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Relationship Between ChatGPT-Powered Personalized Instruction and Students' Attitude, Academic Engagement and Achievement in Mathematics

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Abstract

This study investigated the relationship between ChatGPT-powered personalized instruction and students' attitude, academic engagement and achievement in mathematics. The study employed descriptive correlational survey design, and a sample of 270 students. ChatGPT-Powered Personalized Instruction and Mathematics Learning Questionnaire (CPPI-MLQ) and Students' Attitude Towards Mathematics Scale Questionnaire (SATMSQ) were the instrument used for the study. The instrument yielded reliability coefficient indices of 0.76 and 0.79 using Cronbach's Alpha reliability indices. The findings of this study showed that there exist: a medium direct positive relationship between students' attitude and academic achievement in mathematics; a small direct negative relationship between students' attitude and students' academic engagement in mathematics due to students' usage of ChatGPT powered personalized instruction in mathematics. It was recommended among others that government or stakeholders should invest in upgrading school technological infrastructure to support ChatGPT-powered personalized instruction.

Keywords: ChatGPT-Powered App, Engagement, Attitude, Perceived Achievement, Personalized Learning, Correlation, Medium Relationship

Introduction

Mathematics education has been generally observed as a cornerstone for personal and global advancement in the 21st century (Machaba & Khoboli, 2026). It's knowledge application is observed in everything man does for survival. In the field of arts, it is used for measurement, enlargement, symmetry, sequence and the likes (Abugu, 2024); in engineering it is used for measuring of quantities, size (Tang et al., 2022); and in sports, it is used for measuring tracks, space and area. Despite these applications, students' performances in the subject over the years have been low compare to other subjects (WAEC, 2022-2025). The cause of this could be learners' poor utilization of ChatGPT-powered personalized instructions in their mathematics learning. Scholars have suggested learning using open AI apps in classroom instructions (Nja et al, 2024; Egara & Mosimege, 2024). Hence, the need for this study which explores the predictive power of the use of ChatGPT-powered personalized instructions and attitudes on students' academic achievement and engagement in mathematics.

Student academic engagement in mathematics refers to the degree to which students are motivated, interested, and participatory in mathematics learning activities. Students engagement in mathematics is important as it boast mathematics achievement and understanding, encourages critical thinking and problem-solving, develops persistence and resilience in mathematics learning and prepares students for their careers (Abiahu et al., 2021; Ukwueze et al., 2025). Despites various strategies geared towards enhancing academic engagement and achievement in mathematics by fostering the teaching and learning of mathematics in the classroom (Abugu, 2024; Ukwueze, 2024; Ukwueze, 2026), the usage of open AI ChatGPT- powered personalized learning by the learners could be a factor. Thus, this calls for the study to explores the predictive power of the use of ChatGPT-powered personalized instructions and attitudes on students' academic achievement and engagement in mathematics.

Open AI ChatGPT-powered personalized instruction is one of the artificial intelligence-based

systems that has brought in new possibilities for individualized instruction in the classrooms (Nja et al. 2024). It provides step-by-step explanations, adaptive feedback, practice questions, and personalized support that aligned with learners' pace and ability level (Egara & Mosimege, 2024). ChatGPT has made provision for individualized and adaptive learning experiences, on-the-spot feedback and opportunities for personalized-directed learning, that are geared towards specific needs and interests of individual students (Tang et al., 2019; Samad et al., 2022; Nkereuwem, et al 2023). Researchers have noted that the usage of AI powered tools in education have transformed the classroom instructions (Egara & Mosimege, 2024, Nja et al. 2024). Despite its increasing use, limited empirical research exists on the degree of association between the usage of ChatGPT-powered personalized instruction and students' attitudes on mathematics outcomes especially in secondary schools creating a gap in the knowledge. To fill this gap, necessitate the need to determine whether: students' attitude correlate to high students' perceived achievement as a result of an increase exposure to ChatGPT-powered personalized instruction; Students' attitude correlate to high students' engagement as a result of an increase exposure to ChatGPT-powered personalized instruction.

