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EDITORIAL

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Prof. Patrick C. Igbojinwaekwu

Editor-in-Chief

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**EFFECT OF PERSONALIZED INSTRUCTIONAL MODEL ON STUDENTS
ACHIEVEMENT IN MATHEMATICS**

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Abstract

The study investigated the effect of personalized Instructional Model on Students achievement in mathematics. The population consists of all SS2 students of the 14 Government owned secondary schools in Owerri Municipal Council of Imo State. A sample of 180 students from 2 co-educational schools selected through purposive sampling technique were used for the study. The objectives of the study informed the formulation of 3 research hypotheses. The study was a quasi-experimental research type adopting the pre-test, posttest non-equivalent control design. The instrument for data collection was a researcher made test titled "Mathematics Achievement Test (MAT)". The instrument had reliability coefficient of 0.81 determined using kuder Richardson 20(KR20) formula. The experiment group was taught using personalized learning model, while the control group was taught using traditional approach. The data generated were analyzed using ANCOVA to test the hypotheses at 0.05 level of significance. The results of the study showed that there was a significant difference ($F(1, 173) = 238.552, P = 0.000 < 0.05$) between the mean achievement scores of students taught mathematics using personalized learning model and those taught using traditional approach. There was no significant difference ($F(1, 173) = 1.598, P = 0.208 > 0.05$) between the mean achievement scores of male and female students taught mathematics using personalized learning model. No significant difference ($F(1, 173) = .224, P = 0.637 > 0.05$) was found between the mean achievement scores of low and high achievers taught mathematics using personalized learning model. Based on the results, it was recommended that mathematics teachers in secondary schools should employ personalized learning model in teaching to improve students' achievement.

Keywords: *Personalized Learning Model, Students achievement, Mathematics*

Introduction

One of the most crucial subjects that supports all other scientific disciplines is mathematics. Students' performance in every other area of their scientific endeavors is determined by their mathematical skills. Mathematics is the universal language that underpins our understanding of the world, from the intricate patterns found in nature to the technological marvels that power our modern lives (Sharma, 2024). The knowledge of mathematics is relevant in entrepreneurship skills development, economic viability, scientific and technological development and global presence of any nation. Mathematics is responsible for developing students' variety of fundamental numeracy skills that are necessary for them to function appropriately in society. Farrajallah (2017) averred that it is the mainstay of all scientific disciplines in school, playing a key part in the rejuvenation of nations and peoples, towards the advancement, expansion and prosperity of past civilizations, as well as the contemporary era. Irrespective of the relevance and importance of mathematics in individual and nations wellbeing, it has continued to suffer high levels of hatred by students and subsequent poor outcomes because of the instructional processes. Obaid cited in Alabi (2020) reported a feeling of dissatisfaction for poor mathematics instruction towards learning, in which mathematics education suffers difficulties in the content, teaching and learning instruction, educational activities, and learning outcomes at all stages of education. Similarly, Owolabi et al (2010) indicated that in spite of the pride of place accorded Mathematics up to tertiary education level, students find themselves struggling to acquire the necessary skills for living and many of them end up with either complete failure or very weak passes in the subject. This has always been blamed on the teachers adopted instructional process in the mathematics classroom.

The instructional process of mathematics has always been centered on the one-size fits-all traditional approach. This approach, which is a teacher-centered approach, has no regards for students learning characteristics as such, results to poor critical thinking abilities and problem-solving. Sharma (2024) stated that traditional teaching methods have been criticized for their limited ability to promote a thorough grasp of mathematical concepts and the development of critical thinking abilities. Rote memorization as a component of traditional instructional process allows students to follow procedures but not apply mathematical knowledge in solving real-world problems creatively. By prioritizing speed and accuracy over deep understanding, traditional methods stifle students' curiosity and problem-solving abilities, creating a generation of students who view mathematics as a chore rather than a

powerful tool for understanding the world. In the same vein Fuchs et al. (2014) found that students exposed solely to traditional methods showed weaker conceptual understanding and application skills over time compared to those engaged in problem-based learning. The 21st century mathematics learning seeks approaches that are student-centered and drive development of creativity, problem-solving, critical thinking and communication skills that will enable individuals' function effectively in today's economic, entrepreneurship and technological vibrant society. This makes it pertinent for adoption of instructional approach that will cater for students' concerns in mathematics learning such as personalized learning model. In support of this, Alabi (2024) indicated that mathematics requires a planned learning instruction that would allow students' active participation in mathematics classroom such as personalization of instruction in mathematics.

