mathematical problems to collectively solve. Algani (2021) posits that the performance of students in mathematics significantly improves when cooperative learning techniques are employed, surpassing the outcomes of conventional teaching methods.

3. Dispelling Gender Stereotypes:In an effort to dispel gender stereotypes related to mathematics, the researcher proffered success narratives of prominent women in the field of mathematics. Additionally, students were actively encouraged to establish elevated expectations for them in the realm of mathematics, facilitated by motivational anecdotes that underscored the contemporary relevance and importance of mathematics in the modern world.

4. Fostering an Appreciation for Challenge:During mathematics instruction, the researcher employed a positive self-talk approach when tackling mathematical challenges in the classroom. The researcher modeled multiple problem-solving approaches, allowing students to witness the process of navigating intricate mathematical questions. Furthermore, students were encouraged to celebrate the journey of problem-solving, even in instances where they did not arrive at the correct solutions, provided they exhibited persistent effort. These experiences were instrumental in helping students recognize the practical utility of these problem-solving skills, thereby augmenting their motivation.

5. Mitigating Mathematics Anxiety:To mitigate mathematics-related anxiety among students, the researcher introduced mindfulness practices before and after mathematics lessons, incorporating guided breathing exercises and other mindfulness techniques. Research has indicated that students who engage in mindfulness exercises prior to math assessments report diminished math anxiety and perform more effectively (Brunyé et al., 2013; Shobe, Brewin, &Carmack, 2005).

7.0 Results and Discussion

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Table 1 provides an overview of the students' attitudes toward learning mathematics before the intervention, as measured by their responses to various statements.

Sl.No	Statements	SA	A	Neutral	D	SD
1	Learning mathematics is fun to me.	5%	35%		42%	18%
2	I enjoy talking to others about mathematics.	4%	42%		48%	6%
3	If I had time, I would spend more time in learning mathematics.	20%	28%		40%	12%
4	I feel that mathematics is not require for my future career.	13%	45%	2%	32%	8%
5	Studying and working with mathematics do fear me.	62%	12%		10%	16%
6	Mathematics makes me feel uncomfortable and nervous	56%	14%	6%	24%	
7	I love to work with friends while solving Mathematics questions.	20%	48%		20%	12%

The pretest results reveal a multifaceted picture of students' attitudes towards mathematics. Notably, the responses to the statement "Learning mathematics is fun to me" indicate that a significant portion of students (60%) disagreed with this assertion, suggesting a prevailing lack of enthusiasm for mathematics among this cohort. Similarly, when asked if they enjoyed discussing mathematics with

others, only 46% of students agreed, while the majority remained either neutral or in disagreement. These findings highlight a notable portion of students who do not find mathematics particularly engaging or may be disinclined to engage in mathematical discussions with their peers.

However, there were positive responses as well. Approximately 48% of students expressed an interest in dedicating more time to learning mathematics if the opportunity presented itself. Furthermore, most students disagreed with the statement asserting that mathematics is not required for their future careers, indicating recognition of the subject's relevance.

Conversely, the results also underscore significant concerns. A substantial majority of students (70%) strongly agreed that mathematics makes them feel uncomfortable and nervous, reflecting the prevalence of negative emotions associated with the subject. Additionally, a majority (74%) agreed with the statement that they fear studying and working with mathematics, signaling a lack of confidence in their mathematical abilities.

Overall, the pretest results reveal a mixed landscape of attitudes towards learning mathematics, with notable challenges related to discomfort, anxiety, and fear. These negative sentiments may potentially hinder students' capacity to engage with and excel in the subject.

In the subsequent comparison of pretest and post-test scores among the sample group, the subject achievement test was utilized to assess students' academic performance in mathematics both before and after the intervention. The test comprised two parts, with a total score of 20. Part I consisted of multiple-choice questions accounting for five marks, while Part II featured extended questions contributing to a total of 15 marks.

The scores observed in the pretest ranged from 4 to 13, reflecting the varying levels of mathematical proficiency among students at the outset of the study. However, the post-test scores exhibited a noteworthy improvement, with scores ranging from 7.5 to 18.5. This marked enhancement in post-test scores suggests a positive impact stemming from the intervention strategies implemented during the course of the study.