Many scholars blame learners' poor academic engagement and achievement to students' poor attitude and non-utilization of open AI ChatGPT-powered instructional learning by teachers and learners (Emrah et al., 2020; Kimario & Otieno, 2022; Moura & Carvalho, 2024; Nja et al, 2024; Egara & Mosimege, 2024; Ukwueze et al., 2025). From the above studies reviewed, it is evident that there is a lack of research on secondary school mathematics students' knowledge and usage of ChatGPT app in mathematics education, particularly in African countries such as Nigeria. While ChatGPT has been successfully utilized in other fields, including education, its specific application like secondary school students' usage in mathematics learning remains underexplored. This gap in the literature highlights the necessity of exploring the predictive power of ChatGPT-powered personalized instruction and attitude on students' academic achievement and engagement in mathematics.

The purpose of this study was to examine relationship between students' attitude and perceived academic achievement, relationship between students' attitude and students' engagement due to an increase students' exposure to ChatGPT-powered personalized instruction in mathematics.

Research Questions

The study was guided by the following research questions

1. What is the relationship between students' attitude and academic achievement as result of their ChatGPT-powered personalized instruction usage in mathematics?
2. What is the relationship between students' attitude and academic engagement as a result of their ChatGPT-powered personalized instruction usage in mathematics?

Theoretical Framework

Theoretical, this study is framed on constructivist learning theory (CLT) and flow theory (FT) propounded by Dewey in 1933, and Mihaly Csikszentmihalyi in 1975 respectively.

Constructivist Learning Theory: According to this theory knowledge is built on prior existing knowledge: students use what they already know to make connections to new material. This connection is the focus of learning using ChatGPT-powered personalized instruction. When students make these connections, they are learning new material and relating it to what they already know (Dewey, 1933). This theory is based on the tenets that students should: Create mental representation/schemata or frameworks on which to store, link and recall the information; Broadens representation/schema, allowing them to learn more; Allow them to acquire multiple kinds of experiences and information about a subject and link them appropriately to produce a strong base on additional levels of information; Provide multiple representations of reality; Emphasizes knowledge constructions instead of knowledge reproduction; Emphasizes authentic tasks in a meaningful context rather than abstract instruction out of context; Provide learning environments such as real-world settings or case-based learning instead of predetermined sequences of instruction; Encourages thoughtful reflection on experience; Enables context and content-dependent knowledge construction (Institute of Education UNN, 2013). These tenets are the core of personalized instruction using ChatGPT app for learning of mathematics as used in this study. As the students already connect the solutions from their ChatGPT app to their previous known knowledge. As can be seen from this study, where students' behavior is discarded in lieu to their cognitive behavior. The epistemological assumptions of this theory are that Knowledge is physically constructed by learners who are involved in

active mental learning using ChatGPT app; Knowledge is symbolically constructed by learners ideally linking what is displayed by ChatGPT to their internal ideas thereby making their own representations of action; Knowledge is theoretically constructed by learners who try to explain things they do not completely understand (Dewey, 1933). Since, Dewey constructive learning process has assumed that knowledge is constructed from the learners' previous knowledge, and learners are actively involved in the learning process, this helped the researcher in the current study to identify the predictive power of the use of ChatGPT-powered personalized instruction and attitude on students' perceived academic achievement and engagement in mathematics classroom. The fact that students' use ChatGPT app according to their personalized need in learning mathematics linking their learning to their previous existing knowledge and needing clarifications from their teachers makes this theory most needed.

