

Impact of a Remedial Programme on Students' Mathematics Achievement: Evidence from a Sixth Form College

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Abstract

This study aimed to explore the impact of a remedial intervention programme on improving Year 13 students' mathematics performance. The participants comprised 84 high-risk students from a Sixth Form centre in Brunei Darussalam, selected through purposive sampling. A pretest–posttest quantitative research design was employed to examine the effect of the intervention on students' academic performance in mathematics, specifically in the areas of logarithmic and exponential functions. Data were analysed using a paired-samples t-test to compare mean scores. A pilot study was conducted on the self-designed pre-test and post-test instruments to ensure their validity and reliability. The results indicated a statistically significant difference between pre-test and post-test mean scores ($p < .05$, $N = 84$), with the mean increasing from 59.98 to 73.54, suggesting that the remedial intervention programme effectively improved students' academic performance. These findings highlight the value of targeted remedial support for students experiencing difficulties in mathematics, demonstrating that structured, focused interventions can lead to meaningful academic gains. Further *MORE*, the study underscores the effectiveness of such programmes in enhancing achievement among high-risk students. It suggests that similar approaches may be beneficial across other subject areas, with implications for policy development, resource allocation, and the promotion of *MORE* inclusive and supportive educational environments.

Keywords: Remedial, Mathematics Performance, Intervention, Pre-test, Post-test

Introduction

Students' mathematics performance has been investigated in numerous studies in many countries, particularly for students who achieved low passing marks. Educational experts have recommended various teaching strategies and approaches to improve students' learning outcomes. Remedial teaching has been identified as one of the many educational strategies that can enhance the academic performance of low-performing students. Remedial teaching involves identifying specific learning difficulties among low-performing students and providing them with the necessary support and guidance to close the gap in their academic performance to the required standard and prevent it from recurring in the future. According to Mundia and Metussin (2019), the recurrence rate of mathematics underachievement is a major concern for all stakeholders in Brunei, including the Ministry of Education, parents, students, teachers, and educational researchers. They have identified numerous factors that can contribute to improving mathematics achievement in GCE A Level in Brunei, such as education funding, teacher quality, and teaching and learning materials (Mundia & Metussin, 2019).

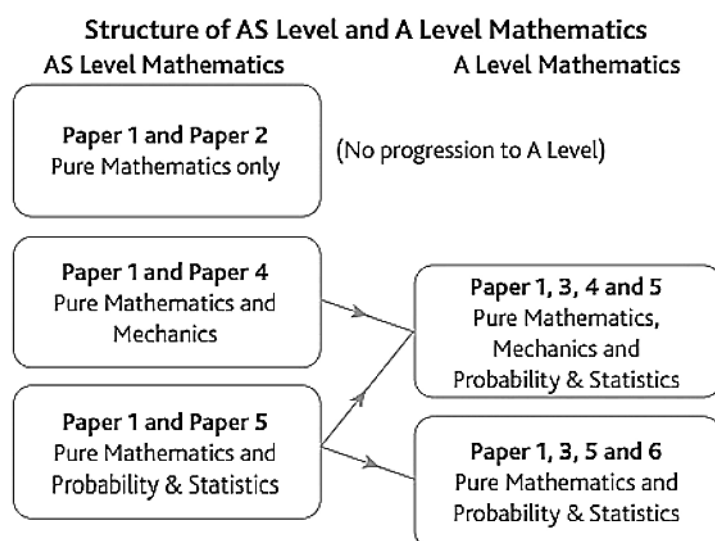
According to Nyibizi and Kazinyirako (2024), remedial teaching strategies play a significant role in addressing students' academic challenges. Some examples of these strategies include a wide range of remedial interventions, such as custom-made tutoring, specialised skill-building exercises, adaptive learning tools, and collaborative learning environments. Several researchers, such as Zhao et al. (2022), also stated that the effectiveness of these remedial procedures can greatly affect students' academic journeys, helping them overcome obstacles to achieving their full potential in science and mathematics (Zhao et al., 2022).

