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EDITORIAL

Journal of Science Education and Research (JSER) is a peer-reviewed published Bimonthly. It aimed at advancing knowledge and professionalism in all aspects of educational research, including but not limited to innovations in science education, educational technology, guidance and counselling psychology, childhood studies and early years, curriculum studies, evaluation, vocational training, planning, policy, pedagogy, human kinetics, health education and so on. JSER publish different types of research outputs including monographs, field articles, brief notes, comments on published articles and book reviews.

We are grateful to the contributors and hope that our readers will enjoy reading these contributions.

Prof. Patrick C. Igbojinwaekwu
Editor-in-Chief

TABLE OF CONTENTS

Self-Concept and Academic Stress As Predictors of Basic Education Students' Test Anxiety in Basic Science in Anambra State Anachuna A. A., Okigbo E. C	1
South Sudan Conflicts: A Critical Analysis of Its Impact on Diaspora Nigerian Settlers Bieni Victor Emenike	14
Artificial Intelligence Integrated Teaching Method on Secondary School Students' Interest and Academic Achievement in Mathematics in Aba Education Zone, Abia State. Njoku, Celestine (Ph.D), Inah, Lovinah Idoko. A (Ph. D), Emeka, Standhope .I (Ph. D)	36
Influence of Secondary School Students' Engagement on Academic Achievement in Mathematics in Anambra State, Nigeria A. T. Nwamaradi, Momalife Divine Nkemakonam	52

**INFLUENCE OF SECONDARY SCHOOL STUDENTS' ENGAGEMENT ON
ACADEMIC ACHIEVEMENT IN MATHEMATICS IN ANAMBRA STATE,
NIGERIA**

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Abstract

This study investigated the influence of secondary school students' engagement on academic achievement in Mathematics in Anambra State, Nigeria, and examined whether gender moderates this relationship. The study was anchored on the Self-Determination Theory and the Theory of Constraints and adopted a correlational research design. The population comprised 20,148 Senior Secondary II (SS II) students in 226 mixed public secondary schools in Anambra State, while a sample of 385 students was selected through proportionate stratified random sampling. Data were collected using the Students' Engagement Questionnaire (SEQ) and students' Mathematics academic achievement scores obtained from school records. The questionnaire was validated by experts in Mathematics Education, Measurement and Evaluation, and Educational Psychology. Cronbach's alpha coefficients of 0.813, 0.784 and 0.783 were obtained for the behavioural, cognitive and emotional engagement subscales respectively. Data were analyzed using mean and standard deviation, independent-samples t-test, multiple regression and hierarchical multiple regression at the 0.05 level of significance. The findings revealed that students demonstrated a moderate level of engagement in Mathematics. Behavioural, cognitive and emotional engagement jointly had a significant influence on academic achievement in Mathematics ($R^2 = .035$, $F(4,380) = 3.459$, $p = .009$). Emotional engagement significantly influenced students' academic achievement ($\beta = .119$, $p = .030$), whereas behavioural and cognitive engagement did not make significant independent contributions. Gender did not significantly moderate the relationship between students' engagement and academic achievement. The study concludes that strengthening students' emotional engagement is essential for improving Mathematics achievement. It recommends that Mathematics teachers adopt learner-centred instructional strategies that promote students' interest, enjoyment and active participation in classroom learning.

Keywords: Student engagement, emotional engagement, mathematics achievement, gender

Introduction

Education remains one of the most effective instruments for individual and national development because it equips learners with the knowledge, skills and values required for productive participation in society. It facilitates intellectual growth, social transformation and economic advancement while preparing individuals to respond effectively to contemporary societal challenges (Federal Republic of Nigeria [FRN], 2014). Within the Nigerian educational system, secondary education occupies a strategic position because it provides the bridge between basic and tertiary education and prepares learners for higher education, employment and lifelong learning.

Among the subjects taught at the secondary school level, Mathematics occupies a central position because of its relevance to science, technology, engineering, business and everyday decision-making. The National Policy on Education recognizes Mathematics as a compulsory subject because competence in Mathematics is fundamental to scientific literacy, technological innovation and national development (FRN, 2014). Consequently, students' achievement in Mathematics has remained an important indicator of educational quality.

