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Predicting Mathematics Achievement: The Role of Emotional Intelligence and the Academic Self-Concept

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Abstract: The longitudinal analysis of student performance in mathematics has consistently demonstrated a pattern of discouraging trends. This necessitated the examination of the student's emotional intelligence along with their academic self-concept so as to determine how much they

predict achievement in mathematics. In order to investigate the relationship between emotional intelligence, academic self-concept, and mathematics achievement in SSI students, a correlational research design was employed. The study population consisted of 2084 SSI students. Through a multi-stage sampling technique, a sample of 330 students was selected for participation in the study. The data was collected using the Emotional Intelligence Questionnaire (EIQ), Academic Self-Concept Questionnaire (ASCQ), and Mathematics Achievement Test (MAT). These instruments were validated and trial tested to ensure their trustworthiness. Research questions 1 and 2 were addressed through linear regression analysis, while research question 3 was tackled using multiple regression. The hypotheses were all evaluated using ANOVA. The result showed that the proportion of students' academic achievement that can be attributed to emotional intelligence was low (4.1%), while that of academic self-concept was found to be moderate (11.8%). These variables jointly accounted for 7% of the achievements of the students in mathematics. Emotional intelligence and the academic self-concept were found to be significant to the students' mathematics achievement. Based on these findings, curriculum planners should prioritise a holistic approach to education that emphasises the integration of social and emotional development alongside academic skills. Some of the responses provided by the participants may have been presented in a way that is socially acceptable rather than truthfully. The teachers were recommended to encourage project-based learning or problem-solving activities that allow students to apply mathematical concepts to solve practical problems, fostering a sense of accomplishment and boosting self-concept. An open line of communication should also be established among teachers, students, and parents, allowing for the discussion of emotional challenges and academic progress.

Keywords: Achievement, emotional intelligence, mathematics, predictors, self-concept.

Introduction

Mathematics is a pivotal subject offered in both primary and secondary schools in Nigeria. This subject focuses on logical reasoning and quantitative calculations, thereby shaping various fields of human endeavour (Ugwuanyi et al., 2023). A success in mathematics enhances the overall quality of one's academic certificate (Hashim et al., 2021). For instance, obtaining a credit in mathematics is often a requirement for gaining admission to most tertiary-level courses. This recognition has resulted in the incorporation of mathematics as a fundamental subject in the primary and secondary schools' curriculum in Nigeria. Federal Government of Nigeria is playing a crucial role in determining an individual's academic achievements (Federal Republic of Nigeria, 2013).

Academic achievement is defined as a student's successful completion of academic tasks and objectives once the teaching and learning activities have been completed (Okeke et al., 2022). This can be seen as the outcome of effectively completing school assignments or programs, as well as the degree to which educational stakeholders have realised their educational objectives. Furthermore, Onukwufor and Ugwu (2017) defined academic achievement as a measure reflecting the level of accomplishment a student has reached following the teaching and learning process, essentially serving as an indicator of the effectiveness of the learning experience. In light of these

assertions, academic achievement in mathematics can be seen as the extent of a student's learning outcomes in mathematics throughout the learning journey. Nevertheless, it is worth noting that students placed in identical academic situations can vary in their academic achievements.