Statement of the Problem

In Brunei Darussalam, students who have completed their Year 11 Brunei Cambridge Ordinary Level examinations continue their studies either in sixth form, polytechnic, or technical colleges. In a sixth form college, students are between 16 and 20 years old and continue their studies in Years 12 and 13. The researcher has selected a sixth-form college in the Brunei Muara district, Maktab Duli Pengiran Muda Al-Muhtadee Billah, to conduct the study. Students should complete the two years studying the Cambridge International Advanced Subsidiary Level (AS Level) in the first year and continue with the Cambridge International Advanced Level (A Level) the following year. The Cambridge International AS Level and A Level Mathematics syllabus focuses on developing students' knowledge, understanding and skills. The skills include the ability to work with mathematical information, think logically and independently, consider accuracy, model situations mathematically, analyse results, and reflect on findings (CAIE, 2022). Students can apply these skills across a wide range of subjects, and they may equip them well as they progress to higher education or enter employment. Figure 1 illustrates the typical structure of the Cambridge International AS Level and A Level Mathematics route for students in the college.

Figure 1

Structure of Cambridge International AS Level and A Level Mathematics



Source: www.cambridgeinternational.org

Mathematics Academic Performance in the College

In college, students' academic performance is monitored through school-based assessments and public examinations. Tables 1(a) and 1(b) below show the results of the analysis of the percentage of students achieving grades A* to E and A* to C in the mathematics subject from 2016 to 2022.

Table 1(a)

Mathematics Department Performance of Achievement of A to E and A* to C in Cambridge Examinations and School-Based Assessments from 2016 to 2022*

GRADE		2016 (%)	2017 (%)	2018 (%)	2019 (%)	2020 (%)	2021 (%)	APR1 2021 (%)	EOY 2021 (%)	APR2 2022 (%)	MJ AS 2022 (%)	MOCK 2022 (%)	TARGET 2022 (%)	In 2022 (%)
MATH	A* – E	78.44	82.54	91.00	90.94	96.12	95.38	75.7	78.5	89.0	89.36	73.6	97	88.51
	A* – C	45.21	54.14	63.32	56.23	77.16	70.38	48.6	53.7	73.6	61.70	46.8	78	53.62

Table 1(a) shows the percentage of students who achieved A* to E and A* to C in their school-based assessments and public examinations, namely the Cambridge International AS Level and A Level Mathematics, from 2016 to 2022. In 2022, 88.51% of students achieved grades A* to E, while 53.62% achieved grades A* to C in the October/November 2022 A Level results. For this study, the researcher intends to compare the results of the End of Year 2021 with those of the Qualifying Mock Examinations 2022. For this student cohort of academic year 2021/2022, 75.7% of students achieved grades A* to E, and 48.6% achieved grades A* to C in their End of Year Exam 2021. In their 2022 Qualifying Mock Examinations, 73.6% of the students achieved grades A* to E, and 46.8% achieved grades A* to C.

Similarly, Table 1(b) below shows the percentages of students who achieved A* to E and A* to C in their school-based assessments and public examinations, namely Cambridge International AS Level and A Level Mathematics, from 2017 to 2023. Nevertheless, at the time of the study, the October/November 2023 results had not yet been released.

Table 1(b)

Mathematics Department Performance of Achievement of A* to E and A* to C in Cambridge Examinations and School-Based Assessments from 2017 to 2023

											MJ			
GRADE		2017	2018	2019	2020	2021	2022	APR1	EOY	APR2	AS	MOCK	TARGET	In 2023
		(%)	(%)	(%)	(%)	(%)	(%)	2022	2022	2023	2023	2023	2023	(%)
								(%)	(%)	(%)	(%)	(%)	(%)	
MATH	A* – E	82.54	91.00	90.94	96.12	95.38	88.51	62.98	74.45	80.30	80.31	?	97	?
	A* – C	54.14	63.32	56.23	77.16	70.38	53.62	32.18	53.65	62.12	56.30	?	78	?

From this comparison, this shows that there was a decrease in the percentages for both grade categories A* to E and A* to C. Looking at this downward trend, the mathematics teachers in the Mathematics Department of the college felt there is a need to explore ways to improve the number of quality grades of the current batch of the student cohort academic year 2022/2023. Therefore, the mathematics department initiated a remedial intervention programme called the *MORE* Booster programme, which aims to improve students' mathematics achievement in their next school-based assessment.

the Qualifying Mock Examinations. The topics to be covered in the remedial programme are drawn from the Paper 3 syllabus and align with the topics learned in class at the time of the research.