Personalized instruction is a learning model that prioritizes students concerns with respect to their interest and needs. It's a pedagogical paradigm shift from the one-size-fits-all to student-centered model with the intent of meeting their specific needs and interest. De Freitas and Yapp cited in Ogwari et al (2020) stated that personalized system of instruction is an approach that customizes learning for each student, tapping on students' goals, interests, needs and abilities in relation to the curriculum. It addresses values and fosters logical thinking skills particularly in science and mathematics. Nahas (2022) see personalized learning as an educational technique that tailor instruction to each individual learner's unique learning needs, strengths, and interests. It is founded on the premise that everyone learns differently and may realize their maximum potential when training is personalized to the individual's specific needs, rather than following a one-size-fits-all strategy. Although a range of teaching techniques, such as educational technology, can be employed in personalized learning, its main goals are to develop customized learning plans and offer experiential learning opportunities. In the words of pane et al. (2017) personalized learning prioritizes a clear understanding of the needs and goals of each individual student and the tailoring of instruction to address the needs and goals. These needs and goals, and progress towards meeting them are highly visible and easily assessable to teachers as well as students and are frequently discussed among them and are updated accordingly. Awofala (2014) listed the heuristics of personalization strategy which differentiate it from the non-personalized one: (i) the personalization strategy is interest oriented; (ii) use personal referent assessment; (iii) use individual prescription; (iv) allow student choice of problem context; (v) provide meaningful contextual information; and (iv) provide a stimulating study guide.

Personalized learning is based on the theory of Piaget (1954) and Vygotsky (1978) which supports that students actively create their own knowledge and comprehension via interaction with their surroundings and personal experience. Instead of merely absorbing knowledge, students in personalized mathematics learning investigate mathematical ideas through cooperative projects, simulations, and real-world situations. They also infer that Personalized learning leverages active engagement with material tailored to the learner's contextual and cultural background. This approach recognizes the heterogeneity of student populations, acknowledging that learners possess diverse strengths, needs, and prior knowledge.

Personalized learning is noted to enhance student's motivation, engagement and direct deep learning. personalized learning has emerged as a potent tool for enhancing learner motivation, engendering increased levels of engagement, and fostering deeper comprehension (Falcão et al.,2018). Personalized learning accommodates different learning styles, demands, and paces, it is essential for aiding students to develop their mathematical skills and promotes a deeper comprehension and engagement with the subject. Every student's potential is maximized, and learning gaps are filled by tailoring their individual traits, which eventually boosts their confidence and mathematical proficiency.

Researches are bound demonstrating the effectiveness of personalized learning on students' achievement in mathematics and science subjects. Owolabi and Aderinto (2010) in their study on effect of personalized system of instruction on senior secondary school students' performance in mathematics, found that the Personalized System of Instruction (PSI) significantly improved senior secondary school students' performance in Mathematics. The study by Putra et al. (2021) demonstrates that the Personalized System of Instruction (PSI) significantly improves students' mathematics learning outcomes, with experimental class gaining higher average mean than the control class, indicating effective instructional impact. The study by Awofala (2014) examining personalization of Instruction, Attitudes toward and Achievement in Mathematics Word Problems among Nigerian Senior Secondary School Students, demonstrated that personalized instruction significantly enhances students' attitudes and achievement in mathematics word problems, with factors like self-confidence and motivation playing crucial roles. The study by Akinsola and Awofala (2009) found significant differences in mathematics achievement between personalized and non-personalized instruction among secondary students, indicating that personalized instruction enhances student performance. Ogwari et al. (2020) in their study on effect of personalized learning on mathematics performance among secondary schools in Awendo Sub-County,

