Relationship Between Attitudes towards Mathematics and Mathematics Performance among Form Three Students in the Southeast Sub- Region, Botswana.

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ABSTRACT

Despite governments' interventions and education being an important sector in individual and national development, poor performance in Mathematics has been prevalent, and it has been connected to several variables related to schools, teachers, parents, students, and socioeconomic status. The decline in Mathematics performance deprives learners of rewarding opportunities like furthering education and career opportunities in several disciplines, including engineering, social sciences, arts, and medicine. This study aims to: establish the relationship between attitudes towards Mathematics and mathematics performance among Form three students in the Southeast sub-region. The study employed a correlational research design. The study's targeted population of 1320 form three students in 8 junior secondary schools in the Southeast sub-region, Botswana. The research population is form three school students. Stratified random sampling techniques was utilized to choose a sample of four (4) schools and a sample size of 384 students, Simple random sampling was used to sample 200 girls and 184 boys. Affective, Behavioral, Cognitive (ABC) Model; guided the study. A Questionnaire was adapted as data collection instruments. Examination records served as a tool for measuring students' mathematics performance. One school was the site of a pilot study, which was not part of the study, using a sample of 40 students (20 girls and 20 boys) to evaluate the accuracy and dependability of the research tools. The study employed both descriptive and inferential statistical procedures for data analysis. The descriptive statistics involved percentages, frequencies, and tabulations, while inferential statistics involved Pearson Product Moment correlation coefficient. The study hypotheses were tested at $\alpha = .05$. Results from the analysis revealed that attitudes towards mathematics had positive significant relationship with mathematics performance (r (374) = 0.33, $p < .05$). The findings were expected to the expansion of knowledge in Mathematics education and other research fields.

Keywords: Attitudes, Mathematics, Performance, Relationship

INTRODUCTION

Mathematics is one of the most important and fascinating sciences in the world (Oracion et al., 2021). Achieving mathematical proficiency is crucial for several outcomes linked to higher education, careers, and the nation's larger economy. According to Mwangi (2021), mathematics is meant to give students the skills they need to succeed in technology, commerce, science, and industry. Despite the high value attached to mathematics education in this technological era, performance in Mathematics remains significantly low in

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most countries around the globe. Globally there have been concerns about mathematics performance. Program for International Students Assessment (PISA), which is a program that evaluates 15-year-old students, assesses how well they can use their knowledge and skills in reading, mathematics, and science to solve issues in the real world. This program is run by the Organization for Economic Cooperation and Development (OECD). The OECD average for PISA 2018 was 489 and most countries' scores in mathematics fell short of the PISA technical requirements (Schleicher, 2019).

The issue of low mathematics performance has been a concern in the United Kingdom. Students in England take high-stakes mathematical tests, including the Standard Assessment Test (SAT) at age 10 or 11 and the General Certificate of Secondary Education (GCSE) at age 15 or 16. SATS results are frequently used to place learners when they enter secondary school, but GCSE grades can determine which institution or university a student can attend, demonstrating the high-stakes nature of SATS and GCSE. To avoid having to retake a subject, GCSE students should receive a grade of 4 (formerly a C) in mathematics. The stress brought on by this high-stakes test demotivates students, which may increase the negative attitudes, anxiety, tension, and dropout rate, resulting in poor mathematics performance. According to Skipp and Dommett (2021), the UK should build its curriculum on inquiry-based learning, which is linked to the growth of good attitudes towards problem-solving, rather than a broad one because no single topic or concept can be thoroughly examined. On tests of interest and enjoyment in maths, students in countries like Canada, Australia, and the United Kingdom perform below average, according to Wen and Dube (2022), while high mathematical achievement is seen in nations like Finland and Japan as noted by (Maamin et al., 2021).