Mathematics Academic Performance of the High-Risk Potential Students

Students at risk of failing were identified as high-risk potential students who scored D, E, or U in their End of Year 2022 exams. Consequently, for this study, the researcher also compared the percentages of passes and failures among students in the student cohort for the academic year 2022/2023 between their End of Year Exam 2022 results and their Qualifying Mock Examinations 2023 results. The analysis of the school-based assessments and the Cambridge International AS and A Level Exam results for the High-Risk students is shown in Tables 2(a) and 2(b) below, respectively.

Table 2(a)

School-Based Assessment Results Analysis for 2022-2023

MTH / YEAR	SCHOOL -BASED ASSESSMENT	TOTAL STUDENTS	STUDENTS WITH QUALITY PASSES						STUDENTS WITH PASSES				UNGRADED STUDENTS			
			A*	A	B	C	Total	%	D	E	Total	%	U	X	Total	%
APR 2022	L6 APR 1	289	X	43	23	27	93	32.0	46	43	182	63.0	107	0	107	37.0
SEPT 2022	L6 END OF YEAR	274	X	70	39	38	147	53.6	30	27	204	74.5	70	0	70	25.5
FEB 2023	U6 APR 2	264	56	40	36	32	164	62.1	26	22	212	80.3	52	0	52	19.7

Table 2(b)

Cambridge International AS / A Level Results Analysis for 2022-2023

MTH / YEAR	GCE CAMBRIDGE AS/A LEVEL EXAM	TOTAL STUDENTS	STUDENTS WITH QUALITY PASSES						STUDENTS WITH PASSES				UNGRADED STUDENTS					
			A*	A	B	C	Total	%	D	E	Total	%	d	e	U	X	Total	%
O/N 2022	OCT/ NOV 2022	235	15	29	38	44	126	53.6	57	25	208	88.5	0	10	0	17	27	11.5
M/J 2023	MAY/ JUNE 2023	264	0	51	45	47	143	56.3	34	27	204	80.3	0	0	38	12	50	19.7

For public examinations, students may sit the Cambridge Examinations up to three times. The first sitting is the Cambridge International AS Level Examinations scheduled in October/November of the first year and then in May/June of the following year. The final exam is the Cambridge International A Level Examinations in October/November of that same year. School-based assessments are the Academic Progress Report 1 (APR1), End of Year Examination (EOY), Academic Progress Report 2 (APR2) and Qualifying Mock Examinations.

Table 3*Analysis of Students' School-Based Assessment Results 2022 – 2023*

	<i>School-Based Assessments</i>	<i>PASS</i>	<i>FAIL</i>
2021 – 2022	Academic Progress Report 1 2021	75.70	24.30
	End of Year 2021	78.50	21.50
	Academic Progress Report 2 2022	89.00	11.00
	Qualifying Mock Exam 2022	73.60	26.40
2022 – 2023	Academic Progress Report 1 2022	62.98	37.02
	End of Year 2022	74.45	25.55
	Academic Progress Report 2 2023	80.30	19.70
	Qualifying Mock Exam 2023	?	?

As shown in Table 3 above, the percentage of students passing the End of Year Exam 2022 was 74.45%, compared to 78.50% in the previous Year's End of Year Exam 2021. This shows a decrease in the number of students passing the exam and an increase in the number of failures during that year. Thus, to further provide sufficient evidence that these students needed extra assistance in their studies. Essentially, the *MORE* Booster programme was introduced to support students at risk of failing the subject and help them score better in their exams.

Mathematics Department Initiative: *MORE* Booster Programme

The poor performance in mathematics among students prompted this study. The first *MORE* programme was introduced to Year 12 students as an online revision resource for their Cambridge AS level syllabus, hence the term *MORE*, short for “Mathematics Online Revision.” The programme was one of the remedial strategies implemented to assist Year 12 students with their revision for the End-of-Year Exams. At the time of the study, the students were already in Year 13. Students who scored below 50 per cent in their End-of-year school-based assessment were selected as participants in the study. These students are identified as potentially at risk for failing the subject and chosen to participate in the remedial intervention programme called the *MORE* Booster Programme. The main objective of the programme is to enhance students' understanding of the subject and to improve their mathematics performance in the next school-based assessment.

Specifically for this study, the *MORE* Booster programme focused on teaching and learning Paper 3 topics. This programme was scheduled for the afternoons after normal lessons and ran from February to September of that year. Every week, mathematics teachers take turns teaching different subtopics, as shown in Table 4.