Research Problem

Reports on students' academic achievement in mathematics paint a very dismal picture. The available data over a 5-year period (2010–2015) revealed that only a mean value of 37.02% of the students who registered for the exams failed to achieve a credit pass in mathematics (Onyeka & Arokoyu, 2018). This figure rose to 45.08%, spanning over 10 years, 2010–2020 (Aneshie-Otakpa, 2023). Despite the slight improvement, these statistics are still worrying and have caused anxiety among teachers, students, curriculum planners, and researchers. Perhaps the low performance in mathematics could be attributed to factors such as fatigue and stress. A survey by Sharaj et al. (2016) indicated that insufficient break periods, peer pressure, inadequate infrastructure, and travel distance are some of the factors that affect students' active participation during classes. Chen and Qin (2023) also identified fatigue as a significant cause of student's poor academic achievement. Available data from the study also revealed that severe fatigue even led to poorer academic achievement by the students. A similar case of fatigue was also reported to be a challenge among the students in the Aguata Education Zone, which is the area of this study. Most students in this education zone have to deal with the everyday struggle of trying to complete their academic work while dealing with the severe emotional strain brought on by a long walk to school (Nnadi et al., 2016). These emotional strains could affect the students, as mathematics requires a lot of attention and concentration. The students' ability to stay focused despite the emotional strain might depend on their emotional intelligence and academic self-concept (Gkintoni et al., 2023; Liu et al., 2023).

The existing literature on emotional intelligence, academic self-concept, and academic achievement highlights both similarities and differences. While some studies have explored physical and social self-concepts, this study specifically focuses on academic self-concept. Additionally, most of the research in this field has been conducted in areas other than mathematics and none have been carried out in the Aguata Education zone of Anambra state. It is also noted that the majority of studies have not examined the combined impact of these variables. Furthermore, there are inconsistencies in the findings of researchers regarding the relationship between emotional intelligence and academic self-concept. While some previous researchers found a significant relationship among the variables of emotional intelligence, academic self-concept and academic achievement in mathematics, other researchers found no significant relationship. Against this background, the current study aimed to investigate the extent to which differences in students' performance in mathematics can be explained by emotional intelligence and academic self-concept.

Research Focus

Emotional intelligence, as described by Kurdi and Hamdy (2020), pertains to one who is able to understand and positively express their own emotions while also empathising with the feelings of others. It also includes the ability to motivate oneself to achieve goals. Mattingly and Kraiger (2019) argue that emotional intelligence involves the ability to address deviant behaviour by means of self-

awareness and self-motivation. It also involves the regulation of emotional and social competencies and the transformation of emotional energy into a positive force. Research by Maguire et al. (2017) demonstrated that students with high emotional intelligence tend to excel in tasks involving emotions, while those with lower emotional intelligence skills struggle in such tasks. Academic self-concept on the other hand is characterized as the collection of distinct attitudes, emotions, and perspectives related to one's intellectual or educational abilities (Hansen & Henderson, 2019). This often signifies an individual's self-confidence and self-perceptions within an academic context. When students attain success in their educational endeavours, their academic self-concept becomes more robust, and as this self-concept strengthens, it bolsters student motivation, determination, and academic accomplishments (Areepattamannil et al., 2023). Literature on these variables in relation to the academic achievement of the students has been contradictory, which necessitated this present research to ascertain the predictive powers of the variables.

Research Aim and Questions

The objective of this study was to determine the predicting powers of the emotional intelligence and the academic self-concept of the achievement of the students in mathematics. Specifically, the study examined:

1. What proportion of students' achievement in mathematics is predicted by emotional intelligence?
2. What proportion of students' achievement in mathematics is predicted by academic self-concept?
3. What proportion of students' achievement in mathematics can be jointly predicted by emotional intelligence and academic self-concept?

Hypotheses

Tested at 0.05 level of significance

HO₁: Emotional intelligence has no significant predictive power on students' academic achievement.

HO₂: Academic self-concept has no significant predictive power on students' academic achievement.

HO₃: Emotional intelligence and academic self-concept jointly have no significant predictive power on students' academic achievement.

Literature Review

The consistent low performance of students in mathematics over the years is a pressing issue that concerns everyone involved in education. In order to address this issue effectively, a mere improvement of conventional teaching methods may not be sufficient. It is crucial to delve deeper

into the psychological and emotional well-being of students, as research has shown that these aspects play a significant role in their ability to learn mathematics (Schukajlow et al., 2023). By fostering emotional intelligence and strong academic self-concept, educators can build a supportive learning environment that promotes students' mathematical abilities. This is because teachers play important roles on student's creativity in mathematics related concepts (Metu et al. 2023). Therefore, it is essential to review literatures so as to understand existing research, identify the gaps and provide the foundations for improving the achievement of the students in mathematics through emotional intelligence and academic self-concept.