The Association of South East Asian Nations (ASEAN), which consists of Laos, Myanmar, Cambodia, Singapore, Thailand, Brunei, Indonesia, Malaysia, the Philippines, and Vietnam, is underachieving in mathematics. According to the Maamin et al., (2021) study, several factors, including students, families, teachers, schools, and policymakers, have an impact on how well ASEAN nations perform mathematically. The students' factor is the largest variable in mathematics achievement, the affective characteristics for example attitudes towards mathematics, self-efficacy, willingness to solve mathematics problems, and gender influence mathematics achievement in ASEAN. Gorman (2021) claims that Singapore succeeds well because of its curriculum, which instills in students a thorough grasp of the subject through thoughtfully planned fundamental learning. As students become more adept and self-assured problem solvers, they use graphical models that translate words into easily understood pictures for young minds to help them comprehend the subject matter more deeply.

The West African Examination Council (WAEC) is an examination written by five (5) African countries: Ghana, Liberia, Nigeria, Sierra Leone, and the Gambia. In Ghana, many people have expressed considerable concern about the Senior High School (SHS) students' failure rate, notably in mathematics, as recorded by WAEC each year (Fletcher, 2018). The level of mathematical achievement has not changed significantly despite government attempts. Mathematics achievement levels among SHS students are continuously low (WAEC, 2014, 2015, 2016). Students continue to struggle with mathematics and do poorly on their final examinations. Moreover, half of the students who took the test during the 5 years (2013–2017) and were eligible for university entrance were unable to score a C6 or higher in mathematics, according to WAEC (2018) data on SHS students.

The Southern and Eastern Africa Consortium for Monitoring Quality (SAECMEQ) is a network of sixteen Ministries of Education from Southern and Eastern Africa that work to monitor the conditions of schooling and progress made in achieving the education-related target set within the framework of the global Education for All (EFA) and U.N. Sustainable Development Goals (Goal 4). One of the conditions of the consortium is to gather information on the mathematics achievement level of grade 6. Most grade 6 pupils have mathematics competency levels from 2 to 4 in all except three countries, and only a few countries have competency in levels 5 to 8, which is higher (SACMEQ IV, 2017). This posits that most pupils in grade 6

finish their primary with a low level of achievement in mathematics, thus enabling them not to cope with high-level mathematics in junior secondary school.

According to Mabena and colleagues, in province of Mpumalanga, South Africa believed that students experienced low learner performance due to problems associated with teachers. Among these are the teachers' insufficient experience in the classroom as well as their lack of pedagogical content understanding and teaching abilities in mathematics. It is hypothesized that teacher-related characteristics, such as teachers' excitement, ingenuity, helpful demeanor, in-depth subject matter expertise, and capacity to make mathematics engaging, improve students' favorable views towards the subject.

In 2015, Botswana took part in Trends in International Mathematics and Science Study (TIMSS), a global assessment that allows nations to track how well primary and secondary school students understand concepts and develop attitudes towards mathematics and science. TIMSS tests were graded on a scale from 0 to 1000, with 500 serving as the scale's midpoint. Botswana came in third from the bottom out of 39 nations with a mathematics score below average of 390. Baliyan and Khama (2020) found a correlation between the time students spend studying after school and their mathematics proficiency. It was stated that both shorter (low) and longer (high) distances from the school significantly affected students' math performance. In other words, students' math performance is influenced not only by their after-school study habits but also by their commute time. According to Bhusumane and Nkhwalume (2019), various techniques have been used to improve mathematics performance in junior secondary schools, including discussions, hands-on learning, problem-solving activities, investigative work, and the utilization of contemporary technology to place mathematics in a realist context. All these are aimed at improving the teaching of mathematics to improve performance. Despite this, poor performance is prevalent in mathematics in national examinations and international assessments.

A student's attitude toward mathematics can be described as either liking or disliking the subject and tendency to practice or refrain from mathematical activities (Kibrislioglu, 2016). The way one feels about mathematics determines whether one will react favorably or unfavorably to it. Mazana et al. (2019) concluded in their study that students were interested in mathematics and considered it to be enjoyable since they could see how it applied to their daily lives. On the contrary, Chand et al. (2021) noted that the majority of students believed mathematics is a challenging subject, they feared it, had a preference for other subjects, and did not wish to continue studying it in college. Tomperi (2020) expressed that students learn the value of mathematics while taking other classes and Mathematics also helps students get into the upper secondary school they want to attend and influences their decision to pursue a career in a math-related field of study.

