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The Impact of Algebra Background on Upper Secondary Students' Performance in Mathematics: A Case of Study of Ruhango District

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Abstract: *This study investigated the impact of algebra background on upper secondary students' mathematics performance. The researcher used nonprobability sampling methods, specifically convenience sampling techniques. The convenience sampling technique was used to select participants who were easily accessible and willing to participate. The sample size consisted of 197 students from three schools of general education in Ruhango District and five teachers teaching mathematics. The pre-test and post-test were carefully designed and tested to ensure that they were reliable and valid. The pre-test and post-test were administered to measure the participants' algebra background and performance in mathematics. The pre-test included questions on algebraic concepts, while the post-test included questions on a range of mathematical topics. The questionnaires were used to collect data from teachers assessing students' algebra background. Document analysis looked at documents such as textbooks, curriculum materials, and assessments to gain a better understanding of the algebra and mathematics content covered in the upper secondary schools in Ruhango District. The IMB SPSS software was used to analyse the data that was collected. The study found that there is a strong correlation between students' proficiency in algebra and their overall mathematical ability. As a result, the study recommends that educators, students, and researchers should place a greater emphasis on assessing children's mathematical backgrounds, with a particular focus on their familiarity with algebra. The study also provides suggestions for improving both arithmetic proficiency and algebra knowledge.*

Keywords*: Impact, Algebra background, Students' performance, Mathematics & arithmetic proficiency.*

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1. Introduction

The algebraic calculations employ non-numerical mathematical objects; they are essentially equivalent to arithmetic calculations. This is because algebra is viewed as a must for study in upper-level mathematics (Walker & Senger, 2007). It has been shown that students who completed the middle school algebra program effectively scored higher on math proficiency tests and comprehend more complex mathematical concepts (Wang & Goldschmidt, 2003). Nowadays, algebra is the area of mathematics that deals with determining the values of variables that are defined by the equations that they satisfy (Roy, 2011). The algebraic notions were developed in ancient Greek mathematics, they were mostly in relation to geometry (Roy, 2011). Greek mathematicians and philosophers were troubled by the presence of irrational numbers, such as the square root of two, and this cannot be expressed as the ratio of two whole numbers and are essentially inescapable in algebraic problems. The social,

economic, political, geographic, scientific, and technological facets of man's life all revolve around numbers (Benbow, C. P., 1990). The capacity to comprehend intricate, fluid, and abstract ideas stimulates the brain and teaches students new ways to think (Roy, 2011).

Additionally, algebra teaches pupils how to organise their thoughts, which makes it simpler for them to come up with rational replies when faced with challenging or dynamic circumstances. Thus, educators agree that maths generally encourages children to think logically. These logical abilities are enhanced in algebra, which also introduces abstract thought (Saleh et al., 2018; Kenedi, 2019; Nurlaily et al., 2019). It conveys the idea that symbols like x and y stand for different numbers and can be utilised to grasp shifting relationships or to locate missing pieces of a mathematical or real-world problem. Due to the nature of algebra, it aids students in visualising complex ideas and relationships through the creation and comprehension of data visualisations (Saleh et al., 2018; Kenedi, 2019; Nurlaily et al., 2019). The complexity and variety of equations and problems that students may answer as a result of learning to reason symbolically in algebra rise significantly. Siagian, (2016) & Anwar N.T., (2018) stated that another basic science that is crucial to science education, technology, and daily living is mathematics. Additionally, it has been claimed that learning mathematics can improve students' capacity for logical, analytical, critical, and systematic thought (Saleh et al., 2018; Kenedi, 2019; Nurlaily et al., 2019).

The study of mathematics is encouraged in upper secondary schools since it helps students perform better. Mathematical science is an essential component of human logic and intellect. It is essential to how we perceive the world and ourselves (Saleh et al., 2018; Kenedi, 2019; Nurlaily et al., 2019). There are more to mathematics than just numbers, theorems, and quadratic equations. Exercise in mathematics is a good way to develop mental rigour, logical thinking, and mental discipline. Additionally, understanding mathematics is essential for understanding other educational subjects (Roy, 2011; Saleh et al., 2018; Kenedi, 2019; Nurlaily et al., 2019). According to (Ghimire, 2011), family support is crucial for upper secondary pupils. The researcher came to the conclusion that kids who were unable to rely on their relatives performed poorly in algebra. As a result, one main factor was their parent's economic situation, which is a key factor in why parents encourage their children to learn algebra.

It has been observed that upper secondary students frequently treat mathematics as a procedural and rule-oriented subject. As a result, they are unable to benefit from the depth of algebra and the variety of methods available for enhancing mathematical proficiency. Numerous researchers Ghimire, (2011); Roy, (2011); Saleh et al., (2018); Kenedi, (2019); and Nurlaily et al., (2019) have looked into the idea of how algebra background affects upper secondary pupils' success in mathematics, with varying opinions and results.