These results underscore the potential effectiveness of the interventions in fostering academic progress and performance in mathematics among the student cohort. It is imperative to acknowledge the correlation between improved attitudes and the observed enhancement in academic achievement, as this reaffirms the significance of addressing attitudes as a precursor to realizing positive outcomes in mathematics education. Furthermore, the findings underscore the importance of addressing the emotional and psychological aspects associated with mathematics, including discomfort, anxiety, and fear, as pivotal factors in shaping students' attitudes and performance in the subject.

In summation, the results and subsequent discussion underscore the multifaceted nature of students' attitudes towards mathematics and its consequential impact on academic achievement. The interventions implemented in the study show promise in addressing these attitudes and effecting positive changes in both attitudes and performance, suggesting the potential for broader application in mathematics education.

Comparison of Pre-test and Post-test Scores of the Sample Group

To evaluate the impact of the interventions on students' academic performance in mathematics, a subject test was administered both before and after the application of the intervention. The test encompassed a total score of 20, consisting of two parts: Part I comprised multiple-choice questions worth five marks, while Part II featured extended questions worth 15 marks.Table 2 presents a comparative analysis of the pre-test and post-test scores of the sample group:

Table 2: Comparison of Pre-test and Post-test of the Sample Group

Group	Pretest		Posttest		Mean difference	P value
	Mean	SD	Mean	SD		
Sample Group	7.75	2.47	10	0.71	2.25	0.000

The pre-test scores for the sample group exhibited a mean of 7.75, with a standard deviation of 2.47. In contrast, the post-test scores displayed a mean of 10, with a standard deviation of 0.71. The mean difference between the pre-test and post-test scores amounted to 2.25, signifying a notable increase in the mean of the post-test scores.

Statistical analysis revealed a significant p-value of 0.000, which is lower than the conventional significance threshold of 0.05 ($P<0.05$). This outcome underscores a statistically significant elevation in the post-test scores when compared to the pre-test scores within the sample group.

In essence, these findings elucidate a marked improvement in the academic performance of the sample group in mathematics following the implementation of the intervention strategies. The statistically significant difference underscores the effectiveness of the interventions in fostering enhanced mathematics proficiency among the students.

Table 3 presents the results of a post-test survey conducted to assess students' attitudes towards learning mathematics following the implementation of the intervention. The intervention encompassed strategies aimed at fostering a growth mindset, utilizing collaborative learning

approaches, alleviating mathematics-related anxiety, and promoting a positive perspective on mathematical challenges.

Table 3 Students' Attitude towards learning Mathematics after intervention (Post-test)

Sl. No	Statements	SA	A	Neutral	D	SD
1	Learning mathematics is fun to me.	20%	45%		30%	5%
2	I enjoy talking to others about mathematics.	24%	48%		28%	
3	If I had time, I would spend more time inlearning mathematics.	22%	58%		18%	2%
4	I feel that mathematics is not requiring for myfuture career.	8%	12%		72%	8%
5	Studying and working withmathematicsdoes fear me.	12%	14%	4%	52%	18%
6	Mathematics makes me feel uncomfortableand nervous	18%	20%		28%	34%
7	I love to work with friends while solving Mathematics questions.	35%	33%		20%	12%

The post-test results illustrate a discernible shift in students' attitudes towards learning mathematics following the intervention. Notably, 65% of the participants expressed agreement with the statement that learning mathematics is enjoyable, while 35% indicated disagreement. A significant majority (72%) of students affirmed that they derive enjoyment from discussing mathematics with others. Moreover, a remarkable 80% of students concurred that they would allocate more time to learning mathematics if it were feasible, signifying an enhanced commitment to the subject.

Furthermore, only 20% of students agreed with the statement asserting that mathematics is unnecessary for their future careers, with a substantial 72% of students opposing this viewpoint. This attests to an evolving recognition among students regarding the relevance and importance of mathematics in their future pursuits.