Table 4*Schedule of the MORE Booster Programme from February to September 2023*

Week	Topic	Writer/Presenter
06 February to 11 February 2023	Logarithms & Exponential	Teacher A
13 March to 18 March 2023	Algebra	Teacher B
22 May to 27 May 2023	Trigonometry	Teacher C
29 May to 03 June 2023	Differentiation	Teacher D
05 June to 11 June 2023	Integration	Teacher E
12 June to 17 June 2023	Numerical Solutions	Teacher F

Week	Topic	Writer/Presenter
19 June to 24 June 2023	Vectors	Teacher G
03 July to 08 July 2023	Differential Equations	Teacher H
11 September to 16 September 2023	Complex Numbers	Teacher I

For this study, the research focuses only on collecting and analysing data from Week 1, which covers Logarithms and Exponentials. This is because the researcher was the mathematics teacher assigned to prepare lesson slides, Quizizz pre-test and post-test, and to teach the content to the student participants during the programme week. The intervention teaching emphasises supporting students understanding through reteaching and scaffolding of key concepts.

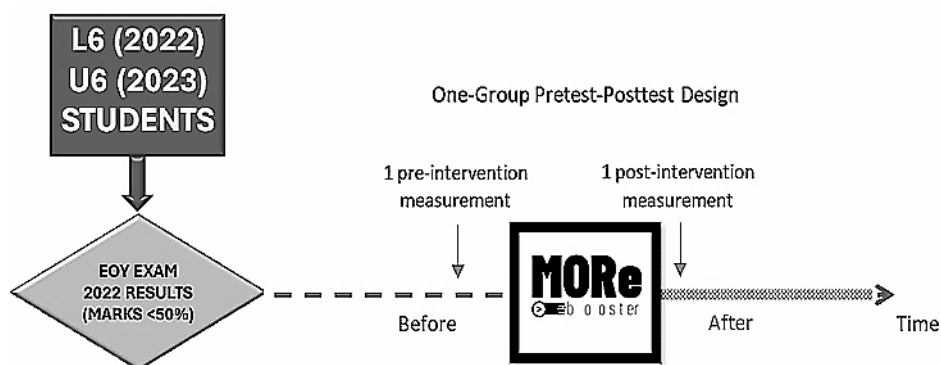
Methodology

Research Design

A one-group pre-test post-test quantitative research design was employed in this study, as shown in Figure 2. The research aimed to investigate the impact of the remedial intervention programme on students' academic performance in mathematics, specifically in the topic of Logarithmic and Exponential Functions. This was done by comparing the pre-test and post-test means for the topic taught during the *MORE* Booster programme lesson intervention. The End of Year exam 2022 results serve as the baseline marks for the study and are then compared with their Qualifying Mock Exam results in 2023.

Figure 2

One-Group Pre-test-Post-test Design



Research Questions

For the remedial intervention *MORE* Booster programme to be effective, it must meet the criteria for helping students improve their academic achievement in the subject. What impact can the *MORE* Booster programme have on students' mathematics achievement in their school-based assessments?

The following questions guided this research:

1. Is there a significant difference in students performance on the pre -test and post-test before and after joining the *MORe* Booster remedial group intervention?
2. Is there a significant difference in students overall results on their school -based assessment after joining the *MORe* Booster remedial group intervention?

Research Hypotheses

The research was conducted to address the following null hypothesis:

1. There is no significant difference in students performance on the pre -test and post-test before and after joining the *MORe* Booster remedial group intervention.
2. There is no significant difference in students overall results on their school -based assessment after joining the *MORe* Booster remedial group intervention.

Research Participants

The participants in this study were 84 students identified as high-risk potential students who scored below 50% in their End of Year Examinations. Of the 84 students, 11 scored a grade of D, 19 scored a grade of E, and 54 were ungraded. Table 5 below shows the grade threshold for the college's school-based assessment.

Table 5

Grade Threshold for School-Based Assessment of the College

Marks Scale	Grade
90 – 100	A*
80 – 89	A
70 – 79	B
60 – 69	C
50 – 59	D
40 – 49	E
0 – 39	U

Instruments

To explore the impact of the remedial intervention programme on Year 13 students academic performance in mathematics, the cooperation and implementation of the remedial tasks by the mathematics teachers were monitored according to schedule. Pre-test and Post-test questions were administered online via Quizizz. Before the intervention teaching, the pre-test was administered to the students. The post-test was administered to the students immediately after each intervention lesson. The pre-test can determine students prior and current knowledge of the topic, and the post -test is identical to the pre-test and is administered to assess their understanding of the topic after the remedial intervention programme.