Numerous investigations of the variables influencing mathematics performance have been done. The following elements have been linked to this issue: socioeconomic status, instructional strategies, learner aptitude, lack of learning resources, teacher-related variables, classroom management, and lack of parental participation (SACMEQ IV, (2017); Mweni, (2015); Maamin et al. (2021); Ohanyelu (2021) while the psychological factors on students' mathematics performance have received very little attention. There is scanty evidence of empirical research on attitudes towards mathematics. done in Botswana using form three students. The studies focused more on cognitive factors, socio-economic status, and distance from schools (Trends in International Mathematics and Science Studies, 2015; Baliyan & Khama, 2020; Nkhwalume & Bhusumane, 2019). The goal of this research study is to close this gap by identifying the psychological elements that underlie treatments that promote attitudes toward mathematics. Additional studies on attitudes towards mathematical performance are necessary to bridge the gap.

Statement of the problem

Mathematics performance is underachieving in Botswana, the overall analysis of Math performance in

Botswana shows inadequate results over three years. The percentages of Southeast Sub-region candidates who were awarded A to C in Mathematics were 30.9% in 2019, 30.7% in 2020, and 29.9% in 2021 where A to C is credit. (Botswana Examination Council Annual Report, 2021). This continued mathematics underachievement is a concern to educational stakeholders because the loss of skilled personnel hurts the country's economy and stunts its development. The student might miss the chance to continue their study, which may increase youth unemployment. Researchers found that by tackling various barriers to high-quality education in the nation, numerous initiatives have been implemented for all learners. These issues include a shortage of qualified teachers, ineffective teachers, low teacher morale, big classrooms, declining enrollment, student retention, bad attitudes among students, and high dropout rates. The government has provided training for mathematics teachers, adequate classrooms, less number of students per class, and incentives for mathematics teachers, all of these aimed to improve the performance of learners.

Despite the efforts to deal with the issue, mathematics performance remains low. Studying psychological factors that may influence performance is vital, particularly when the nation is dealing with many difficulties, like high unemployment rate and lack of employable skills among graduates. Studying the psychological elements connected to mathematics performance is necessary because mathematics performance depends not only on cognitive factors but also on affective ones like attitudes towards mathematics. Interestingly, not many studies have addressed this psychological variable among Form three students in Botswana. In light of this the current study's objective is to ascertain how attitudes towards mathematics, relate to mathematical performance in the Southeast sub-region, of Botswana.

METHODS

Research design

This study employed the correlational research design with quantitative method. The degree to which two or more variables are significantly correlated within a single population or between the same variables in two populations was assessed using a correlational research design (Kothari, 2019). As a result, this study's design was appropriate given that it aimed to establish how the attitude towards mathematics relate to mathematics performance. Many researchers, including (Moussa, 2022; Mutegi et al., 2021 & Hwang et al., 2021), have successfully employed it.

Research Setting

South East Sub-region of Botswana, one of the sub-regions, was the location of the study. The sub-region was chosen because it still performs below regional average results in Junior Certificate of Education (JCE) mathematics when compared with Gaborone sub-region and Northeast sub-region averages. For the last three years, the sub-region has not been doing well in mathematics (South East Regional Office reports, 2022).

Research Respondents

South East Regional Statistical Office (2024) availed a population of 1320 (686 female and 634 male) form three students from 8 junior secondary schools with a sample size of 384 students from 4 public junior secondary. Students in form three were singled out since it is thought that they've developed attitudes towards mathematics. They have also selected their examinable subjects based on their career goals. They are preparing to take their final examination and they have covered the majority of the content.

Research Instruments

Adapted questionnaires were used to gather information from participants. The questionnaires were divided

into five sections.