Flow Theory: The flow theory was propounded by Mihaly Csikszentmihalyi in 1975. According to this theory, Flow is a state of complete immersion and involvement in an activity where one's skills and abilities are well-matched to the challenge of the activity. This was observed when students completely depend on the use of technology such as ChatGPT app for mathematics learning sometimes discarding the help from others. Flow occurs when three conditions are met: clear goals, immediate feedback and a balance of skills and challenge. This clear goal is what the independent learner should set before embarking on ChatGPT-powered personalized learning. Flow can be hindered by activities that are too easy since display from ChatGPT app can easily been authenticated by the learners' previous knowledge or too difficult as students tend to be distracted by not having an idea of how the result looks like from their existing schema. According to the flow theory, students become highly inspired and engaged in their learning activity when they have clear goals or objectives to guide their actions, receive immediate feedback about their progress and performance and also balance their skills and challenges. ChatGPT-powered personalized instruction support this by adjusting the students' challenges and the level of learning activities based on learners' predisposition and skill levels. Also, by providing immediate feedback and guidance to learners as they work through learning activities ChatGPT app make learning activities more engaging and more personalized as we have in this study.

Methods

The study adopted a descriptive correlational research design. A correlation study, as noted by Ezeh (2015), seeks to establish what relationship exists between two or more variables. Also, Nworgu (2015) stated that in correlation research, the main interest is to determine whether two or more variables co-vary and if so, to establish the direction, magnitude and forms of the observed relationship. This design is justified, in the fact that exploring the predictive power of ChatGPT-powered personalized instruction and attitude on students' academic achievement and engagement in mathematics, variables are not manipulated, but rather it examines relationships between ChatGPT instruction and attitude on students' achievement and engagement in mathematics, allowing prediction using regression analysis.

The population of this study comprised of 5,229 senior secondary one (SS3) students in Obollo-Afor education zone of Enugu State (PPSMB, Obollo-Afor Education Zone 2025/2026 session). Two hundred and seventy (270) students were selected using multi-stage sampling technique. In stage one, simple random sampling technique with replacement was used to select two Local Government Area (Igbo Eze North and Igbo Eze South) out of the three Local Government Area in Obollo-Afor Education zone. In stage two, purposive sampling technique was used to select only 8 schools from the two L.G.A (five from Igbo Eze North, and three schools in Igbo Eze South). The choice of purposiveness was based on selecting schools that their mathematics teachers have introduced their students to ChtGPT app. Lastly, in stage three, proportionate stratified random sampling technique was used to choose 40% of the total population of SS3 students from the selected schools. Proportionate stratified random sampling method was considered suitable for the study because of the heterogeneous nature of the number of students in the selected schools.

Instrumentation: The instrument for data collection was ChatGPT-Powered Personalized Instruction and Mathematics Learning Questionnaire (CPPI-MLQ) and Students' Attitude Toward Mathematics Scale Questionnaire (SATMSQ). The CPPI-MLQ has 3 sections: Section A: seeking for bio-data information of the respondents, Section B: contains items on Mathematics Academic Engagement Scale (MAES), Section C: contains items on Perceived Impact of ChatGPT on Mathematics Learning (PICML). Students' Attitude Toward Mathematics Scale Questionnaires (SATMSQ) had items on bio-data and attitude scales.

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The questionnaire was administered to the students and their responses on academic engagement and perceived impact were correlated against responses from Students' Attitude Toward Mathematics Scale Questionnaires (SATMSQ).

Both questionnaires had a 4- point likert scale that ranged from Strongly Agreed (SA=4points), Agree (A=3points), Disagreed (D=2points) and Strongly Disagreed (SD=1point). Some of the items were negatively scored.

Validity and reliability: The instrument was face and content validated by three experts in the field of measurement and evaluation, mathematics education. The instrument was trial tested by subjecting them to 40 students in Nsukka education zone and yielded indices of 0.76 and 0.79 using Cronbach's Alpha reliability indices respectively.

Method of data analysis: The collected data were analyzed using Pearson Product Moment Correlation (r): to determine strength and direction of relationships using SPSS version 20. The criteria for judgment was based on the following according to Cohen (1988, pp. 79-81), r = .10 -.29 indicate a small relationship, r =.30 -.49 indicate a medium relationship, while r =.50 -1.0 indicate large relationship.