Additionally, the results underscore the potential advantages of collaborative learning strategies, with 68% of students expressing a preference for working with friends while tackling mathematics problems.

Overall, the post-test results suggest that the intervention has exerted a positive influence on students' attitudes towards learning mathematics. The majority of students now find the subject enjoyable, regard it as pertinent to their future endeavors, and are open to collaborative learning approaches.

These findings reflect the effectiveness of the intervention in fostering a more positive and constructive attitude towards mathematics among the student cohort.

The pre-test scores for the sample group exhibited a mean of 7.75, with a standard deviation of 2.47. In contrast, the post-test scores displayed a mean of 10, with a standard deviation of 0.71. The mean difference between the pre-test and post-test scores amounted to 2.25, signifying a notable increase in the mean of the post-test scores.

Statistical analysis revealed a significant p-value of 0.000, which is lower than the conventional significance threshold of 0.05 ($P<0.05$). This outcome underscores a statistically significant elevation in the post-test scores when compared to the pre-test scores within the sample group.

In essence, these findings elucidate a marked improvement in the academic performance of the sample group in mathematics following the implementation of the intervention strategies. The statistically significant difference underscores the effectiveness of the interventions in fostering enhanced mathematics proficiency among the students.

8.0 Conclusion

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The findings of this action research endeavor demonstrate a significant enhancement in students' attitudes toward mathematics and a notable improvement in their academic performance following the implementation of intervention strategies, which encompassed collaborative teaching approaches, the alleviation of mathematics-related anxiety, and the cultivation of a growth mindset. These outcomes align with the research conducted by Gillies (2004) and Walmsley (2003), which also highlighted the positive impact of cooperative teaching-learning strategies on students' attitudes. This suggests that non-traditional pedagogical methods, particularly those promoting cooperation, have the potential to foster positive learning attitudes, prosaically behaviors, and successful learning outcomes among students.

Furthermore, our results are consistent with the findings of Yamarik (2007), emphasizing that the incorporation of cooperative learning techniques and the reduction of mathematics-related anxiety can contribute to the development of students' confidence and, consequently, improvements in their learning outcomes. The intervention's success in promoting the enjoyment of tackling mathematical challenges aligns with the assertions of OECD (2013) and Van der Bergh (2013), who posit that students tend to learn more effectively when they derive enjoyment from their lessons. This perspective is further corroborated by Ngussa and Mbuti (2017), who have demonstrated that humor, when employed as a teaching strategy, renders lessons engaging and enjoyable, leading to improved student performance.

In light of these findings, the study offers the following recommendations:

1. Pedagogical Diversity: Educators should embrace a range of instructional techniques that cater to the diverse needs and potential learning barriers encountered by students. This inclusive approach should aim to reduce fear, stimulate active interest, and promote enjoyment in the learning process.
2. Fear Mitigation: Efforts should be made to mitigate students' fear associated with mathematics by creating a supportive learning environment where students feel confident and supported in their mathematical endeavors.
3. Support Mechanisms: Teachers should be equipped to provide timely and tailored support to students whenever needed, fostering an atmosphere of mutual understanding within the teaching and learning milieu.
4. Continual Professional Development: Educators should engage in ongoing professional development to stay abreast of innovative teaching methodologies and strategies that promote positive attitudes and enjoyment in mathematics.
5. Collaboration and Sharing: Teachers should collaborate and share successful strategies for enhancing students' attitudes and performance in mathematics, promoting cross-pollination of effective practices.
6. Parental Involvement: Encouraging parents to actively engage in their children's mathematics education can complement the efforts made within the classroom.
7. Resource Allocation: Educational institutions and authorities should allocate resources and support to facilitate the implementation of effective teaching strategies that promote positive attitudes and enjoyment in mathematics.

In conclusion, this action research underscores the pivotal role of educators in shaping students' attitudes, fostering enjoyment, and ultimately enhancing their academic achievements in mathematics. It affirms that a multifaceted approach, encompassing instructional innovation and emotional support, can effectively nurture a positive and constructive disposition towards mathematics among students.

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