Despite its importance, students' achievement in Mathematics in Nigeria has continued to attract concern among educators, parents and policymakers. Reports of public examinations have consistently shown that a substantial proportion of candidates fail to attain the expected level of proficiency in Mathematics. In Anambra State, available examination statistics between 2021 and 2024 indicate fluctuating but persistently high failure rates in Mathematics, suggesting that many students still

experience difficulties in achieving the expected learning outcomes. This trend persists despite several government interventions, including the recruitment of qualified teachers, provision of instructional facilities and curriculum reforms aimed at improving Mathematics education.

Students' academic achievement is influenced by numerous school-related and learner-related factors, among which student engagement has received considerable research attention. Student engagement refers to the quality of students' participation, commitment and involvement in learning activities and is widely regarded as an important determinant of academic success (Fredricks, Blumenfeld, & Paris, 2004). Engaged students demonstrate greater persistence, invest more effort in learning, participate actively during instruction and develop positive attitudes toward academic tasks.

Student engagement is commonly conceptualised as a multidimensional construct comprising behavioural, cognitive and emotional engagement. Behavioural engagement reflects students' participation in classroom activities, attendance, task completion and compliance with school expectations. Cognitive engagement refers to the psychological investment students make in understanding learning tasks, applying effective learning strategies and persisting in solving academic problems. Emotional engagement relates to students' interest, enjoyment, sense of belonging and positive feelings toward learning, teachers and the school environment (Fredricks et al., 2004; Reeve, 2012).

The Self-Determination Theory (SDT) developed by Deci and Ryan (1985, 2000) provides a useful explanation for the relationship between engagement and academic

achievement. The theory posits that students become intrinsically motivated and actively engaged when their psychological needs for autonomy, competence and relatedness are satisfied. When these needs are adequately supported within the classroom, students are more likely to participate actively, regulate their learning and achieve better academic outcomes.

Similarly, the Theory of Constraints (TOC) proposed by Goldratt (1984) argues that every system contains limiting factors that restrict optimal performance. Within Mathematics classrooms, constraints such as overcrowded classes, inadequate instructional resources, mathematics anxiety, limited learner participation and ineffective instructional strategies may reduce students' engagement and consequently hinder academic achievement. Addressing these constraints is therefore essential for improving learning outcomes.

Although previous studies have established positive relationships between student engagement and academic achievement, findings regarding the relative influence of behavioural, cognitive and emotional engagement remain inconsistent. While some studies report that all three dimensions significantly predict academic achievement, others identify emotional engagement as the strongest predictor. Furthermore, evidence regarding the moderating role of gender remains inconclusive, with some studies reporting significant gender differences and others finding no meaningful moderation. These inconsistencies indicate the need for further investigation, particularly within the Nigerian secondary school context.

Statement of the Problem

In Anambra State, several initiatives have been introduced to improve Mathematics achievement, including increased recruitment of qualified teachers, improved curriculum implementation and greater investment in educational resources. Nevertheless, many students continue to record achievement below expectations. This situation raises important questions regarding the extent to which students are genuinely engaged in Mathematics learning and whether the different dimensions of engagement significantly influence academic achievement.

The present study therefore investigated the influence of behavioural, cognitive and emotional engagement on secondary school students' academic achievement in Mathematics in Anambra State, Nigeria, while examining whether gender moderates these relationships. Findings from the study are expected to provide empirical evidence that will assist teachers, school administrators, curriculum planners and policymakers in developing effective strategies for improving Mathematics achievement through enhanced student engagement.

Purpose of the Study

The main purpose of this study was to investigate the influence of secondary school students' engagement on academic achievement in Mathematics in Anambra State, Nigeria. Specifically, the study sought to:

1. Determine the level of students' behavioural, cognitive, emotional and overall engagement in Mathematics;

2. Determine the joint and relative influence of behavioural, cognitive and emotional engagement on students' academic achievement in Mathematics; and
3. Determine whether gender significantly moderates the relationship between students' engagement and academic achievement in Mathematics.

Research Questions

The following research questions guided the study;

1. What are the levels of students' behavioural, cognitive, emotional and overall engagement in Mathematics among secondary school students in Anambra State?
2. What is the joint influence of behavioural, cognitive and emotional engagement on secondary school students' academic achievement in Mathematics?
3. What are the relative influences of behavioural, cognitive and emotional engagement on secondary school students' academic achievement in Mathematics?
4. Does gender significantly moderate the relationship between behavioural, cognitive and emotional engagement and secondary school students' academic achievement in Mathematics?