Ethical Consideration

Ethical permission started with the visit to Post Primary School Management Board (PPSMB) to get approval from the Chief Supervising Principals of Obollo-Afor education zone. On the approval, the researcher got the population documents from the Statistical Planning and Research Unit of the Board. The researcher visited sample schools used for the study to inform principals and gain approval from them. During the visit, the researchers explained to school officials that he is purely for research study. Students consented to participate by agreeing to take part in the study, and were giving the privilege to withdraw their consent when they are no longer interested in filling the questionnaire.

Results

Table 1: Pearson's Product-Moment Correlation Analysis of Students' Attitude and Academic Achievement as a result of ChatGPT-powered personalized instruction usage in mathematics

Variables	N	r	R^2	Sig.(2-tailed)
Attitude Scale	270			
		.356**	.126	.000
Achievement Scale	270			

α= 0.05, r = Pearson Correlation Coefficient, R^2 = Coefficient of determination

To answer this research question, the respondents scores from participant on students' attitude toward mathematics were correlated with the respondents scores from students' perceived academic achievement scale questionnaire. The result in table 1 showed that the correlation coefficient obtained was .356. This means that there exist, a medium direct positive relationship between students' attitude and perceived academic achievement in mathematics. It showed that the coefficient of determination (R^2) associated with the correlation coefficient of .356 was .1267. This coefficient of determination (R^2) indicates that 13% of students' attitude toward mathematics accounted for students' perceived academic achievement in mathematics. This is an indication that 87% of variation in students' attitude is attributed to other factors not studied.

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Table 2: Pearson's Product-Moment Correlation Analysis of Students' attitude and academic engagement as a result of using ChatGPT-powered personalized instruction in mathematics.

Variables	N	r	R^2	Sig.(2-tailed)
Attitude Scale	270			
		-.139*	.019	.022
Engagement Scale	270			

α= 0.05, r = Pearson Correlation Coefficient, R^2 = Coefficient of determination

To answer this research question, the respondents scores from participant on students' attitude in mathematics were correlated with the respondents scores from students' academic engagement questionnaire. The result in table 2 above showed that the correlation coefficient obtained was -.139. This means that there exist, a small direct negative relationship between students' attitude and students' academic engagement in mathematics. It showed that the coefficient of determination (R^2) associated with the correlation coefficient of -.139 was .019. This coefficient of determination (R^2) indicates that 2% of students' attitude toward mathematics was accounted for students' academic engagement in mathematics. This is an indication that 98% of variation in students' attitude toward mathematics was attributed to other factors not studied.

Table 3: Summary of Pearson's Product-Moment Correlation Analysis of Students' academic achievement, engagement and attitude as a result of using ChatGPT-powered personalized instruction in mathematics

Variables	N	r	R^2	Sig.(2-tailed)
Attitude*Achievement	270	.356**	.126	.000
Attitude*Engagement	270	-.139*	.019	.022

α= 0.05, r = Pearson Correlation Coefficient, R^2 = Coefficient of determination

Discussion of the Findings

The result from this study showed that there exist, a medium direct positive relationship between students' attitude and academic achievement in mathematics. Thus, the study adds to the empirical evidence that students' attitude correlates to secondary school students' academic achievement due to students' usage of ChatGPT powered personalized instruction in mathematics. Additionally, the result shows that 13% of students' attitude toward mathematics accounted for students' academic achievement in mathematics as result of ChatGPT usage. This is an indication that 87% of variation in students' attitude is attributed to other factors not studied. The associate null hypothesis was rejected as can be seen from the table one above indicating that there was significant relationship between students' attitude and academic achievement due to students' usage of ChatGPT-powered personalized instruction in mathematics classroom. The strength of the relationship was medium, and this could be that students at the stage of secondary schools are mostly carried away by the display from their smart phones when data are loaded thereby diverting their mind from their original intentions.

