



Impact of Hybrid Learning Mode on Students' Achievement in Mathematics in Secondary Schools in Owerri Municipal Council

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Abstract

The study investigated the impact of hybrid learning mode on students' achievement in mathematics in secondary schools in Owerri municipal Council of Imo State Nigeria. Based on the objectives of the study, two research questions and three hypotheses guided the study. Two coeducational schools were purposively selected for the study and a sample of 165 SS2 students from four intact classes were used for the study consisting of 80 males and 85 females. The instrument for data collection was a researcher-made objective test questions titled "Mathematics Achievement Test (MAT)". The instrument had a reliability coefficient of 0.87 determined using the Kuder-Richardson formula 20 (KR20). The experiment group was taught mathematics using hybrid learning mode while the control group was taught using the conventional method. The data generated were analyzed using mean and standard deviation to answer research questions while the hypotheses were tested at 0.05 level of significance using ANCOVA statistical tool. The result of the study revealed that the hybrid learning mode improved students' achievement in mathematics and there was no gender difference in their achievements. Based on the result of the study, it was recommended that Hybrid learning mode should be introduced in teaching and learning mathematics in secondary schools to improve students' achievement.

Keywords: Hybrid Learning Mode, Achievement, Mathematics.

Introduction

Mathematics remains a vital subject in the attainment of scientific and technological development of any nation and the level of students' outcomes in the subject determines the nation's scientific progress. Mathematics is an important subject that not only gives academic qualification but also prepares students for the future; irrespective of whichever career they choose to be part of, as mathematics permeates every aspect of human endeavours such as politics, economy, science and technology (Diovu, Ogbonna & Eze, 2021). Davis and Harsh (2012) allayed that mathematics is a bedrock and indisputable tool for scientific, technological and economic development of any nation. The knowledge of mathematics leads to students' development of reasoning skills, creative ability, abstract or spatial thinking, critical thinking, problem-solving ability, effective communication and collaborative skills.

Mathematics is the fundamental tool required for the achievement of desired goal of education. Unfortunately, this important subject has continuously

become a nightmare and mysteriously difficult for students at all levels of education (Nwoke, Emenyonu & Ihekaire, 2017). This has resulted from teachers' methods of teaching as pointed out by most researchers. Oni (2018) opined that the traditional method such as the lecture method used by teachers has made the learning of the subject difficult thus affecting their performance in both internal and external examinations. Jameel and Ali (2016) observed that the main reason for failure in mathematics is directly related to the development of the curriculum and the ways teachers teach mathematics in the classes. Different teaching approaches, techniques, methods and ways can influence the outcomes in mathematics. Waskitoningtyas (2016) outlines several factors that cause students to experience difficulties in learning mathematics, including low attraction to math, the necessity of memorizing many formulas, a lack of teaching aids, monotonous methods, and a lack of teachers' attention for students with low levels of



understanding. Rachina as cited in Nwoke et al (2017) indicated that teaching Mathematics is not only concerned with the computational know-how of the subject but is also concerned with the selection of the mathematics content and communication leading to its understanding and application. So, in teaching Mathematics there is the need to use teaching methods, strategies and pedagogical resources that are much more fruitful in gaining adequate responses from the students.

The traditional face-to-face method served as the only effective method of teaching and learning before now. However, the 21st century has been flooded with technologies which have penetrated every aspect of life activities including education and learning styles. The education sector has undergone a sea change and completely transformed with the introduction of new technologies and gadgets. There is no longer time for theory and rote learning, as more emphasis is laid on skill development and problem-solving abilities (Itek Group, 2021). Dewi, Herman and Sugiman (2021) suggested that effective mathematics teaching requires a technology-based learning model, not just the lecturing method. They further pointed that, in today's digital era, the majority of high school students are accustomed to utilizing information and communication technology (ICT) in their daily lives, but unfortunately the use of the internet in learning is not yet at an effective level to support learning activities. Technology-enhanced learning plays a pivotal role in helping students acquire 21st-century skills (such as computational thinking, communication, creativity and analytical and collaborative skills) needed in the labour market (Adarkwah, 2022). Technology has brought in a great transformation in the method of teaching and adoption of new technologies in pedagogy has led to a paradigm shift in teaching and learning process especially in science and mathematics. Technology-aided teaching and learning has mainstreamed new concepts, such as Hybrid Learning.