Kenya, concluded that personalized learning can have an influence on achievement in mathematics if proper implementation is done and factors such as resources, manpower, time and methodology are given prime consideration. Romiro (2012) in a study on the effects of personalized instruction on the academic achievement of students in physics, found that students in the experimental group performed better than their counterparts in the control group as evidenced by their post-test mean score. Personalized learning is also noted to support mathematics achievement of students with different learning abilities. Smith and Brown (2020) concluded in a study that personalized learning fosters a supportive environment where all students, regardless of achievement level, can progress at their own pace. Similarly, Cohen and Zheng (2022) in their study concluded that personalized learning not only boosts mathematics achievement but also plays a key role in closing the achievement gap, particularly in high-stakes testing scenarios.

There have been conflicting results over gender achievements in mathematics as recorded by various researchers. For instance, Lu et al. (2023) indicated gender differences in mathematics achievements, revealing that boys outperform girls in math assessments after controlling other skills. Zogheib et al (2015) indicates that female students outperformed male students in mathematics classes, despite being outnumbered. Yohannes and Sukma (2022) in a study indicated no difference in mathematics achievement between male and female students and highlights PBL's effectiveness in improving overall mathematics achievement. This implies that gender achievement in mathematics may be dependent on instructional approach. Geist and King (2008) suggested that personalized learning in mathematics can address gender differences by creating a supportive classroom climate that acknowledges individual learning styles. This approach helps to meet the distinct needs of both boys and girls, improving their confidence and achievement in mathematics.

Statement of the Problem

Despite the numerous reforms and innovations outlined in education, students' achievement in mathematics has continued to nosedive nationally. This has been blamed on the traditional instructional approach adopted by teachers. The approach has failed to address students' diverse learning characteristics. As a result, they struggle to understand mathematical concepts taught leading to poor performance. Personalized learning is noted to offer instructions according to learners' needs, interest and pace which has resulted in enhanced

students' achievement. However, there is no clear evidence of the impact of personalized learning on students' mathematics achievement within the area of the present study.

Therefore, this study investigated the effect of personalized learning on students' mathematics achievement in secondary schools.

Purpose of the study

The main purpose of the study was to investigate the effect of personalized learning on students' achievement in mathematics in secondary schools. Specifically, the study determined whether;

1. Students taught mathematics concept using personalized learning model will have improved achievement than those taught using traditional approach.
2. Male and female students taught mathematical concept using personalized learning model will differ in their achievement.
3. Low and high achievers taught mathematics using personalized learning model will differ in their achievements.

Research Questions

The following research questions guided the study

1. What is the difference between the mean achievement scores of students taught mathematics using personalized learning model and those taught using traditional approach?
2. What is the difference between the mean achievement scores of male and female students taught mathematics using personalized learning model?
3. What is the difference between the mean achievement scores of low and high achieving students taught mathematics using personalized learning model?

Hypotheses

The following hypotheses were formulated to guide the study

H₀₁: There is no significant difference between the mean achievement scores of students taught mathematics using personalized learning model and those taught using traditional approach.

H0₂: There is no significant difference between the mean achievement scores of male and female students taught mathematics using personalized learning model.

H0₃: There is no significant difference between the mean achievement scores of low and high achievers taught mathematics using personalized learning model.