The finding is in harmony with the result of study of Ogurlu and Mossholder (2023) who showed that middle school, and elementary school raises concern potential loss of higher-order thinking skills, overreliance on technology, lack of authenticity, decreased content comprehension, fear of the unknown, and concern for social-emotional well-being. Also, the finding is in line with the finding of Chinoso et al. (2023) who revealed that some of the problems of ChatGPT are associated with inaccurate solutions thereby leading to students' misconceptions in learning. The result is at variance with the report of Wardat et al. (2023) who indicated that ChatGPT is acknowledged for enhancing mathematical skills and contributing to educational success by offering users foundational knowledge in mathematics and diverse subjects. However, the findings also highlight ChatGPT's limitations in comprehending mathematics and rectifying misconceptions effectively. The predictions of the instrument vary based on the students' dispositions at the moment of reacting to the

instrument thereby authenticating the tenet of flow theory.

The result from this study showed that there exist, a small direct negative relationship between students' attitude and students' academic engagement in mathematics. This finding adds to the existing empirical evidence that students' attitude correlates to secondary school students' academic engagement due to students' usage of ChatGPT powered personalized instruction in mathematics. Additionally, the result indicates that 2% of students' attitude toward mathematics was accounted for students' academic engagement in mathematics. This is an indication that 98% of variation in students' attitude toward mathematics was attributed to other factors not studied. The associated null hypothesis was rejected indicating that there was significant relationship between students' attitude and academic engagement due to students' usage of ChatCPT-powered personalized instruction in mathematics classroom. The reason for this finding could be that attitude of students decreases their academic engagement in mathematics due to ChatGPT usage, as they are mostly carried away by the technology. This is in harmony, with the study Getenent (2024) who compared pre service teachers (PSTs) and ChatGPT solution using diverse strategies asserted that PSTs solutions did not always align with children's levels of understanding, while, ChatGPT produced incorrect solutions, emphasizing the necessity of contextualizing its performance, especially in primary and secondary school contexts. The study suggests significant room for improvement in AI problem-solving strategies. Also, the finding of Memarian and Doleck (2023) who revealed in their studies that some of the problems of ChatGPT are that the results produced and offered to learners by ChatGPT are not accurate thereby leading to students' misconceptions in learning supports this finding. The finding was at variance with the study of Sánchez-Ruiz et al. (2023) who asserted that students expressed a high level of confidence in the accuracy of ChatGPT's responses, showing a substantial percentage of correct answers compared to numerical solutions.

Given the substantial impact of ChatGPT-powered personalized instruction in mathematics learning outcomes, secondary school students' usage of ChatGPT app do not effectively influence learning outcomes in mathematics classroom as can be seen from the findings of this study. Their stages of life could be a factor in this as most of them are always carried away with pictorial display from the phone when data is on, knowing that ChatGPT usage is data oriented. This study is limited to only one education zone of a state, SS 3 students from two local governments and uses a correlational design. Collection of data from many respondents across many education zone could have made the finding more robust.

Contribution to knowledge: This finding have provided empirical evidence on AI personalization in secondary school mathematics, thereby informing school policy on AI integration, and have provided the baseline data for ChatGPT usage in Nigerian secondary schools

Conclusion

This study had shown that there exist, a medium direct positive relationship between students' attitude and academic achievement in mathematics; there exist, a small direct negative relationship between students' attitude and students' academic engagement in mathematics due to students' usage of ChatGPT powered personalized instruction in mathematics. The study concludes that students' usage of ChatGPT-powered personalized instruction in secondary school level for mathematics learning should be highly monitored by the teacher in classroom instruction. The usage of ChatGPT app can only be effectively used by more mature learners and instructors who can sieve out errors when obtained along the line. Should secondary school students endeavor to use ChatGPT, they should be properly guided by their instructors to make sure that they are using it for what they intended to do at the onset.

Recommendations

Following the limitation of this study, the following recommendations were made.

1. Government should discourage students in using ChatGPT app and encourage hard work among students.
2. Government and other stakeholders should first invest in upgrading school technological infrastructure to support ChatGPT-powered personalized instruction learning under the guidance of their instructors.
3. There should be a policy statement that should be put in place by government to discourage students' usage of ChatGPT-powered personalized learning outside school setting.
4. Promoting and facilitating peer collaboration among mathematics learners should be encouraged in place of ChatGPT app usage for mathematics learning in secondary school.

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