The hybrid learning is a two-way learning model that allows the learner to have a classroom face-to-face and online learning experiences. Jamison, Anette and Jette (2014) defined hybrid learning as a process of acquiring knowledge and skills (learner centered) that is developed with an instructional design that integrates digital (internet and mobile), printed, recorded, and traditional face-to-face class activities in a planned, practical pedagogical way. In the words of Pesen (2014) hybrid learning is an ideal approach for

combining the strongest aspects of classroom and online learning and developing the knowledge and communication skills necessary for success. Hutajulu and Eva (2017) stated that hybrid learning is an approach that seeks to incorporate the best benefits of “old” and “new” teaching methods so that the quality of learning developed is the optimal quality that is better than face-to-face quality or just online learning activities online. The hybrid learning model, allows the learners to choose to physically attend the classes partly or completely or follow them on screen from any location also partly or completely. Hybrid learning seeks to find a balance that ensures the best experience for student needs via any possible learning technique. Musdariah, Basri and Jabu (2021) noted that Hybrid Learning requires the presence of classrooms that encourage innovative, independent, dynamic, and student-centred learning. Students can now learn anywhere and anytime, even on their smartphones and portable computers, rather than relying on classrooms.

Hybrid learning implements synchronous lessons taught simultaneously in-person and online. It is a type of blended learning that focuses more on bridging the physical classroom and virtual learning spaces closer together into a more complete education. Qi and Tian (2011) stated that hybrid learning has four properties introduced, particularly, (1) mix of collective learning and individual learning, (2) mix of synchronous learning and asynchronous learning, (3) a mix of self-paced and group-paced learning, and (4) mix of formal learning and non-formal learning in terms of lifelong learning incorporation and/or setting of learning. Christensen (2015) classified hybrid learning into four models which include; Rotation Model: For each subject, students rotate either on a fixed schedule or at the teacher's discretion among the learning modalities with one of them being online learning. Flex Model: For each subject, online learning becomes important in the learning process and directs students to offline activities. A La Carte Model: Subjects attended by students are fully done online to provide other experiences to students in face-to-face learning. Enriched Virtual Model: Students are required to conduct face-to-face learning sessions with teachers and then be free to complete their remaining subject matter online.

Academic achievement refers to student assessment measured by tests and examinations during the learning process. Merrill in Lin, Tseng and Chiang (2017) mentioned that academic achievement is usually



measured by “achievement tests.” Therefore, this research uses learning performance indicated by achievement test scores as a dimension factor to evaluate learning efficiency.

Hybrid learning is reported to provide a lot of benefits to learners in terms of academic success and educators with regard to lecture delivery. For instance, Martinsen (2017) reported that hybrid learning can improve student engagement and accomplishment, but it is crucial to provide online content that encourages critical thinking, considers students’ learning styles, and allows for flexible teacher intervention to handle technological issues. Dewi et al (2021) noting the contribution of hybrid/blended learning mode in mathematics achievement reported that, the blended learning model is suitable for trigonometric material, where it allows students to learn through face-to-face, practical activities, and online learning. During face-to-face learning, students can discuss the material directly with teachers and peers, and they can practice the material from the media during their practical activities. Students can also study materials at any time in the form of e-books, pdfs, PowerPoints, or videos, and complete online test items in the learning management system. Rudianto, Yuliani and Mega (2019) in their study showed that students’ learning achievement increased significantly using hybrid learning compared to traditional courses in a Mathematics Classroom for Higher Education. Arifin and Herman (2017) pointed out that internet-based learning can enhance students’ mathematical conceptual understanding and learning independence. Cahyono and Asikin (2019) indicated that hybrid learning model has the potential to influence the nature of mathematics education and the concept of mathematics learning. Yullys-Helsa and Dadang (2023) in their study indicated that hybrid learning is an alternative learning system that can be applied by teachers in enhancing students’ understanding of mathematical concepts. Rodrigo and Platon (2021) concluded in their study that hybrid learning proved to have positive impacts on student’s academic performance in the aspects of high thinking skills, integrative learning, and reflective learning. They further suggested that, With proper teacher training, planning, integration of various methodologies and student-centred assessments, and support from university administrators, hybrid learning can successfully equip learners with the skills required of the 21st-century graduates. Musdariah, et al. (2021) reflected that students’ interaction in Hybrid Learning