An investigation by Ghosh and Paul (2022) into the connection between emotional intelligence and school-related activities in Sundarban areas of India discovered a strong correlation and a strong predictor between the two. A similar study by Zhou et al. (2024) also revealed a considerable association between the variables. Alipour et al. (2024), Amponsah et al. (2024), Tariq et al. (2020), and Ugwu and Agwagah (2024) all corroborated these findings, stating that emotional intelligence is an important component of academic performance. However, Getahun Abera (2023) refuted these findings, stating that there is no meaningful connection between emotional intelligence and student accomplishment. In a recent study conducted by Chang and Tsai (2022) on the emotional intelligence of Shanghai students, it was revealed that there was no direct correlation between their emotional intelligence and academic performance. The conflicting findings from previous studies highlight the need for more research to determine the extent to which emotional intelligence influences students' success in mathematics. If a significant relationship is established, enhancing emotional intelligence could potentially boost students' confidence levels and foster a more positive academic self-perception.

In the reports of Ajmal and Rafique (2018), Jaiswal and Choudhuri (2017), Kania and Juandi (2023), Ustun (2023), and Verhofste et al. (2024), a significant positive relationship was found involving academic self-concept and achievement. While Laryea et al. (2014) discovered that students' self-concept is evaluated favourably by students, the available data in the study also shows that self-concept directly does not predict a student's academic success. More so, a study by Basith (2021) revealed that academic self-concept has no direct effect on a student's success in academic activities. It will only do so if students are willing to put in some effort to learn what has been taught during their private studies. With the disparity found between the various literatures, additional investigation was necessitated so as to determine the amount of variation in student's academic achievement that may be attributed to their academic self-concept.

Research Methodology

Design

The correlational research design was used for this investigation. According to Seeram (2019), this kind of design was used to help anticipate and explain the link between variables. This approach was chosen as they determined a proportion of students' mathematical achievement that is

attributable to emotional intelligence and academic self-concept. Similar investigations by Ahmad et al. (2024), Ani (2022), and Azhani et al. (2024), and used the same design.

Sample

The study's population comprised of 2084 SSI students from Anambra State's Aguata Education Zone. The study had 330 participants, representing 15.83% of the total population, drawn using the multistage sampling procedure. Cohen et al. (2018) guideline for determining a sample size of a finite population was used.

Instrument and Procedures

The 'Emotional Intelligence Questionnaire (EIQ), Academic Self-Concept Questionnaire (ASCQ), and Mathematics Achievement Test (MAT)' were used to collect the needed data for this study. The Emotional Intelligence Questionnaire (EIQ) was used in order to obtain information on the students' emotional intelligence, while the Academic Self-Concept Questionnaire (ASCQ) was used to collect information on the academic self-concept. Both the EIQ and the ASCQ have 17 items, each constructed on a four-point Likert-style scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The scale has response options of 4, 3, 2, and 1, respectively. The Mathematics Achievement Test (MAT) was made up of 40 multiple-choice questions with 4 response alternatives for each item, with only one considered the correct response and the other options as distractions. The test was built following a test blueprint.

Four experts - two from the University of Nigeria, Nsukka's Educational Psychology Unit, the Department of Educational Foundations, the Measurement and Evaluation Unit, and the Department of Science Education - face validated the 3 instruments (EIQ, ASCQ, and MAT). MAT underwent content validation, while EIQ and ASCQ underwent further construct validation. This progress was undertaken to ensure that these tools accurately measure their intended constructs. After a trial test with 30 students, the reliability indices for EIQ and ASCQ were found to be 0.79 and 0.84, respectively, using the Cronbach alpha method. The MAT had a computed index of 0.80 using the KR-20 calculation.