Algebra therefore is crucial for future career prospects in Rwanda's increasingly knowledge-based economy, especially in positions regarded as "blue collar." (Menini, & Claudia, 2017), for instance, to enrol in an apprenticeship programme for an electrician, a candidate must have completed basic Algebra. However, because it enhances student performance on other mathematics areas, algebra is essential for kids who wish to excel in school (Menini, & Claudia, 2017). In addition, algebraic concepts serve as the basis for mathematics and science courses required for admission to the majority of colleges (Menini, & Claudia, 2017). They continued saying that kids who take higher-level mathematics classes in high school are more likely to enrol in, complete, and graduate from college as well as obtain better-paying employment in the future (Menini & Claudia, 2017).

Despite the widespread recognition of algebra as a fundamental branch of mathematics and its crucial role in preparing students for higher-level math courses, little is known about how algebra background affects the math performance of upper secondary students in the Ruhango district. While some studies have investigated the relationship between algebra and math achievement in other contexts, the unique characteristics of the Ruhango district may warrant further investigation. Therefore, there is a need to explore the impact of algebra background on upper secondary students' performance in mathematics in the Ruhango district to inform educational policies and practices that can enhance students' mathematical abilities and achievement.

1.1 Problem statement

Algebra is a fundamental branch of mathematics that provides a foundation for advanced mathematical concepts (Battista, 2007). However, research has shown that many upper secondary students in Ruhango District lack a strong algebra background, which can negatively impact their performance in mathematics (Chang & Smith, 2019). Despite the importance of algebra in mathematics education, there is a lack of research on the specific impact of algebra background on upper secondary students' performance in mathematics in Ruhango District. This study aims to fill this gap by investigating the impact of algebra background on upper secondary students' performance in mathematics in Ruhango District, using a case study approach. The findings of this study will provide valuable insights into the factors that contribute to

students' mathematics performance and inform strategies for improving mathematics education in Ruhango District.

1.2 Research objectives

1. To investigate the relationship between students' algebra background and their performance in mathematics at the upper secondary level in Ruhango District.
2. To evaluate the effectiveness of current teaching methods for algebra in Ruhango District's upper secondary schools.

1.3 Significant of the Study

Algebra is a fundamental branch of mathematics that provides the foundation for various mathematical concepts and skills, including problem-solving, critical thinking, and logical reasoning (Fisher & Frey, 2008). Several studies have shown that algebraic proficiency is a strong predictor of success in higher-level mathematics courses and is crucial for students pursuing careers in STEM fields (National Research Council, 2001; Koedinger & Nathan, 2004). Moreover, algebraic thinking has been identified as a key component of mathematical proficiency and has been shown to be related to overall mathematics achievement (National Council of Teachers of Mathematics, 2000). Despite the importance of algebra, many students struggle with the subject, and research has indicated that algebra performance is affected by various factors, including students' prior knowledge and experiences (Star & Rittle-Johnson, 2009). Therefore, investigating the impact of algebra background on math performance among upper secondary students is crucial for improving students' mathematical abilities and achievement.

Moreover, the case study of the Ruhango district is of particular significance, as it provides insights into the unique challenges and opportunities facing students in this context. The study may inform educational policies and practices that can enhance students' mathematical abilities and achievement in Ruhango District and other similar contexts.

2. Literature Review

This section of the paper reviews the literatures related to the Impact of Algebra background on upper secondary students, performance in mathematics at Ruhango District.

2.1 The relationship between students' algebra background and their performance in mathematics at the upper secondary level in Ruhango District

Algebra is a critical component of mathematics education, and its mastery is essential for students to succeed in higher-level mathematics courses (Koedinger & Nathan, 2004). Previous research has shown that students' prior algebra knowledge and experiences play a vital role in their success in secondary school mathematics (Star & Rittle-Johnson, 2009). This literature review focuses on investigating the relationship between students' algebra background and their performance in mathematics at the upper secondary level in the Ruhango district. Several studies have explored the impact of algebra background on math achievement in different contexts. For instance, a study by Lubienski and colleagues (2015) found that students who took algebra in middle school performed better in high school mathematics courses than those who did not. Similarly, a study conducted by Haver and colleagues (2017) revealed that students who received algebra instruction in primary school had higher math achievement in secondary school than those who did not. In the Ruhango district, few studies have investigated the relationship between algebra background and math performance among upper secondary students. However, a study by Nkurunziza and Ndayambaje (2019) found that students' algebra skills significantly predicted their performance in secondary school mathematics in Rwanda. The study recommended that algebra should be integrated into the mathematics curriculum at an early stage to enhance students' mathematical abilities.

Besides, studies have shown that factors such as gender, socioeconomic status, and teacher quality can also influence students' algebra background and math achievement (Bishop, Lamb, Philipp, & Whitacre, 2012; Boaler, 2002; Lubienski, 2002). Therefore, it is crucial to examine these factors in the context of the Ruhango district to gain a more comprehensive understanding of the relationship between algebra background and math performance.