improves their collaborative skill to work with other students respectively and responsibly in a group work. Students also recognized the importance of hybrid learning in fostering collaborative and high-quality learning experiences. The research also indicated that students perceived that the use of technologies in their learning developed their creativity. Supporting this, Vernadakis et al. (2012) reported that the hybrid or blended learning environment enables students to be more involved in their learning process, thus improving their learning. In addition, hybrid courses provide flexibility in terms of time and location, make courses more accessible and interactive, increase students’ interest and self-exploration, and accommodate students’ varied learning needs. Ezeanyika and Okigbo (2021) in a study found that the students taught using blended learning instructional approach performed better than those in the conventional group because the use of blended learning provided the opportunity to engage the students to learn in different ways and at their pace. Nwoke, et al (2017) in a study found that pre-service teachers taught mathematics using blended e-learning performed better than their counterparts taught using the traditional method.

Gender is a very vital variable concerned with students’ performance in mathematics. Gender is a social construct that distinguishes between male and female. Ezeanyika et al (2021) defined gender as a social phenomenon that defines masculinity and femininity. It depicts the sexual dimension of being either male or female. Gender performance in mathematics has been very dichotomous as no balance has been achieved by researchers. Awofala (2017) allayed that the relation between gender and achievement in mathematics and perhaps algebra also presents a somewhat inconclusive finding. Ojaleye and Awofala (2018) revealed a significant difference in the mean achievement scores of male and female students taught mathematics using blended learning and problem-solving approach. Awodeyi, Apkan and Udo, (2014) argued that male and female could utilize equal opportunities provided by technology-based instruction; blended learning and online learning, and function effectively in learning mathematics. Fabiyi and Binuyo (2023) found that gender has nothing to do with students’ response to the use of any of the instructional strategies i.e. spaced-learning, blended learning and conventional.

Research reports have revealed the overwhelming benefits of hybrid learning mode in improving students understanding and learning outcomes in mathematics against conventional classrooms' face-to-face learning. However, there has not been any accompanying research report on the area within the domain of the study to the researchers' knowledge. Therefore, the present study sort to investigate the impact of the hybrid learning mode on secondary school students' achievement in mathematics.

Purpose of the Study

The major purpose of the present study was to investigate the impact of hybrid learning mode on students' achievement in mathematics in secondary schools. Specifically, the study sort to determine whether:

- 1). Students taught mathematics through hybrid learning mode will differ in achievement when compared with those taught through the conventional approach.
- 2). Male and female students taught mathematics using hybrid learning mode will differ in their achievement.
- 3). There will be any interaction effect between methods of teaching and gender achievement in mathematics.

Research Questions

The following research questions guided the study

- 1). What is the difference between the mean achievement scores of students taught mathematics through hybrid learning mode and conventional method?
- 2). What is the difference between the mean achievement scores of male and female students taught mathematics through hybrid learning mode?

Hypotheses

The following hypotheses were formulated to guide the study

- Ho₁:** There is no significant difference between the mean achievement scores of students taught mathematics through hybrid learning mode and conventional method.
- Ho₂:** There is no significant difference between the mean achievement scores of male and female students taught mathematics using hybrid learning mode.

- Ho₃:** There is no interaction effect between and gender achievement in mathematics.