Hypotheses

The following null hypotheses were tested at the 0.05 level of significance;

1. There is no significant gender difference in students' behavioural, cognitive, emotional and overall engagement in Mathematics.
2. Behavioural, cognitive and emotional engagement do not jointly have a significant influence on secondary school students' academic achievement in Mathematics.
3. Behavioural, cognitive and emotional engagement do not significantly and independently influence secondary school students' academic achievement in Mathematics.
4. Gender does not significantly moderate the relationship between behavioural, cognitive and emotional engagement and secondary school students' academic achievement in Mathematics.

Methods

This study adopted a correlational research design. A correlational design was considered appropriate because the study sought to determine the extent to which students' behavioural, cognitive and emotional engagement predict academic achievement in Mathematics without manipulating any of the study variables. According to Creswell and Creswell (2018), correlational research is suitable for examining the nature and strength of relationships among variables and for determining the predictive influence of one or more independent variables on a dependent variable. The design was therefore appropriate for investigating the influence of students' engagement on academic achievement and examining the moderating role of gender.

The study was conducted in Anambra State, Nigeria. The State is located in the South-East geopolitical zone and is administratively divided into 21 Local Government Areas and six education zones, namely Aguata, Awka, Nnewi, Ogidi, Onitsha and Otuocha. Anambra State has one of the highest school enrolment rates in southeastern Nigeria and places considerable emphasis on secondary education. Despite sustained government interventions—including the recruitment of qualified teachers, provision of instructional facilities and curriculum reforms—students' achievement in Mathematics has remained below expectation in public examinations. Reports of the West African Senior School Certificate Examination (WASSCE) continue to indicate substantial proportions of students who fail to attain credit-level performance in Mathematics. This persistent challenge makes Anambra State an appropriate setting for investigating how students' engagement influences academic achievement in Mathematics (West African Examinations Council [WAEC], 2024; Federal Ministry of Education, 2024).

The population of the study comprised 20,148 Senior Secondary Two (SS II) students (9,980 males and 10,168 females) enrolled in 226 mixed public secondary schools across the six education zones of Anambra State during the 2024/2025 academic session. Senior Secondary II students were selected because they had acquired sufficient exposure to the senior secondary Mathematics curriculum and were not under the pressure associated with external examinations experienced by SS III students. The population figure was obtained from the Planning, Research and Statistics (PRS) Department, Anambra State Post Primary Schools Service Commission (PPSSC), Awka (2024).

A sample of 385 SS II students was selected for the study. The sample size was determined using the Krejcie and Morgan (1970) sample size determination table, which recommends a minimum sample of 377 for a population of approximately 20,000 at the 95% confidence level and 5% margin of error. The researcher increased the sample to 385 to improve representativeness and compensate for possible attrition or incomplete responses, a practice recommended in survey research (Creswell & Creswell, 2018).

A multi-stage sampling procedure was employed. At the first stage, proportionate stratified sampling was used to allocate the sample across the six education zones in proportion to their student populations. At the second stage, simple random sampling (balloting without replacement) was used to select the participating mixed public secondary schools from each education zone. At the third stage, proportionate allocation was used to determine the number of students selected from each participating school based on the school's SS II population. Finally, simple random sampling was used to select the individual students who participated in the study. This procedure ensured that every SS II student had an equal opportunity of being selected while maintaining adequate representation across the education zones.

Two sources of data were used. The first was the Students' Engagement Questionnaire (SEQ) developed by the researchers after an extensive review of literature on student engagement. The questionnaire consisted of two sections. Section A elicited respondents' demographic information, including gender while Section B contained items measuring the three dimensions of students' engagement:

- Behavioural Engagement
- Cognitive Engagement
- Emotional Engagement

The items were measured on a four-point Likert scale of:

Strongly Agree (4)

Agree (3)

Disagree (2)

Strongly Disagree (1)

The second source of data was students' Mathematics Academic Achievement Scores (MAAS) obtained from official school examination records. These scores served as the measure of students' academic achievement in Mathematics.