Pilot Test

A pilot test was conducted for the self-designed pre-test and post-test to ensure the validity and reliability of the instruments (Teresi et al, 2022). The pilot test was administered to a group of 16 students who were not part of the main study but had characteristics comparable to those of the target population. Fifteen mathematics teachers in the department checked the content validity of the instruments. The reliability of the instruments was assessed using Cronbach's alpha, which yielded a coefficient of .85, signifying good internal consistency. The feedback from the pilot test was used to refine the questions and assess the instruments clarity and appropriateness.

Data Analysis

Quantitative data were analysed using descriptive statistics, including means, standard deviation and frequencies. The study's data were analysed using a paired-samples t-test for means in Microsoft Excel. The paired-samples t-test was conducted to compare the mean marks of pre-test and post-test scores to find out if there is any significant difference in the performance of the students between the pre-test and post-test before and after joining the *MORe* Booster remedial group intervention, as well as if there is any significant difference in the overall results of the students in their school-based assessment after joining the *MORe* Booster remedial group intervention.

Result Findings

This study aimed to investigate the impact of a remedial intervention programme on the mathematics performance of 84 high-risk potential students in a Sixth Form college. The following questions guided this research:

1. Is there a significant difference in students performance on the pre-test and post-test before and after joining the *MORe* Booster remedial group intervention?
2. Is there a significant difference in students overall results on their school-based assessment after joining the *MORe* Booster remedial group intervention?

Results from the Pre-test and Post-test

The data collected were processed, analysed, and interpreted using the paired-samples t-test for means. For both research questions, the paired-samples t-test was employed to compare the means between the pre-test and post-test and for the school-based assessment results. The means and standard deviation for the research questions are shown in Tables 6 and 7, respectively.

Research Question 1

To answer research question 1, the mean and standard deviation were used to assess the performance of high-risk potential students on the pre-test and post-test, before and after the remedial intervention programme, respectively.

Evaluation of the hypotheses was done by comparison of the mean scores of the pre-test and post-test. The pre-test scores were from the test administered before intervention, while the post-test scores were from the same test administered after intervention. The pre-test and post-test were administered to students via Quizizz. Students take the tests online, either by scanning a QR code or by entering a code to join.

Table 6

Performance of the High-Risk Potential Students in the Pre-Test and Post-Test

	<i>N</i>	Mean	<i>SD</i>
Pre-Test	84	59.983	20.091
Post-Test	84	73.542	13.787

Table 6 shows that the mean score of the students before the remedial intervention programme is 59.98. On the other hand, the mean result after the remedial intervention programme increased to 73.54. This implies that the remedial intervention programme helps students improve their academic achievement in mathematics.

The increase in post-test scores following the remedial intervention programme was also confirmed in the case study conducted by Ulichnie (2015) at an elementary school in Nevada. Their students had undertaken a series of Mathematics intervention programmes and eventually earned a High Achievement award for their school performance. In addition, the students have started making the shift toward understanding where they are and where they need to be at the beginning, middle, and end of the year (Ulichnie, 2015). Further *MORE*, Carter and Dean (2006) stated that activating prior knowledge is especially important in Mathematics for understanding the relationships between prior and current learning.

Result Findings from the School-Based Assessment

Research Question 2

For research question 2, the mean and standard deviation were used to assess the performance of high-risk potential students on the school-based assessments after the remedial intervention programme. Hypotheses were evaluated by comparing the mean scores of the school-based assessment exams. The school-based assessments measured were the results of the End of Year Exam 2022 (pre-intervention) and the Mock Exam 2023 (post-intervention).

Table 7

Performance of the High-Risk Potential Students in the School-Based Assessments

	<i>N</i>	Mean	<i>SD</i>
End of Year Exam 2022	84	33.667	13.103
Qualifying Mock Exam 2023	84	35.286	16.052

Table 7 presents the school-based assessments of the students before and after the remedial intervention programme. Data from Table 7 show that the mean score on the end-of-year exam before the remedial intervention programme is 33.67. On the other hand, the mean result of the Qualifying Mock Exam after the remedial intervention programme increases to 35.29. This also indicates that the remedial intervention programme improves students performance in the

mathematics course. Flores and Garcia (2017) stated that remedial classes are essential for students who have difficulty understanding a particular subject correctly. The students have different learning styles, which should be considered while teaching and conducting remedial classes. These remedial classes were an effort to improve students performance.