Methodology

The study was a quasi-experimental research design adopting the pre-test, posttest non-equivalent control type to investigate the impact of hybrid learning mode on students' achievement in mathematics. The population of the study consists of all the 4,044 senior secondary two (SS2) students of the 10 Government-owned secondary schools in Owerri Municipal Council of Imo State. Two coeducational secondary schools were purposively selected for the study. In the schools selected, one was used as experiment group while the other school was used as control group in each of the schools, intact classes were used. These gave a sample size of one hundred and seventy five (175) students consisting of 80 males and 95 females. The experiment group consist of ninety(90) students (42males and 48females) while the control group consist of eighty five (85) students (38males and 47 females). The instrument for data collection was a researcher made 30-item objective test questions titled "Mathematics Achievement Test (MAT)". A table of specifications was used to draw up the questions based on the topics taught to the students. The response options ranged from A-D with one correct answer and three distracters. The instrument was validated by 2 experts in mathematics education and 1 expert in measurement and evaluation. Their expert judgments guided the restructuring of the instrument to meet the objectives of the study. To determine the reliability of the instrument, 25 copies were pilot tested on students with the same characteristics as the study group but outside the selected schools. The result gave a reliability coefficient of 0.87 using the Kuder-Richardson formula 20 (KR20). Two research assistants were trained for two weeks on the application of hybrid learning mode in mathematics teaching and learning. To ensure their cognitive balance, both groups were pre-tested before the instructional treatment.

Treatment

The experiment group was taught trigonometry (trigonometric ratios, Sine and Cosine Rules and their applications) by the research assistant using a detailed hybrid learning mode lesson plan. The students were guided through connection to Zoom and other access links provided before the commencement of the lesson. The process involved the use of online and

conventional teaching methods. The research assistant first taught the students using the conventional method and then allowed them to go and study in their various groups via interaction with online materials under the supervision of the research assistant and the researcher. In the online section, students were open to lesson materials via the internet and they were allowed to partly join the class through Zoom using available technology facilities such as iPhones, Tablets, etc. They were also allowed to continue the class offline at home after the face-to-face learning. They interacted with the teacher who guided them on problem areas. They asked

and answered questions both offline and online. The control group was taught the same concept by their classroom teacher as outlined in the traditional method lesson plan. The entire learning process was restricted around the teacher and the students were passive during the entire process. The process lasted for four weeks after which the posttest was administered to both groups and scored over 100 percent. The data generated were analyzed using mean and standard deviation to answer research questions while, the hypotheses were tested at 0.05 level of significance using Analysis of Covariance(ANCOVA).

Result

Table 1: Summary of students' achievement in experiment and control group

Group	N	Test	Mean	SD	Mean gain	Mean diff
Experiment	80	Pretest	30.25	8.21		
		Posttest	54.91	9.82	24.66	23.07
Control	85	Pretest	31.03	8.15		
		Posttest	32.62	8.28	1.59	

Table 1 shows that the experiment group had a pretest mean score of 30.25 with a standard deviation of 8.21 and a posttest mean score of 54.91 with a standard deviation of 9.82. These gave a mean gain of 24.66. The control group had a pretest mean score of 31.03 with a

standard deviation of 8.15 and a posttest mean score of 32.62 with a standard deviation of 8.28, these gave a mean gain of 1.59. The mean difference between the mean gains of both groups stood at 23.07 in favour of the experiment group.

Table 2: Summary of gender achievements in Experiment group

Gender	N	Test	Mean	SD	Mean Gain	Mean diff
Male	42	Pretest	31.13	7.83		
		Posttest	55.50	10.65	24.37	0.17
Female	38	Pretest	30.09	8.16		
		Posttest	54.29	8.92	24.20	

Table 2 shows that the male participants had a pretest mean score of 31.13 with a standard deviation of 7.83 and a posttest mean score of 55.50 with a standard deviation of 10.65. These gave a mean gain of 24.37. The female participants had a pretest mean score of 30.09 with a standard deviation of 8.16 and a posttest

mean score of 54.29 with a standard deviation of 8.92, these gave a mean gain of 24.20. The mean difference between the mean gains of both male and female participants stood at 24.20 in favour of the male participants.