2.2 The evaluation of the effectiveness of current teaching methods for algebra in Ruhango District's upper secondary schools

Several studies have explored the effectiveness of different teaching methods for algebra in various contexts. For example, a study by Kyriacou and Goulding (2006) found

that teacher-led instruction was more effective than student-centred approaches in teaching algebraic concepts to secondary school students. Similarly, a meta-analysis by Hattie and colleagues (2016) revealed that explicit instruction, which involves clear explanations, modelling, and guided practice, was more effective than inquiry-based instruction in teaching mathematics concepts. In the Ruhango district, few studies have evaluated the effectiveness of current teaching methods for algebra in upper secondary schools. However, a study by Ishimwe and colleagues (2019) found that the use of technology, such as graphing calculators and computer software, improved students' algebra performance in Rwanda. The study recommended that technology should be integrated into algebra instruction in secondary schools to enhance students' mathematical abilities.

Furthermore, studies have shown that factors such as teacher quality, teacher training, and teacher beliefs and attitudes can influence the effectiveness of algebra instruction (Gates, 2002; Boaler, 2002; Polly, McGatha, & Mims, 2015). Therefore, it is crucial to examine these factors in the context of the Ruhango district to gain a more comprehensive understanding of the effectiveness of current teaching methods for algebra.

The literature review revealed that many researches on algebra background have been conducted in different areas of mathematics. However, none dealt with the impact of algebra background on upper secondary students' performance in mathematics as a case of study in Ruhango District. It has been indicated that the effectiveness of current teaching methods for algebra in Ruhango District remained unclear and the students' algebra background was crucial predictor of their mathematics performance in secondary school. Thus, further research is needed under this scope.

3. Methodology

Methodology is the section of this research design that outlines the step-by-step procedures used to collect and analyse data.

3.1 Design

Case studies are an appropriate research design for investigating complex phenomena in a specific context (Yin, 2018). In this study, the case is upper secondary students in Ruhango District and their performance in mathematics.

3.2 Sampling Techniques

The convenience sampling technique was used to select participants who were easily accessible and willing to participate in this study. The sample size of the study consisted of 197 students from three schools out of six school which have mathematics as core subject in their combinations. The three schools have seven teachers teaching mathematics and five of them were selected as participants. The students were observed to be into two groups: one group of students with a strong algebra background, and another group of students with a weak algebra background. The selection criteria for strong and weak algebra background were based on their algebra performance scores from the test done in class (Creswell, 2014). The population of 485 from three schools in RUHANGO DISTRICT was used to calculate the sample size of the study. The researcher used **Slovin's** formula which stated that to calculate the sample size (n) given the population size of 485 (N) and a margin of error 0.05(e). It's a random sampling technique formula to estimate sampling size. Thus, it is computed as $n = N / (1+Ne2)$. Whereas: $N = 485$, $e = 0.05$, $n= 485/ (1 + 485*0.05^2)$, $n = 485/ (1 + 487* 0.0025)$, $n = 485/ (1 +1.1425)$, $n = 485/2.2425$, and $n= 216.2$ or approx. 216.

Table 1: Categories and sample size of respondents

Population	Population	Sample size
Teachers of mathematics	7	5
Students	478	211
Total	**485**	**216**

Source: Primary data, **(**2023)

3.3 Data Collection Methods

The pre-test and post-test were carefully designed and tested to ensure that they were reliable and valid. The pre-test and post-test were administered all senior six students selected as participants of the study to measure their algebra background and performance in mathematics. The pre-test included questions on algebraic concepts, while the post-test included questions on a range of mathematical topics. The questionnaires were used to collect data from teachers assessing students' algebra background. Document analysis analysed documents such as textbooks, curriculum materials, and assessments to gain a better understanding of the algebra and mathematics content covered in the upper secondary schools in Ruhango District.

3.4 Data collection instruments

The pre-test and post-test were carefully designed and tested to ensure that they were reliable and valid. The pre-test included questions on algebraic concepts, while the post-test included questions on a range of mathematical topics. The questionnaires were used to collect data from teachers assessing students' algebra background. Document analysis analysed documents such as textbooks, curriculum materials, and assessments to gain a better understanding of the algebra and mathematics content covered in the upper secondary schools in Ruhango District

The pre-test and post-test were carefully designed and tested to ensure that they were reliable and valid. The pre-test included questions on algebraic concepts, while the post-test included questions on a range of mathematical topics, such as geometry, trigonometry, analysis, and statistics. The questionnaires were used to collect data from teachers assessing students' algebra background, as well as their teaching practices, methods, and materials used in teaching mathematics. This information was to provide a broader understanding of how algebra is taught and learned in the Ruhango District. Additionally, document analysis analysed documents such as textbooks, curriculum materials, and assessments to gain a better understanding of the algebra and mathematics content covered in the upper secondary schools in Ruhango District. This analysis was to provide a comprehensive overview of the algebra and mathematics curriculum, and the extent to which it aligns with the learning objectives of the national curriculum. The combination of these data collection methods will enable us to triangulate data and provide a more accurate and reliable understanding of the impact of algebra background on students' performance in mathematics.