The Students' Engagement Questionnaire was subjected to face and content validation by three experts from Nnamdi Azikiwe University, Awka. These included one expert in Mathematics Education, one expert in Measurement and Evaluation, and one expert in Educational Psychology. The validators examined the instrument for clarity of language, relevance of items, appropriateness of content coverage and suitability of the items for measuring the intended constructs. Their observations and recommendations guided the modification and improvement of the final version of the questionnaire.

A pilot study was conducted using 50 SS II students from a public secondary school in Awka North Local Government Area, which was not included in the main study. The responses obtained were analysed using Cronbach's Alpha because the questionnaire items were measured on a Likert scale and assessed the internal consistency of the engagement constructs (Field, 2018). The reliability coefficients obtained were:

- Behavioural Engagement = 0.813
- Cognitive Engagement = 0.784
- Emotional Engagement = 0.783

The overall reliability coefficient indicated satisfactory internal consistency, as all coefficients exceeded the minimum acceptable value of 0.70 recommended by Nunnally and Bernstein (1994). The instrument was therefore considered reliable for the study.

The researchers obtained approval from the appropriate school authorities before administering the questionnaire. With the assistance of six trained research assistants, copies of the questionnaire were administered directly to the selected students during school hours. The purpose of the study was explained to the respondents, and they were assured that the information provided would be treated confidentially and used strictly for research purposes. The completed questionnaires were retrieved immediately after completion, resulting in a high response rate. Students' Mathematics achievement scores were subsequently obtained from the official school academic records with the permission of the school authorities.

Mean and standard deviation were used to answer Research Question 1 relating to the level of students' engagement.

Independent-samples *t*-test was used to test Hypothesis 1 on gender differences in students' engagement.

Multiple linear regression analysis was employed to answer Research Questions 2 and 3 and to test Hypotheses 2 and 3 regarding the joint and relative influence of behavioural, cognitive and emotional engagement on students' academic achievement in Mathematics.

Hierarchical multiple regression analysis was used to answer Research Question 4 and test Hypothesis 4 by determining whether gender significantly moderated the relationship between students' engagement and academic achievement in Mathematics.

All hypotheses were tested at the 0.05 level of significance. Decisions were based on the probability (*p*) values such that the null hypothesis was rejected whenever $p < .05$; otherwise, it was not rejected.

Results

Research Question 1: What are the levels of students' behavioural, cognitive, emotional and overall engagement in Mathematics among secondary school students in Anambra State?

Table 1: Mean and Standard Deviation of Students' Engagement in Mathematics (N = 385)

Engagement Dimension	Mean	SD	Decision
Behavioural Engagement	2.93	0.49	Moderate
Cognitive Engagement	2.79	0.48	Moderate
Emotional Engagement	2.92	0.47	Moderate
Overall Engagement	2.88	0.30	Moderate

Criterion Mean: 1.00– 1.49 = Very Low; 1.50– 2.49 = Low; 2.50– 3.49 = Moderate; 3.50– 4.00 = High.

Table 1 shows that students exhibited moderate levels of behavioural (M = 2.93, SD = 0.49), cognitive (M = 2.79, SD = 0.48), and emotional engagement (M = 2.92, SD = 0.47). The overall engagement mean of 2.88 (SD = 0.30). Further indicates that secondary school students in Anambra State were moderately engaged in Mathematics.

H₀₁: There is no significant gender difference in students' behavioural, cognitive, emotional and overall engagement in Mathematics.

Table 2:Independent Samples *t*-test of Gender Difference in Students' Engagement

Variable	Male $\bar{X}$	Female $\bar{X}$	<i>t</i>	<i>p</i>	Decision
Overall Engagement	2.84	2.92	-2.79	.005	Significant
Behavioural Engagement	2.87	2.97	1.94	.053	Not Significant
Cognitive Engagement	2.75	2.92	3.40	.001	Significant
Emotional Engagement	—	—	—	>.05	Not Significant

The independent-samples *t*-test revealed a significant gender difference in overall engagement ($p = .005$) and cognitive engagement ($p = .001$), while no significant gender differences were found in behavioural engagement ($p = .053$) or emotional engagement ($p > .05$). Therefore, the null hypothesis was **partially rejected**.

Research Question 2: What is the joint influence of behavioural, cognitive and emotional engagement on secondary school students' academic achievement in Mathematics?