Attitudes Towards Mathematics Inventory (ATMI)

The current study modified items from Martha Tapia's Attitudes Towards Mathematics Inventory (1986) which has internal consistency (α = .96). Students were graded on a 5-point Likert scale from "Strongly Disagree" to "Strongly Agree." Total scores ranging between 35 and 175, with scores between 35 and 70 implying a negative level of attitudes toward mathematics and scores between 71 and 139 was moderate, while 140-175 indicated positive attitudes toward mathematics. The administration of the 35-item scale took 20 minutes. Permission to adapt the scale was sought from its author.

Data Gathering Procedure

The researcher conducted visits to the selected schools and obtained consent from the principal to gather data on the mutually agreed upon date and time. The day before the activity to gather data, selected schools were visited. The researcher spoke with mathematics teachers and enlisted their assistance in administering and gathering the filled questionnaires from students. The students were also briefed about research. This was done in the afternoon to avoid interfering with the school schedule. The study instrument were distributed to the participants and the instructions were read to them. They were shown how to tick appropriately for the respondents to answer the predetermined questions. This approach is appropriate since it enables rapid data collection from a large sample (Ouma, 2021). They were given a minimum of 40 (20) minutes to fill out the questionnaire. Students' mathematics results were obtained from the respective form three class teachers.

Ethical Considerations

Participants were briefed about the researcher's plans and a guarantee that their answers would be kept private and that the data they gave would be utilized exclusively in this particular study. A consent form was given to the participants to fill out to affirm that they would participate in the research (Appendix A). The participants were made aware that the form was optional and that they could return it if they do not want to participate.

Data Analysis

Collected data was coded, keyed and scored using the Statistical Package of Social Sciences (SPSS) version 25 for statistical analysis. The data was analyzed using both descriptive and inferential statistics. The following hypothesis were evaluated using the quantitative data at a significance level of 0.05:

H_{01}: There was no significant relationship between attitudes toward mathematics and mathematics performance. (Pearson Product Moment Correlation Coefficient).

RESULTS AND DISCUSSIONS

Descriptive Statistics of Mathematics Performance.

The descriptive statistics of mathematics performance raw scores were obtained and were converted to T-scores to determine the minimum score, maximum score, the range, the mean score, standard deviation and coefficient of skewness. The summaries for the raw and T-scores are given in Table 1.

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Table 1: Descriptive analysis of Mathematics Performance

	N	Range	*Min*	*Max*	*M*	*SD*	*Sk*
Mathematics Performance	376	89.00	.00	89.00	36.29	19.85	.616

1. Note: N = 376; M = Mean; SD = Standard Deviation; Max = Maximum; Min = Minimum; Sk = skewness
2. As shown in Table 4.3, the lowest raw score obtained was .00 while the maximum raw score was 89 and coefficient of skewness was +0.62 indicating that majority of the respondents had low scores in mathematics performance with mean score M=36.30 and standard deviation of SD= 19.85)

Descriptive analysis of attitudes towards mathematics

The first key objective was to establish whether attitudes towards mathematics and mathematics performance are statistically related. Attitudes towards mathematics measure scores were evaluated using a 5-point Likert scale. Descriptive analysis of attitudes towards mathematics was obtained. Table 2 shows the results.

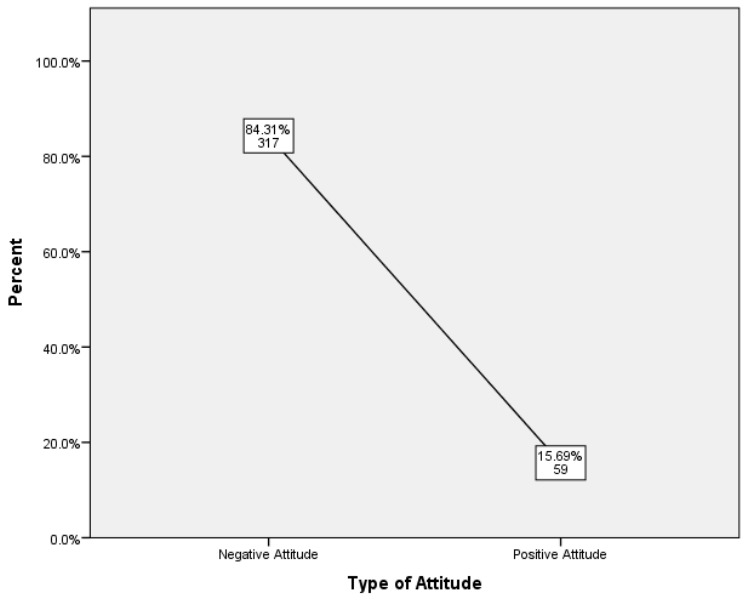
Table 2: Descriptive Analysis of Attitude Towards Mathematics