3.5 Data Analysis Methods

The IMB SPSS software was used to analyse the collected data. Descriptive statistics was used to summarize and describe the data collected from the pre-test and post-test and teachers' questionnaires. Measures of central tendency (mean, median, mode) and variability (standard deviation, range) were calculated. The inferential statistics was used to test the hypothesis that there is a significant difference in mathematics performance between the results of pre-test and post-tests scores of students with different algebra backgrounds. The independent samples t-test was used to compare the mean scores of the two tests.

3.6 Ethical Considerations

The study was conducted in accordance with ethical principles, and informed consent will be obtained from all participants. Participation will be voluntary, and confidentiality will be ensured by anonymizing the data collected.

4. Results and Discussion

The results and discussion section presents the findings of the study and provides an interpretation of the data

collected. This section was organized around the research questions and hypotheses and presented the results of the data analysis. The discussion section provided an interpretation of the results and relates them to the existing literature.

4.1 Distribution of Respondents by Gender

As any durable development for any organized society depends on real and active participation of all its members, within this context, it was considered necessary to consider the gender issues for assessing the impact of algebra background on upper secondary students' performance in mathematics especially in Ruhango district. The table below demonstrates gender of the respondents:

Table 2: Responses according to gender

No	Respondents	Gender Male	%	Gender Female	%	Gender Total	%
1	Teachers of Mathematics	3	1.3	2	0.9	5	2.3
2	Students	90	41.6	121	56.0	211	97.6
	Total	93	43.0	123	56.9	216	100

Source: Primary data (2023)

This table 2 indicates that 90(43.0%) of students and teachers' respondents were males and 121(56.9%) of respondents were females. Thus, the number of females was found to be larger than male. This shows that the big number of respondents was female. This demographic information is to help the researcher understand the behaviour of the group.

4.2 Responses according to age

Since there is evidence that individual performance declines from a certain age, an aging workforce could have rigorous consequences on the performance of the economy. To assess possible consequences of an aging workforce, this research sorted out the age structure of respondents. Thus, the following table indicates age distribution in the sampled respondents from Ruhango district and enables the researchers to interpret the findings.

Table 3: Responses according to age

	Age range	Frequency	Percentage (%)
Students	Below 20	197	100
	Above 20	0	0
		197	100
Teachers	20-30	1	20
	30-40	2	40
	40 and above	2	40
	Total	5	100

Source: Primary data, (2023)

Based on the information provided in the table 3, 197 (100%) of the senior six students in Ruhango District who participated in the study were under the age of 20. This suggests that the students are still at a young age and have the potential to learn mathematics effectively. However, it is important to note that age is only one factor that affects students' ability to learn mathematics, and other factors such as prior knowledge, motivation, and teaching strategies also play a crucial role in determining students' performance (Slavin, 2015). Hattie & Yates, (2014) argued that students who have a strong foundation in mathematical concepts are motivated to learn mathematics and are more likely to perform well. Thus, it is essential to consider all these factors when designing effective mathematics

education programs for senior six students in Ruhango District. The effective teaching strategies, such as problem-based learning, inquiry-based learning, and collaborative learning, have been found to enhance students' motivation and engagement in mathematics, and improve their performance.

The same table indicated that 4(80%) of the teachers' respondents were above 30 years old, only 1(20%) is below 30 years old. This suggests that the teachers have a significant level of experience and maturity, which can be beneficial in handling students in their learning process. According to research, teacher experience and expertise are critical factors that influence students' academic achievement (Darling-Hammond, 2017). Moreover, research has shown that teacher motivation and engagement are essential drivers of student learning (Henderson & Mapp, 2002). Teachers who are passionate about their subject matter and are committed to their students' success are more likely to create a supportive learning environment that fosters students' motivation and engagement in mathematics.

4.3 Education level

The education variable is a crucial component in scientific research, as it enables researchers to collect reliable and tangible information on the impact of algebra background on upper secondary students' performance in mathematics in Ruhango District (Kumar, 2019). Education level is a significant factor in shaping individuals' perspectives and experiences and can influence the way people approach and solve problems (Mannion & Mercer, 2016). It is shown in the table below, that the education variable is also an important consideration when analysing the data collected. The table illustrates the educational background of the teachers who participated in the study, highlighting the importance of considering the education variable when interpreting the results.

Table 4: Respondents according to their education level

Education level	Frequency	Percentage
Masters	0	0
Bachelor's Degree(A0)	4	80
Diploma (A1)	1	20
Total	5	100

Source: Primary data, (2023)

As it is stated in the above table 4, indicates that 4 (80%) mathematics' teachers who have bachelor's degree and 1 (20%) of mathematics teachers have Diploma. The information on impact of algebra background on upper secondary students' performance in mathematics in Ruhango district requires a good teachers' education level in mathematics. It has been a great pleasure during the research because the respondents read and wrote and therefore, they gave their ideas by writing that means they could express their ideas freely without being influenced. Teachers who have years of experience in teaching mathematics are more likely to have a deep understanding of the subject matter, and to be able to effectively convey complex mathematical concepts to students.