Methods

The study was a quasi-experimental research type adopting the pre-test, post-test non-randomized control design. The population of the study consists of all the senior secondary two (SS2) students of the 14-government owned secondary school in Owerri Municipal Council of Imo State. two co-educational secondary schools were purposively selected for the study. in each of the schools selected, two intact classes were randomly assigned to experiment and control groups. This gave a total of 180 students (83males and 97females), the experiment group consists of 85 students (40males and 45females), while the control group consists of 95 students (43males and 52females) with 71 low achievers and 24 high achievers determined using their pre-test scores. The instrument for data collection was a researcher made 30 items objective test questions title” Mathematics Achievement Test (MAT)” with options ranging from A-D. The construction of the instrument was guided by a table of specification. The validity of the instrument was determined by 2 experts in mathematics education and a measurement and evaluation expert, their expert judgement guided the restructuring of the instrument. The instrument had reliability coefficient of 0.81 determined using Kuder Richardson 20 formula (KR20). Prior to treatment, both groups were pretested to ensure equal cognitive readiness after which, the experiment group was taught geometric concepts by a trained research assistant using a lesson plan detailed according to personalized learning model. The pre-test scores for experiment group were used to determine different levels of achievers such as the low achievers and high achievers. Those who scored 40-50% were classed as low achievers while those who scored 50 and above were classed as high achievers. In the experiment group, students were taught considering their learning needs, interest, learning styles, instructional resources, interactive processes, and application of technologies where necessary. The students were guided through taking control of the learning process. The control groups were taught the same concept by their regular mathematics teacher using the traditional approach which teacher-centered and did not allow for active participation in the entire learning process. The entire process lasted for 3 weeks after which a post-test was administered to both groups and scored over 100percent.

The data generated were analyzed using Analysis of covariance (ANCOVA) tested at 0.05 level of significant.

Results

Research Question 1: What is the difference between the mean achievement scores of students taught mathematics using personalized learning model and those taught using traditional approach?

Table 1: Summary of students’ achievements in experiment and control groups

Group	N	Test	Mean	SD	Mean diff	Diff. in achievements
Experiment	85	Posttest	54.62	9.34	22.41	20.73
		Pretest	32.21	7.46		
Control	95	Posttest	33.36	8.35	1.68	
		Pretest	31.68	8.04		

Table 1 shows that the experiment group had a posttest mean score of 54.62 with standard deviation of 9.34 and a pretest mean score of 32.21 and standard deviation of 7.46. These gave a mean difference of 22.41. The control group had a posttest mean score of 33.36 with standard deviation of 8.35 and a pretest mean score of 31.68 and standard deviation of 8.04. These gave a mean difference of 1.68. This resulted in a difference in mean achievement of 20.73 in favour of the experiment group. This indicates that the improvement observed in the experiment group exceeded that of the control, indicating that the intervention was effective.

Research Question 2: What is the difference between the mean achievement scores of male and female students taught mathematics using personalized learning model?

Table 2: Summary of male and female students’ achievements in experiment group

Gender	N	Test	Mean	SD	Mean diff	Diff. in achievements
Male	40	Posttest	54.88	10.16	22.70	0.34
		Pretest	32.18	7.54		
Female	45	Posttest	54.63	9.34	22.36	
		Pretest	32.27	7.31		

Table 2 shows that male students in experiment group had a posttest mean score of 54.88 with standard deviation of 10.16 and a pretest mean score of 32.18 and standard deviation of 7.54. These gave a mean difference of 22.70. The female students had a posttest mean score of 54.63 with standard deviation of 9.34 and a pretest mean score of 32.27 and standard deviation of 7.31. This resulted in a mean difference of 22.36. This resulted in a difference in mean achievement of 0.34 in favour of male students. This small difference implies that both male and female students benefited almost equally from the intervention.

Research Question 3: What is the difference between the mean achievement scores of low and high achieving students taught mathematics using personalized learning model?

Table 3: Summary of mean scores of low and high achievers in experiment group

Achievers	N	Test	Mean	SD	Mean diff	Diff. in achievements
High	71	Posttest	55.31	10.26	22.99	1.33
		Pretest	32.32	8.56		
Low	24	Posttest	53.91	10.17	21.66	
		Pretest	32.25	8.35		

Table 3 shows that high achievers in experiment group had a posttest mean score of 55.31 with standard deviation of 10.26 and a pretest mean score of 32.32 and standard deviation of 8.56. These gave a mean difference of 22.99. The low achievers had a posttest mean score of 53.91 with standard deviation of 10.17 and a pretest mean score of 32.25 and standard deviation of 8.35. These gave a mean difference of 21.66. This resulted in a difference in mean achievement of 1.33 in favour of the high achievers. This slight difference implies that both high and low achievers benefited similarly from the intervention.

H₀1: There is no significant difference between the mean achievement scores of students taught mathematics using personalized learning model and those taught using traditional approach.