	N	*Min*	*Max*	*M*	*SD*	*Sk*
Attitude Towards Mathematics Score	376	35.00	168.00	76.10	27.25	1.15

Note. N= 376; M = Mean; SD = Standard Deviation; Max = Maximum; Min = Minimum; Sk = Skewness

The findings in Table 3.2, indicates that a minimum score obtained was 35 while the maximum score was 168. The mean and standard deviation of the scores was *(M* = 76.10, *SD* =27.25*)* and the coefficient of skewness was found to be +1.15. This indicated that the distribution was positively skewed, most students' performance was low on attitude towards mathematics. Figure 1 shows the respondents attitudes towards mathematics.

Figure 1: Respondents Attitude towards Mathematics



Results in *figure 1* shows that majority of the respondents representing 84.31% were categorized as having

negative attitudes towards mathematics. The remaining 15.69% of the respondents was classified as having positive attitudes towards mathematics.

Table 3: Attitude towards Mathematics Mean Score across Levels of Mathematics Performance

Level of Mathematics Performance	*N*	*Min*	*Max*	*M*	*SD*	*Sk*
Low	205	35.00	145.00	73.81	22.97	.94
High	171	39.00	168.00	78.85	31.48	1.09

Note: N= 376

As indicated in Table 3.3, the mean of attitudes towards mathematics scores was calculated across different levels of mathematics performance and the computation results indicated that students participants categorized as having high level of performance in mathematics were found to have a higher mean score in attitude towards mathematics (M = 78.85, SD = 31.48) as compared with the participants in the category of low mathematics performance (M = 73.81, SD = 22.97). The positive coefficient of skewness (.94 and 1.09 respectively) in low and high levels of attitudes towards mathematics, was a further indication that majority of the participants rated themselves low on the scale. This may further attest to the participants' negative emotional responses toward Mathematics.

Hypothesis Testing

The objective of this study was to establish if there exist a relationship between attitudes towards mathematics and students' mathematics performance. To test this hypothesis, Pearson's Product Moment Correlation Coefficient was used in a bivariate correlational analysis of the data.

Having completed preliminary descriptive analysis for both attitudes towards mathematics and mathematics performance scores, and in tandem with the first objective of the study, the following null hypothesis was tested:

H_{01}: There is no significant relationship between attitudes towards mathematics and mathematics performance.

A bivariate analysis was conducted with the Pearson product-moment correlation coefficient to assess the hypothesis; the results are shown in Table 4.

Table 4: Correlation Coefficient between Attitudes and Mathematics Performance Scores

		Mathematics Performance Score	T Scores
Attitudes Towards Mathematics Score	Pearson Correlation	1	.33**
	Sig. (2-tailed)		.00
	N	376	376
**. Correlation is significant at the 0.01 level (2-tailed).			

The hypothesis posited that there exists no significant relationship between mathematical performance and attitudes towards the subject. The findings showed that respondents' attitudes towards mathematics and their performance scores in the subject had a weak positive and significant link (r (374) = 0.33, $p < 0.05$). The findings show a correlation between excellent performance scores in mathematics and having a positive attitude toward the subject. Based on these findings, the alternative hypothesis (Ha1)—that there is a weak correlation between attitudes towards mathematics and mathematical performance—was accepted and the

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null hypothesis (H0) was rejected.