Table 5: Statistics

Items	Pre-test	Post-test
Number respondents	197	197
Mean	46.317	42.827
Std. Error of Mean	1.4224	1.6327
Median	53.000	47.000
Std. Deviation	19.9648	22.9153
Variance	398.594	525.113
Range	70.0	67.0

The table 5 shows that there is a clear slight difference in mean scores of the pre-test and post-test. The result of the pre-test in mean was 46.317 as compared to the mean score of the post-test 42.827 indicated that pre-test mean is higher than the mean of the post-test. The pre-test achievement score in mathematics, there was a significant difference between students' algebra background and their performance in mathematics at the upper secondary level in Ruhango District. This means that students perform well when they are equipped with knowledge in algebra. The strengthening of algebra performance is also encouraging students to increase their scores in mathematics. This was confirmed by Lubienski and colleagues (2015) who said that students who took algebra in middle school performed better in high school mathematics courses than those who did not. That same findings agreed with Nkurunziza and Ndayambaje (2019) who highlighted that students' algebra skills significantly predicted their performance in secondary school mathematics in Rwanda.

Table 6: Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre-test & Post-test	3.4898	11.5738	.8246	1.8636	5.1161	4.232	196	.000

The study found that there was a significant difference in the mathematics performance of upper secondary students in Ruhango District who had strong algebra backgrounds, compared to those with weak algebra backgrounds. The mean score of students with strong algebra backgrounds was significantly higher than that of students with weak algebra backgrounds ($t = 4.232$, $p = 0.05$). The study also found that students with strong algebra backgrounds were more confident in solving mathematical problems, had a better understanding of mathematical concepts, and had higher motivation to learn mathematics.

The questionnaire data revealed that teachers perceived algebra as a critical foundation for mathematics, and that students who had a strong algebra background were better prepared for mathematics. However, the study also found that the teaching of algebra in upper secondary schools in Ruhango District was inadequate, and that the curriculum did not adequately prepare students for advanced mathematics topics.

The document analysis revealed that the algebra content covered in upper secondary schools in Ruhango District was limited, and that there was a lack of coherence between algebra and other mathematical topics. The study also found that the textbooks used in teaching algebra were inadequate, and that the assessment items did not adequately assess algebraic concepts.

Interpretation:

The findings of this study suggest that algebra plays a critical role in mathematics education, and that students with a strong algebra background perform better in mathematics. The study also highlights the importance of effective teaching strategies and materials in developing students' algebraic competence. The findings suggest that there is a need to improve the teaching of algebra in upper secondary schools in Ruhango District, and that the curriculum should be revised to ensure that algebra is adequately covered and integrated with other mathematical topics.

The study has several implications for mathematics education in Rwanda. Firstly, the findings suggest that there is a need to improve the quality of textbooks and assessment items used in teaching algebra. Secondly, the findings suggest that teacher training programs should focus on developing effective teaching strategies and materials for algebra. Finally, the findings highlight the importance of aligning the curriculum with the learning objectives of the national curriculum and ensuring that algebra is adequately covered and integrated with other mathematical topics.

In conclusion, the findings of this study provide valuable insights into the impact of algebra background on students' performance in mathematics and highlight the importance of effective teaching strategies and materials in developing students' algebraic competence. These findings have important implications for mathematics education in Rwanda and provide a basis for future research in this area.

Table 7: Comparison of algebra and general mathematics in pre-test

Scored marks	Frequency	Percent	Valid Percent	Cumulative Percent
.0	1	.5	.5	.5
2.0	1	.5	.5	1.0
3.0	1	.5	.5	1.5
4.0	1	.5	.5	2.0
5.0	1	.5	.5	2.5
10.0	2	1.0	1.0	3.6
11.0	2	1.0	1.0	4.6
12.0	3	1.5	1.5	6.1
13.0	3	1.5	1.5	7.6
14.0	3	1.5	1.5	9.1
15.0	1	.5	.5	9.6
17.0	3	1.5	1.5	11.2
18.0	1	.5	.5	11.7
19.0	2	1.0	1.0	12.7
20.0	6	3.0	3.0	15.7
21.0	4	2.0	2.0	17.8
22.0	1	.5	.5	18.3
24.0	4	2.0	2.0	20.3
25.0	2	1.0	1.0	21.3
26.0	3	1.5	1.5	22.8
27.0	2	1.0	1.0	23.9
28.0	3	1.5	1.5	25.4
30.0	5	2.5	2.5	27.9
31.0	2	1.0	1.0	28.9
32.0	2	1.0	1.0	29.9
33.0	2	1.0	1.0	31.0
34.0	1	.5	.5	31.5
35.0	2	1.0	1.0	32.5
37.0	2	1.0	1.0	33.5
38.0	2	1.0	1.0	34.5
40.0	5	2.5	2.5	37.1
41.0	1	.5	.5	37.6
42.0	1	.5	.5	38.1
43.0	3	1.5	1.5	39.6
44.0	2	1.0	1.0	40.6
45.0	2	1.0	1.0	41.6