Data Analysis

The researchers were assisted by 2 research assistants in distributing the instruments to the participants in the schools that were sampled. The instruments were quickly handed out and collected. Simple linear regression was used to address research questions 1 and 2, whereas multiple regression was employed to address research question 3. ANOVA was used to test the hypotheses at a significance level of 0.05. Nworgu's (2015) guide served as the foundation for the correlation coefficient interpretation. Correlation coefficients falling between 0.00-0.30, 0.31-0.70, and 0.71-1.00 were classified as low, moderate, and high, respectively, according to the guidelines.

Results

Table 1

Emotional Intelligence & Academic Self-Concept Predicting Academic Achievement in Mathematics

Model	N	R	R²
Emotional Intelligence	330	.203	.041
Academic Self-concept	330	.344	.118
Emotional Intelligence & Academic Self-concept	330	.264	.070

Note. Predictors: (Constant), Emotional Intelligence, Academic self-concept.

Table 1 depicts the number of students' mathematical achievement that can be ascribed to emotional intelligence. The resulting correlation coefficient (R) of the regression analysis is 0.203, with $R^2 = 0.041$. This shows that there was a weak positive link between emotional intelligence and academic achievement as emotional intelligence accounted for only 4.1% of the diversity in students' mathematical achievement. Table 1 also shows a correlation coefficient (R) of 0.344 for the prediction of academic self-concept on students' academic achievement in mathematics, indicating moderately positive relationship. A coefficient of determination (R^2) of 0.118 obtained means that 11.8% of students' achievement in mathematics is predicted by their academic self-concept. The result, as presented also in Table 1, on the combined prediction of emotional intelligence and academic self-concept of the achievement of the students in mathematics revealed $R = 0.264$ and $R^2 = 0.070$, thereby indicating a low positive relationship as these variables jointly predicted 7% of the achievement of the students in mathematics.

Table 2

ANOVA Result of Emotional Intelligence Predicting Students' Achievement

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	30.108	1	30.108	14.047	.000 ^b
	Residual	703.002	328	2.143		
	Total	733.110	329			

Note. $p < 0.05$

The analysis of data in Table 2 on the significance of the prediction of emotional intelligence on students' academic achievement in mathematics shows that $F = 14.047$ and $p = 0.000$. Since 0.000 is less than the level of significance of 0.05, H_{O1} is rejected. Hence, emotional intelligence significantly predicts students' achievement in mathematics.

Table 3

ANOVA result of academic self-concept predicting students' achievement

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	417.729	1	417.729	434.443	.000 ^b
	Residual	315.381	328	.962		
	Total	733.110	329			

Note. $p < 0.05$

The analysis of the data in Table 3 on the significance of the prediction of academic self-concept on academic achievement in mathematics shows that $F = 434.443$ and $p = 0.000$. Since 0.000 is less than the level of significance of 0.05, H_{O2} is rejected. Hence, academic self-concept significantly predicts students' achievement in Mathematics.

Table 4

ANOVA Result of Emotional Intelligence, Academic Self-Concept and Achievement

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	423.665	2	211.833	223.850	.000 ^b
	Residual	309.445	327	.946		
	Total	733.110	329			

Note. $p < 0.05$

The examination of the data in Table 4 regarding the impact of emotional intelligence and academic self-concept on student achievement in mathematics demonstrates a significant joint prediction with an F-value of 223.850 and a p-value of 0.000. As the p-value is lower than the set significance level of 0.05, H_{O3} is declined, indicating a noteworthy joint prediction.