High-Risk Students' Performance in Pre-Test and Post-Test

Table 8 shows the paired differences between the students pre-test and post-test scores before and after the remedial intervention programme. Using the paired-samples t-test for means, the p-value is 0.00000135 ($p < 0.05$). Thus, this indicates a significant difference between the pre-test and post-test scores at the 95% confidence level ($p < 0.05$; $df = 58$; $N = 84$; pre-test mean = 59.98; post-test mean = 73.54).

Table 8

Paired-Samples t-test of Students' Performance between Pre-Test and Post-Test

	Paired Differences					<i>t</i>	<i>df</i>	Sig. (2-tailed)
	Mean	<i>SD</i>	Std. Error Mean	95% CI of the Difference				
				Lower	Upper			
Pre-Test - Post-Test	-13.5593	14.8876	1.9383	-17.4406	-9.6780	-6.995	58	0.000

In summary, the paired-sample t-test indicates a highly statistically significant increase in scores from the pre-test to the post-test. This implies that the remedial intervention programme has a significant positive impact on students' mathematics performance and has improved their achievement scores.

High-Risk Students' Performance in the School-Based Assessments

Table 9 shows the paired differences between the end-of-year exam results and the Qualifying Mock exam results for students before and after the remedial intervention programme. Using the paired-samples t-test for means, the p-value is 0.154509 ($p > 0.05$). Thus, there is no significant difference between the End-of-year exam results and the Mock exam results at 95% confidence interval ($p > 0.05$, $df = 83$, $N = 84$, end-of-year mean score = 33.67, mock exam mean score = 35.29).

Table 9

Paired-Samples t-test of Students' Performance in the School-Based Assessments

	Paired Differences					<i>t</i>	<i>df</i>	Sig. (2-tailed)
	Mean	<i>SD</i>	Std. Error Mean	95% CI of the Difference				
				Lower	Upper			
EOY - MOCK	-1.6190	10.3706	1.1328	-3.8718	0.6338	-1.437	83	0.155

In summary, the t-test indicates no statistically significant difference between the End-of-year exam scores and the Qualifying Mock exam scores. The reason is probably that the remedial intervention programme focuses only on Paper 3. In contrast, the overall Qualifying Mock exam marks should be the average of Paper 3 and either Paper 4 or Paper 6. Nevertheless, the mean of the Qualifying Mock exam results was significantly higher than their baseline End of Year

exam results, indicating that the remedial intervention programme positively impacts students' mathematics performance and improves their achievement scores.

Conclusions and Recommendations

Conclusions

From the study's results, several conclusions can be drawn. The remedial intervention programme demonstrated a positive impact on the academic performance in mathematics of 84 high-risk students from a Sixth Form centre in Brunei Darussalam. This finding aligns with previous studies that underscore the value of relearning mathematical concepts in significantly improving students' mathematics achievement. The programme proved to be a competent and reliable method for improving assessment scores and academic performance, as evidenced by higher Qualifying Mock Exam results than End of Year Exam results. The effectiveness of the remedial intervention programme is further supported by post-test results that are significantly higher than pre-test results. Providing support and remediation programmes for underperforming or struggling students can enhance the schools' overall academic results in the long run.

Recommendations

Based on the findings of this study, several recommendations can be made. Schools should implement structured remedial programmes tailored to students' specific needs and increase the frequency of remedial sessions to support continuous learning and retention of concepts. These programmes should be designed to be *MORE* engaging, to encourage active student participation, and to promote collaboration and interaction. Ongoing professional development for teachers is crucial to enhance their instructional skills and familiarity with effective remedial strategies. Continuous monitoring of remedial programmes is recommended to identify areas for improvement and to promote collaboration among teachers, parents, and stakeholders. Principals and heads of schools should encourage and inspire teachers to implement remedial support programmes to improve their students' academic achievement. Support from other stakeholders within the Ministry of Education, including funding and the provision of appropriate teaching resources, is essential to the successful implementation of remedial programmes. For future research, it is recommended to conduct comparable studies for other subjects. The findings of this study suggest that teachers can utilise tutorial and remediation programmes as a strategy to improve students' performance in various subjects.

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