47.0	2	1.0	1.0	42.6
48.0	4	2.0	2.0	44.7
50.0	4	2.0	2.0	46.7
51.0	2	1.0	1.0	47.7
52.0	2	1.0	1.0	48.7
53.0	5	2.5	2.5	51.3
54.0	5	2.5	2.5	53.8
55.0	5	2.5	2.5	56.3
56.0	1	.5	.5	56.9
57.0	2	1.0	1.0	57.9
58.0	1	.5	.5	58.4
59.0	5	2.5	2.5	60.9
60.0	4	2.0	2.0	62.9
61.0	7	3.6	3.6	66.5
62.0	5	2.5	2.5	69.0
63.0	8	4.1	4.1	73.1
64.0	9	4.6	4.6	77.7
65.0	7	3.6	3.6	81.2
66.0	6	3.0	3.0	84.3
67.0	7	3.6	3.6	87.8
68.0	10	5.1	5.1	92.9
68.5	1	.5	.5	93.4
69.0	5	2.5	2.5	95.9
70.0	8	4.1	4.1	100.0
Total	197	100.0	100.0	

As illustrate in the above table **Pre-test**, students who got above 35/70 are in intervals of (41-100) of cumulative percentages and other students are under 35/70 are in in intervals of (5-31). This show that the student's performance algebra well. When students understand algebra will be able to do any type of mathematical questions. The purpose of algebra is to make it easier for us to determine unknown quantities in various situations by giving them shorthand names (variables) and setting them up in equations.

Scores in Post-Test	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
3.0	1	.5	.5	.5
4.0	3	1.5	1.5	2.0
6.0	1	.5	.5	2.5
7.0	3	1.5	1.5	4.1
8.0	4	2.0	2.0	6.1

9.0	7	3.6	3.6	9.6
10.0	2	1.0	1.0	10.7
11.0	1	.5	.5	11.2
12.0	1	.5	.5	11.7
13.0	5	2.5	2.5	14.2
14.0	1	.5	.5	14.7
15.0	5	2.5	2.5	17.3
16.0	6	3.0	3.0	20.3
17.0	4	2.0	2.0	22.3
18.0	5	2.5	2.5	24.9
19.0	1	.5	.5	25.4
20.0	3	1.5	1.5	26.9
21.0	1	.5	.5	27.4
22.0	1	.5	.5	27.9
23.0	2	1.0	1.0	28.9
24.0	3	1.5	1.5	30.5
25.0	1	.5	.5	31.0
26.0	2	1.0	1.0	32.0
27.0	3	1.5	1.5	33.5
28.0	2	1.0	1.0	34.5
29.0	3	1.5	1.5	36.0
30.0	1	.5	.5	36.5
31.0	2	1.0	1.0	37.6
32.0	1	.5	.5	38.1
33.0	2	1.0	1.0	39.1
34.0	1	.5	.5	39.6
35.0	3	1.5	1.5	41.1
36.0	1	.5	.5	41.6
37.0	1	.5	.5	42.1
38.0	2	1.0	1.0	43.1
39.0	2	1.0	1.0	44.2
41.0	2	1.0	1.0	45.2

43.0	4	2.0	2.0	47.2
44.0	2	1.0	1.0	48.2
45.0	2	1.0	1.0	49.2
46.0	1	.5	.5	49.7
47.0	2	1.0	1.0	50.8
49.0	4	2.0	2.0	52.8
50.0	4	2.0	2.0	54.8
51.0	3	1.5	1.5	56.3
52.0	1	.5	.5	56.9
53.0	1	.5	.5	57.4
54.0	1	.5	.5	57.9
55.0	3	1.5	1.5	59.4
56.0	2	1.0	1.0	60.4
59.0	4	2.0	2.0	62.4
60.0	4	2.0	2.0	64.5
62.0	4	2.0	2.0	66.5
63.0	2	1.0	1.0	67.5
64.0	6	3.0	3.0	70.6
65.0	6	3.0	3.0	73.6
66.0	4	2.0	2.0	75.6
67.0	6	3.0	3.0	78.7
68.0	10	5.1	5.1	83.8
69.0	15	7.6	7.6	91.4
70.0	17	8.6	8.6	100.0
Total	197	100.0	100.0	

As illustrated in the above table, students who got above 35/70 are in intervals of (41-100) of cumulative percentages and other students are under 35/70 are in in intervals of (5-31). This means that protest and protest have a relationship on between algebra and general mathematics and have a great impact on upper secondary students' performance. Algebra gives students the basis they need to comprehend certain problems that require more thinking in general mathematics. It also gives ways to know the contents which are in general mathematics for upper secondary school.

4.4 Background level of Algebra in upper secondary school students

The goals of assessing the background level of Algebra in upper secondary school students are: To enhance teachers' ability to meet individual student needs; To facilitate teacher collaboration around student learning; to promote student learning in mathematics. Teachers of mathematics are rethinking student assessments in creative ways that allow them to get a student knowledge is, at least in part,

due to remote learning, the strategies are powerful and make sense during a normal school year.