Discussion

This study found that emotional intelligence accounts for 4.1% of learner's academic proficiency in mathematics. As a result of emotional intelligence, students can effectively regulate their emotions, leading to increased concentration and communication in their academic endeavours. Research has demonstrated that emotional intelligence is a key factor in predicting students' success in mathematical achievement. This result agrees with those of Ugwu and Agwagah (2024), who found that emotional intelligence is associated with and predicts academic achievement. These results are consistent with those of Amponsah et al. (2024), who discovered a substantial association between the variables. The test of H_{O1} revealed a significant relationship between emotional intelligence and achievement in mathematics, thus in agreement with Pranata et al. (2023). Based on these results, it is possible to argue that emotional intelligence acts as a mediating factor between other factors and mathematical achievement, affecting how students

approach their studies, manage stress, or interact with peers and teachers—all of which have an impact on mathematical achievement.

The study's findings also demonstrated the critical impact that the academic self-concept plays in the comprehension of the material being taught in the classroom, as it predicts 11.8% of the mathematics achievement of the students. Academic accomplishment will be improved by a person's view of and confidence in their academic ability. The result of the HO₂ revealed a significant relationship exists between these variables. These results agree with Jaiswal and Choudhuri (2017) and Ustun (2023), who found a positive relationship between academic achievement and the variables of academic self-concept. This supports the findings of Verhofste et al. (2024), who discovered a good link between students' academic success and their self-concept. As a result, the findings are consistent with a holistic approach to education, which recognizes the importance of a student's perceptions and beliefs for their academic achievement. This supports the notion that education should nurture the whole person in addition to transferring knowledge.

Further results demonstrated that academic self-concept and emotional intelligence together explain 7% of students' mathematical achievement. The HO₃ test also indicated a notable correlation. This implies that academic achievement in mathematics is likely to improve along with improvements on how students control emotions and perceive themselves. The study's findings also demonstrated how important it is to forecast students' progress in mathematics based on both academic self-concept and emotional intelligence. While academic success has traditionally been associated with cognitive abilities, recent research suggests that emotional intelligence and self-concept play a crucial role in determining achievement levels. The results of Maciver and Kebbi (2018), who found that a large portion of the variance in students' academic performance could be explained by the linear combination of emotional intelligence and self-concept, support this finding.

Some of the responses provided by the participants may have been presented in a way that is socially acceptable rather than truthfully. This may have affected the result of the study. The researchers also made use of the available funds. Access to more funds will lead to increased population and sample size. The time spent with the respondents in some schools was limited as the management only gave approved a little time. Adequate time would have given the respondents enough time to respond to the items properly.

Conclusions and Implications

The students' achievement in mathematics is significantly predicted by both academic self-concept and emotional intelligence, both independently and jointly. Based on this finding, it was determined that students who have strong emotional self-regulation skills, both for themselves and others, are more likely to succeed in math-related activities. This is because they can communicate effectively and clearly, unlike those who struggle with emotional challenges. To support students in their math learning, it is crucial to address academic self-perception and emotional intelligence in educational settings. This calls for a more comprehensive approach to understanding and fostering academic success. Through a project-based learning and problem-solving exercises promoted by

the teacher, students can use mathematical ideas to address real-world issues which will give them a sense of achievement to improve their perception of themselves. So, this study recommends trainings and workshops for teachers and school administrators, on ways to help students get through emotional difficulties. It is vital to include regular training sessions or workshops in the mathematics curriculum to foster emotional intelligence, empathy, and interpersonal skills among students. To increase children's self-concept and motivation in mathematics, educators and parents should recognize and applaud academic accomplishments as well as personal development. The implications of this study are that teachers can utilise the findings to manage learners with varying levels of emotional intelligence and academic self-concept. Students will also gain insight into how these variables contribute to academic success, particularly in mathematics. Curriculum planners should look towards the holistic approach of education, thereby promoting an integrative method that values social and emotional development with academic abilities

Suggestions for Future Research

1. This study could be replicated using a wider geographical scope so as to make comparison and generalisation of the findings.
2. Other instruments may be used to collect data on these variables so as to ensure consistency of the findings.
3. Future researchers can assess emotional intelligence and academic self-concept variables through surveys, interviews, or self-reflection exercises to track changes and identify areas for improvement among the students.

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Conflict of Interest

None.

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