DISCUSSION OF THE RESULTS

The first objective of this study was to determine the relationship between attitudes towards mathematics and students' mathematics performance. The study's findings established a significant positive relationship between attitudes towards mathematics and mathematics performance. The students who exhibits high positive attitudes towards mathematics will get high mathematics performance and the higher negative attitudes towards mathematics the lower mathematics performance.

The present findings are in line with the research conducted by Moussa et al. (2022) on university students in the United Arab Emirates (UAE). Their findings suggest that students who aim for higher education exhibit moderate to high attitudes toward mathematics, indicating a positive correlation between students' attitudes and their mathematical performance.

The results also corroborated with Hwang et al., (2021) in Korea who emphasized the link between mathematical achievement and learners' attitudes toward mathematics. The Pearson correlations between the three attitudes toward mathematics components were found to be significant, ranging from .356 to .699. The correlations between the three attitudes and math achievement ranged from .137 (value in math and math achievement) to .377 (confidence in math and math achievement), and they were all favorably significant. The findings showed that the students with a positive attitudes perform better in math than those who had a negative attitude.

The results analysis using Pearson's r revealed a weak positive and statistically significant relationship between attitudes towards mathematics and mathematics performance ($r(374) = 0.33$, $p<0.05$). This is supported by the earlier findings of Hussain et al. (2020) who conducted a study among secondary school students from two districts of Kasur and Lahore in Punjab, Pakistan, on the association between students' attitudes towards mathematics and achievement in mathematics. Pearson's correlation coefficient showed weak significant relationship between the overall mathematics attitude of respondents and their mathematics achievement ($r = 0.335$, $\alpha = 0.000$). The results demonstrated the importance of students' attitudes towards mathematics in mathematics achievement.

The results is in agreement with Orogo (2022) study in Pasacao District, Philippines who found similar findings on attitudes towards mathematics, and mathematics performance. A total of sample of 966 Grade 10 were sampled. Descriptive Pearson correlation between attitudes towards mathematics and mathematics performance was 0.33 which was significant. Similarly in Kenya, Mutegi et al. (2021) conducted a study on secondary school learners' attitudes towards mathematics and mathematical performance. There was a link between mathematical attitude and performance. Therefore, regardless of the cross-cultural differences in these studies, Student's attitudes towards mathematics and mathematics performance have been revealed to be positively and significantly related. The results from these studies imply that attitudes towards mathematics is not only relevant to students in the western countries, Asian countries, or Middle East but also in African settings and developing country like Botswana.

CONCLUSION AND RECOMMENDATIONS

The findings showed that respondents' attitudes towards mathematics and their performance scores in the subject had a positive and significant link ($r(374) = 0.33$, $p = 0.00$). The results led to the rejection of the initial null hypothesis. Performance in mathematics and attitudes towards mathematics were positively and significantly correlated. High scores in attitude towards mathematics are associated with high scores in mathematics performance. Majority of respondents representing 84.31% were classified as having negative

attitudes towards mathematics. The remaining 15.69% of the respondents was classified as having positive attitudes towards mathematics. This implies that most learners had negative attitudes towards mathematics.

There is a need for education stakeholders to come up with guidelines on how to improve the students' attitudes towards mathematics to help them improve on their mathematics performance. These guidelines should be incorporated into the learning content of the students.

1. There is a need for the parents, teachers, and other education stakeholders to work together and come up with guidance programs to help the students acquire positive attitudes towards mathematics, understand that their academic performance in mathematics solely depends on their individual input.
2. To boost students' attitude towards mathematics, teachers should employ a variety of instructional strategies to ensure that students fully grasp mathematical ideas. Teachers should use innovative teaching strategies, including presenting maths lectures using audiovisuals, to keep students interested and help them understand the material better. This will help the students develop a more positive attitude towards.
3. Having established that attitudes towards mathematics, and mathematics performance are significantly correlated in Southeast sub-region, further studies should be done in other regions to confirm these findings to enhance generalization.
4. The study involved secondary school students and therefore, in order to improve the generalizability of the findings, more study including elementary school children and college students is required.

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