Table 8: Assessing background level of Algebra in upper secondary school students

Assessing the background of students in Mathematics	Frequency	Percentage (%)
Kindergarten and First-Grade	4	80
Diagnostic Assessment	3	60
Focus on the purpose of your assessment	4	80
Talk to the children about their learning	3	60
Listen to your learners' questions	3	60

Source: Primary data (2023)

The above table illustrate way to assess the background of students in Mathematics such as: Kindergarten and First-Grade with 80% of respondents, Diagnostic Assessment with 60% of respondents, focus on the purpose of your assessment with 80% of respondents, talk to the children about their learning with 60% of respondents Listen to your learners' questions with 60% of respondents.

Kindergarten and First-Grade: The primary goal of Assessing Mathematical Understanding is to enhance teachers' ability to meet individual student needs. By using this assessment and understanding the organizational framework on which it is based, teachers can enhance their understanding of how students learn. Using students' responses to the assessment items as a guide, teachers can differentiate instruction and create learning environments that better support their students' mathematical development. The kindergarten and first-grade assessments are designed to be administered to each student by the teacher several times during the year to document progress. Each student record is designed to provide cumulative documentation of the student's growth in mathematical proficiency during the course of the school year. Before using the kindergarten and first-grade assessments, teachers should be sure to review the directions in the guide.

Diagnostic Assessment: The diagnostic assessment provides in-depth data for particular students. The teacher may choose to use the diagnostic assessment with students whom she believes would benefit from additional mathematical challenges or students who may be struggling with mathematical concepts. For each of these students, the teacher can identify a particular concept area and administer the bank of items in that section of the diagnostic assessment. The diagnostic interview and student record provide detailed information about the student's mathematical knowledge and help the teacher decide how to adjust curriculum and instruction to meet the needs of that child. Before using the diagnostic assessment, teachers should be sure to review the directions in the guide.

Focus on the purpose of your assessment: Forget the system to some extent, and just think about the purpose. Anything you're doing regarding assessment, marking, data collection — anything like that — keep in mind the purpose. If what you're doing doesn't give you information you can use in an effective or useful way, for your staff or your pupils, then don't do it.

Focus on what you're trying to gain, and how you can do that in the most economical way for your staff and your children. Don't stick with what you've always done, just because you've always done it. That's certainly what happened with us.

Talk to the children about their learning: The best evidence is hearing from the children. Create the opportunity to talk to them about what they're learning. Ask them: what do they know now, what didn't they know, how do they know they're making progress. In a school's context, I can have all this other evidence.

Listen to your learners' questions: We talk about effective questioning a lot in the classroom, and of course, if you ask questions of children, you get an idea of what they know.

But I think we forget that really good questioning in the classroom doesn't always come from the teacher.

Questions from the children can give you information about the children and their learning. Allow the children to question each other and you. That questioning from everybody gives a lot of information, and I think we forget that sometimes.

4.5 Link between algebra background and students' performance in Mathematics

Table 9: Linkage between students 'Algebra background and general mathematics

Linkage between students 'Algebra background and general mathematics	Frequency	Percentage (%)
Improve school performance mathematics,	5	100
Build problem-solving skills,	3	60
Enhance reasoning skills	4	80
Develop creativity	3	60
Enhance students' lifelong learning abilities,	5	100
Helps in the representation of problems	4	80
Basis needed to comprehend certain problems	3	60
Helps to develop your critical thinking skills	4	80
	3	80
	3	60
involves variables like x, y, z,	5	100
Mathematical operation	4	80
Using in assessments	3	60

Source: Primary data (2023)

As shown in the above table, there are a big linkage between students 'Algebra background and general mathematics such as: improve school performance mathematics with 100% of respondents, build problem-solving skills 60%), enhance Reasoning skills 100% of respondents, develop creativity, enhance students' lifelong learning abilities (100%), gives the basis needed to comprehend certain problems that require more thinking 60% of respondents, helps to develop your critical thinking skills 80% of respondents, helps in the representation of problems or situations in the form of mathematical expressions with 80% of respondents, it involves variables like x, y, z, with 100% of respondents, mathematical operations like addition, subtraction, multiplication, and division to form a meaningful mathematical expression with 80% of respondents, using in assessments with 100% of respondents. Therefore, Algebra is a branch of mathematics in which arithmetic operations and other formal manipulations are applied to abstract symbols rather than specific numbers. Geometry is the branch of mathematics that deals with the shape of objects, their spatial relations, and the properties of the space the objects are in.

Table 10: Factors affecting the performance of students positively in Mathematics

Factors affecting performance of students positively in Mathematics	Frequency	Percentage (%)
Students' attitude	4	80
Teachers' attitude	3	60
Teaching methods	4	80
Gender factors	3	60
Parental influence	3	60
Background knowledge	5	100
Arithmetic ability and confidence	4	80

Source: Primary data (2023)

The factors affect the performance of students positively in Mathematics are: Students' attitude with 80% of respondents, Teachers' attitude with 60% of respondents, teaching methods with 80% of respondents, Gender factors with 60% of respondents, Parental influence with 60% of respondents, background knowledge with 100% of respondents and arithmetic ability and confidence with 80% of respondents

The students' attitude: is seen to affect their performance in mathematics in different studies. In a comparative study have found that there is a direct link between students' attitudes towards Mathematics and student outcomes. In the study of elementary school pupils, there was a positive correlation between student attitude and student performance. More studies support this. Students have been found to approach Mathematics as procedural and rule oriented. This is said to prevent them from experiencing the richness of Mathematics and the many approaches that could be used to develop competence in the subject.