Table 3: Multiple Regression Analysis of the Joint Influence of Students' Engagement on Academic Achievement

R	R²	Adjusted R²	F	Sig.
.187	.035	.025	3.459	.009*

Dependent Variable: Academic Achievement in Mathematics.

The regression analysis showed that behavioural, cognitive and emotional engagement jointly explained 3.5% of the variation in students' academic achievement in Mathematics ($R^2 = .035$). The regression model was statistically significant ($F(4,380) = 3.459$, $p = .009$), indicating that students' engagement jointly influenced academic achievement.

H₀₂: Behavioural, cognitive and emotional engagement do not jointly have a significant influence on secondary school students' academic achievement in Mathematics.

Since the regression model was statistically significant ($F(4,380) = 3.459$, $p = .009$), the null hypothesis was rejected. Therefore, behavioural, cognitive and emotional engagement jointly had a significant influence on students' academic achievement in Mathematics.

Research Question 3: What are the relative influences of behavioural, cognitive and emotional engagement on secondary school students' academic achievement in Mathematics?

Table 4 : Regression Coefficients for Behavioural, Cognitive and Emotional Engagement

Predictor	B	β	T	Sig.	Decision
Behavioural Engagement	1.271	.036	0.659	.510	Not Significant
Cognitive Engagement	-3.400	-.094	-1.832	.068	Not Significant
Emotional Engagement	4.463	.119	2.174	.030	Significant
Gender	-2.333	-.066	-1.292	.197	Not Significant

The regression coefficients indicate that emotional engagement was the only significant predictor of academic achievement in Mathematics ($\beta = .119$, $t = 2.174$, $p = .030$). Behavioural engagement ($p = .510$) and cognitive engagement ($p = .068$) did not significantly predict students' academic achievement.

H₀₃:Behavioural, cognitive and emotional engagement do not significantly and independently influence secondary school students' academic achievement in Mathematics.

The regression analysis revealed that emotional engagement significantly predicted academic achievement ($p = .030$), whereas behavioural engagement ($p = .510$) and cognitive engagement ($p = .068$) did not. Accordingly, the null hypothesis was rejected for emotional engagement **but** retained for behavioural and cognitive engagement.

Research Question 4: Does gender significantly moderate the relationship between behavioural, cognitive and emotional engagement and secondary school students' academic achievement in Mathematics?

Table 5: Hierarchical Multiple Regression Analysis of the Moderating Influence of Gender

Model	R ²	ΔR ²	F Change	Sig.
Main Effects	.035	.035	3.459	.009
Interaction Effects	.036	.001	0.077	.972

Introducing the interaction terms between gender and the engagement dimensions increased the coefficient of determination from .035 to .036, representing only 0.1% additional explained variance. This increase was not statistically significant ($\Delta R^2 = .001$, F-change = 0.077, $p = .972$). Thus, gender did not significantly moderate the relationship between students' engagement and academic achievement in Mathematics.

H0₄: Gender does not significantly moderate the relationship between behavioural, cognitive and emotional engagement and secondary school students' academic achievement in Mathematics.

The hierarchical multiple regression analysis showed that none of the interaction terms between gender and the engagement dimensions significantly predicted academic achievement (all $p > .05$). Therefore, the null hypothesis was **not rejected**.

Discussion

Level of Students' Engagement in Mathematics

The study found that secondary school students in Anambra State exhibited a moderate level of behavioural, cognitive, emotional and overall engagement in Mathematics. This suggests that although students participate reasonably well in Mathematics learning activities, their engagement has not reached the level required for optimal academic achievement. The finding implies that many students attend lessons, complete assignments and participate in classroom activities but may not consistently invest the deep cognitive effort and emotional commitment necessary for high-level learning.

The finding supports the Self-Determination Theory (SDT) (Deci & Ryan, 1985, 2000), which posits that students become fully engaged when their psychological needs for autonomy, competence and relatedness are satisfied. The moderate engagement observed suggests that these needs are only partially met in Mathematics classrooms. The finding also agrees with the Theory of Constraints (TOC) (Goldratt, 1984), which explains that system performance is limited by existing constraints.

Such constraints may include overcrowded classrooms, limited instructional resources, mathematics anxiety and teacher-centred instructional practices, all of which may reduce students' active engagement in Mathematics.

The finding is consistent with Fredricks et al. (2004), who described student engagement as a multidimensional construct involving behavioural, cognitive and emotional participation in learning. Similarly, Wang and Eccles (2012) reported that students often demonstrate moderate engagement where instructional environments provide only partial academic and emotional support.