Table 4: Summary of ANCOVA analysis on students' achievement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	20800.941 ^a	6	3466.823	42.349	.000
Intercept	12160.658	1	12160.658	148.550	.000
Pretest	147.220	1	147.220	1.798	.182
Method	19528.407	1	19528.407	238.552	.000
Gender	71.139	1	71.139	.869	.353
Achievers	130.853	1	130.853	1.598	.208
Method * Gender	10.840	1	10.840	.132	.716
Method * Achievers	18.329	1	18.329	.224	.637
Error	14162.170	173	81.862		
Total	371232.000	180			
Corrected Total	34963.111	179			

Table 4 shows that $F(1, 173) = 238.552$, $P = 0.000 < 0.05$. Thus, the null hypothesis is rejected and the alternative accepted. This implies that there is a significant difference between the mean achievement scores of students taught mathematics using personalized learning model and those taught using traditional approach.

H₀₂: There is no significant difference between the mean achievement scores of male and female students taught mathematics using personalized learning model.

Table 4 shows that $F(1, 173) = .869$, $P = 0.353 > 0.05$. Thus, the null hypothesis is upheld and the alternative rejected. This implies that, there is no significant difference between the mean achievement scores of male and female students taught mathematics using personalized learning model.

H₀₃: There is no significant difference between the mean achievement scores of low and high achievers taught mathematics using personalized learning model.

Table 4 shows that $F(1, 173) = 1.598$, $P = 0.208 > 0.05$. Thus, the null hypothesis is upheld and the alternative rejected. This implies that there is no significant difference between the

mean achievement scores of low and high achievers taught mathematics using personalized learning model.

Discussion

The result of the study revealed that personalized learning model is effective in improving students' achievement in mathematics. This was evident in the result which indicated a significant difference between the mean achievement scores of students taught mathematics using personalized learning model and those taught using traditional approach. This result is suspected to be as a result of student-centered nature of the model as it allowed them to learn at their pace, interacted with one another and the teacher, shared ideas, got engaged in the learning process, got access to real-world learning materials resulting in increased motivation and interest. This result is in tandem with reports of Awofala(2014), Salman and Elisha (2021) which variously indicated that personalized learning strategy improved learners' attitude and achievement in mathematics.

The result of the study also revealed that male and female students taught mathematics using personalized instructional approach gained equally as there was no significant difference between their mean achievement scores. This result implied that gender has no effect on students' mathematics achievement when appropriate instructional model is employed in the classroom. The personalized learning model did not allow for any form of gender stereotype as they all learned at their own space without competition. The result supports Turner and Jones (2020) which indicated that personalized learning strategies helps to address gender disparities in mathematics achievement by offering tailored approaches that suit the distinct learning preferences of both genders.

Finally, the study revealed that personalized learning model catered to students with disparities in mathematics achievement. This was evident in their outcomes as there was no significant difference between the mean achievement scores of low and high achievers taught mathematics using personalized learning model. This also indicates that low achievers in experiment group gained as much as higher achievers due to the personalized learning model. This result is in tandem with the report of Cohen and Zheng (2022) which indicated that students in personalized learning environments demonstrated significantly higher performance on standardized math tests, especially low and medium achievers.

Conclusion

The study investigated the effect of personalized learning model on students' achievement in mathematics in secondary schools. Based on the findings of the study, it's concluded that personalized instructional model improves students' achievement in mathematics irrespective of gender and ability levels. The approach encourages deeper engagement, better understanding, and increased achievement by customizing learning experiences to each student's requirements, skills and learning preferences. The approach is convenient for students who struggle in mathematics understanding through the traditional approach of teaching.

Recommendations

Based on the findings of the study, the following recommendations are made

1. Mathematics teachers in secondary schools should employ personalized learning model in teaching to improve students' achievement.
2. Pre-service teachers should be trained to adopt innovative teaching approaches such personalized learning model to cater to students with different learning abilities.
3. Education policy makers and managers should organize workshops, conferences and seminars to train mathematics teachers on student-centered approaches to enhance students' understanding and achievement.

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