H₀₁: There is no significant difference between the mean achievement scores of students taught mathematics through hybrid learning mode and conventional method.

Table 3: Summary of ANCOVA analysis

Source	Tests of Between-Subjects Effects					
	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	20900.069 ^a	4	5225.017	64.414	.000	
Intercept	10210.791	1	10210.791	125.879	.000	
Covariate	314.431	1	314.431	3.876	.051	
Method	20358.500	1	20358.500	250.981	.000	Sig
Gender	76.053	1	76.053	.938	.334	N/Sig
Method * Gender	1.231	1	1.231	.015	.902	N/Sig
Error	12978.513	160	81.116			
Total	345187.000	165				
Corrected Total	33878.582	164				

Table 3 shows that, $F(1,160) = 250.981$, $P < 0.05$. Based on the result, 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 through hybrid learning mode and those taught through conventional method.

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

Table 3 shows that, $F(1,160) = .938$, $P > 0.05$. Based on the result, the null hypothesis is upheld and the alternative was rejected. This implies that, there is no significant difference between the mean achievement scores of male and female students taught mathematics using hybrid learning mode.

H₀₃: There is no interaction effect between hybrid learning mode and gender achievement in mathematics. Table 3 shows that, $F(1,160) = .015$, $P > 0.05$. Based on the result, the null hypothesis is upheld and the alternative was rejected. This implies that, there was interaction effect between hybrid learning mode gender achievement in mathematics.

Discussion

The result of study revealed that hybrid learning mode is very effective in improving students' achievement in mathematics. Table 1 showed that, the students taught mathematics using hybrid learning mode had higher mean gain than those taught using the conventional method. Further statistical analysis of the

students' outcome indicated a significant difference between the mean achievement scores of students taught mathematics through hybrid mode and those taught through conventional method. The difference in achievement is favour of the experiment group. This result is in agreement with the report of Ezeanyika and Okigbo(2021) indicating that, students in the blended learning instructional approach group performed better than those in the conventional group because the use of blended learning provided the opportunity to engage the students to learn in different ways and at their pace. It also conforms with that of Dewi, et al (2021) who concluded that the blended learning model, applied in the experimental class, is more effective than the conventional learning model, applied in the control class, in improving students' achievement of mathematical concepts on the subject of trigonometry, and specifically the basic competencies of trigonometric ratios in right triangles and their contextual problems.

The study also revealed that the hybrid learning mode enhanced students' achievement in mathematics across gender. Table 2 showed that Male and female students taught mathematics through hybrid learning mode had improved mean gains with a slight difference in favour of males. However, there was no significant difference between the mean achievement scores of male and female students taught mathematics through hybrid learning mode. This result is in agreement with Nwoke et al (2017) and that of Al-Basheer and Al-Hasanat (2013) which indicated no significant



difference in the achievement of male and female students in a blended e-learning classroom.

The study finally revealed that there was no interaction effect of methods on gender achievements in mathematics. The result is also in agreement with Ezeanyika et al (2021) who showed no significant interaction effect of teaching methods and gender on the achievement of the students.

Conclusion

The study was carried out to investigate the impact of hybrid learning mode on students' achievement in mathematics in secondary schools. The study revealed that hybrid learning mode is effective in improving secondary school students' achievement in mathematics. The method enabled female students to improve in their achievement in mathematics as well as their male counterparts.

Recommendation

Based on the findings of the study, the following recommendations were made;

- 1). Hybrid learning mode should be introduced in teaching and learning mathematics in secondary schools to improve students' achievement.
- 2). Mathematics teachers should be technologically competent as to implement hybrid learning in the teaching and learning process
- 3). The Government, school administrators, Non-Governmental organizations should organize workshops, seminar and conferences to train teachers on innovative approaches of teaching mathematics such as hybrid learning mode.

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