Joint and Relative Influence of Students' Engagement on Academic Achievement in Mathematics.

The study revealed that behavioural, cognitive and emotional engagement jointly had a statistically significant influence on students' academic achievement in Mathematics. Although the three engagement dimensions explained only 3.5% of the variation in achievement, the regression model was statistically significant, indicating that students' engagement contributes meaningfully to academic achievement.

More importantly, the analysis showed that emotional engagement was the only significant independent predictor of Mathematics achievement. This finding suggests that students who enjoy Mathematics, feel emotionally connected to classroom activities and maintain positive relationships with teachers are more likely to achieve higher academic outcomes. Emotional attachment appears to motivate persistence, sustained effort and resilience when students encounter difficult mathematical concepts.

The finding lends further support to Self-Determination Theory, which emphasizes that students' intrinsic motivation and emotional attachment to learning significantly influence academic success. Students who perceive Mathematics as interesting and worthwhile are more likely to devote sustained effort to learning, thereby improving their achievement.

The finding agrees with Reeve (2012), who reported that emotionally engaged students exhibit greater persistence, enthusiasm and willingness to overcome learning difficulties. It is also consistent with Fredricks et al. (2004), who argued that emotional engagement forms the motivational foundation upon which behavioural and cognitive engagement are built.

However, behavioural and cognitive engagement did not significantly predict achievement independently. This finding differs from those of some previous studies that reported significant positive effects of behavioural and cognitive engagement on academic achievement. The difference may be attributed to contextual factors such as classroom practices, school environment, learner characteristics and the unique educational setting in which the present study was conducted.

Moderating Influence of Gender on the Relationship between Students' Engagement and Academic Achievement

The study further found that gender did not significantly moderate the relationship between students' engagement and academic achievement in Mathematics. The inclusion of the interaction terms between gender and the three engagement

dimensions produced only a negligible increase in the explained variance and failed to reach statistical significance.

This finding indicates that the influence of engagement on Mathematics achievement operates similarly for both male and female students. Consequently, efforts aimed at improving students' engagement are likely to benefit all learners irrespective of gender.

The finding supports the Self-Determination Theory, which maintains that the psychological needs underlying student engagement are universal rather than gender-specific. It also agrees with Wang and Eccles (2012), who reported that supportive classroom environments enhance engagement and achievement among both male and female students. Similarly, Lam et al. (2012) concluded that differences in students' engagement are influenced more by instructional practices and school climate than by gender.

The implication is that interventions designed to improve Mathematics achievement should focus on strengthening students' engagement generally rather than developing separate engagement strategies for male and female students.

Conclusion

This study investigated the influence of secondary school students' engagement on academic achievement in Mathematics in Anambra State, Nigeria. The findings established that students demonstrated a moderate level of behavioural, cognitive, emotional and overall engagement in Mathematics. Behavioural, cognitive

and emotional engagement jointly exerted a significant influence on academic achievement, although the proportion of explained variance was relatively small. Among the three dimensions, emotional engagement emerged as the only significant independent predictor of Mathematics achievement, highlighting the importance of students' interest, enjoyment and emotional attachment to Mathematics learning. The study further established that gender did not significantly moderate the relationship between students' engagement and academic achievement. It is therefore concluded that improving students' emotional engagement offers a promising strategy for enhancing Mathematics achievement among secondary school students in Anambra State.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Mathematics teachers should adopt learner-centred instructional approaches that stimulate students' interest, enjoyment and active participation in Mathematics lessons in order to strengthen emotional engagement.
2. School administrators should organize regular professional development programmes that equip Mathematics teachers with effective strategies for promoting students' behavioural, cognitive and emotional engagement.
3. Curriculum developers and educational policymakers should incorporate instructional activities that foster positive emotional experiences, collaborative learning and active student participation into the secondary school Mathematics curriculum.

4. Since gender did not significantly moderate the relationship between students' engagement and academic achievement, engagement-enhancing interventions should be implemented for all students regardless of gender.
5. Future researchers should investigate additional learner-related and school-related variables, such as mathematics anxiety, academic motivation, classroom climate and teacher instructional practices, that may explain the larger proportion of variation in students' academic achievement.

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