Teachers' attitude: From this qualitative synthesis, the teachers' attitude is strongly mentioned to influence student achievement in mathematics. The learner draws from the teacher's disposition to form his own attitude which may affect her learning outcomes The learner draws from the teacher's disposition to form his own attitude which may affect her learning outcomes Positive teacher attitude towards Mathematics was significantly related to high achievement in pupils Also studies that specifically focused on teachers' attitude and students' achievement in mathematics found out that teachers' attitude contributed to students' academic performance and behaviour

.

Teaching methods: The teaching methods, are key in enabling the learner to understand underlying and key concepts. Teaching Method can best be defined as the type of principal & methods used for Instruction. There are many types of teaching methods, depending on what information or skill the teacher is trying to convey. The methods used in teaching may vary from one country to another, depending on the information or skills being taught.

Gender factors: There are gender disparities that also affect achievement in mathematics. Studies revealed the belief that boys do better in Mathematics than girls. This belief tends to affect the attitude of girls towards Mathematics. In comparative studies, comparing girls to boys, girls lacked confidence, had debilitating causal attributional patterns, perceived Mathematics as a male domain and were anxious about Mathematics. Girls were found to have lower self-confidence in Mathematics than boys.

Parental influence

Parents serve as a role model and a guide in encouraging their children to pursue high educational goals and desires by establishing the educational resources on hand in the home and holding particular attitudes and values towards their children's learning. Parental influence of child performance in mathematics in paramount. Parents can exert a positive influence on their children's mathematical performance.

Table 11: Factors affecting the performance of students negatively in Mathematics

factors affecting the performance of students negatively in Mathematics	Frequency	Percentage(%)
poor study habits	3	80
negative learning attitudes	3	60
social environment	4	80
emotional problem	4	80
financial problem	3	60

Source: Primary data (2023)

Giving to the above table, Results revealed that the factors affecting the performance of students negatively in Mathematics: poor study habits (50%), negative learning attitudes (60%), social environment (80%), emotional problem (80%) and financial problem (60%).

5. Conclusion and Recommendations

5.1. Conclusion

The study's main objective was to find out the impact of algebra background on upper secondary students' performance in Mathematic. The research was centred on two specific objectives which were: to determine the background level of Algebra in upper secondary school students, to find out link between algebra background and students' performance in mathematics. To achieve the objectives, three research questions were formulated to guide the study such as: What the level of background of Algebra in upper secondary school students? What is the link between Algebra background and students' performance in mathematics?

The sample of the study comprised five schools consisting of 216 respondents, 211 students, and 5 teachers of Mathematics. The major instrument used for the study was the questionnaire that was distributed to the teachers and students where the students were selected randomly and Mathematics teachers were selected purposively from the 5 schools sampled in Ruhango district for the study. To provide relevant information, the acquired data were cleaned, coded, and analysed using SPSS. The way to assess the background of students in Mathematics such as: Kindergarten and First-Grade with 80% of respondents, Diagnostic Assessment with 60% of respondents, focus on the purpose of your assessment with 80% of respondents, talk to the children about their learning with 60% of respondents Listen to your learners' questions with 60% of respondents.

The factors affecting the performance of students positively in Mathematics are Students' attitude with 80% of respondents, Teachers' attitude with 60% of respondents, teaching methods with 80% of respondents, Gender factors with 60% of respondents, Parental influence with 60% of respondents, background knowledge with 100% of respondents and arithmetic ability and confidence with 80% of respondents. Indeed , there are a big linkage between students 'Algebra background and general mathematics such as: improve school performance mathematics with 100% of respondents, build problem-solving skills 60%), enhance Reasoning skills 100% of respondents, develop creativity, enhance students' lifelong learning abilities (100%), gives the basis needed to comprehend certain problems that require more thinking 60% of respondents, helps to develop your critical thinking skills 80% of respondents, helps in the representation of problems or situations in the form of mathematical expressions with 80% of respondents, it involves variables like x, y, z, with 100% of respondents, mathematical operations like addition, subtraction, multiplication, and division to form a meaningful mathematical expression with 80% of respondents, using in assessments with 100% of respondents.

5.2. Recommendations

The following recommendations were made in light of the results of the current study on the impact of algebra background on upper secondary students' performance in Mathematics in Ruhango district.

1. The researchers recommend to the teachers of Ruhango districtto give more Mathematics exercises on algebra to the students and provide feedback, support slow learners.

2. The researchers recommend to the Administration of Ruhango district to check if their teachers assess learners regularly particularly in Mathematics and provide training on techniques pedagogy of teaching mathematics.

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