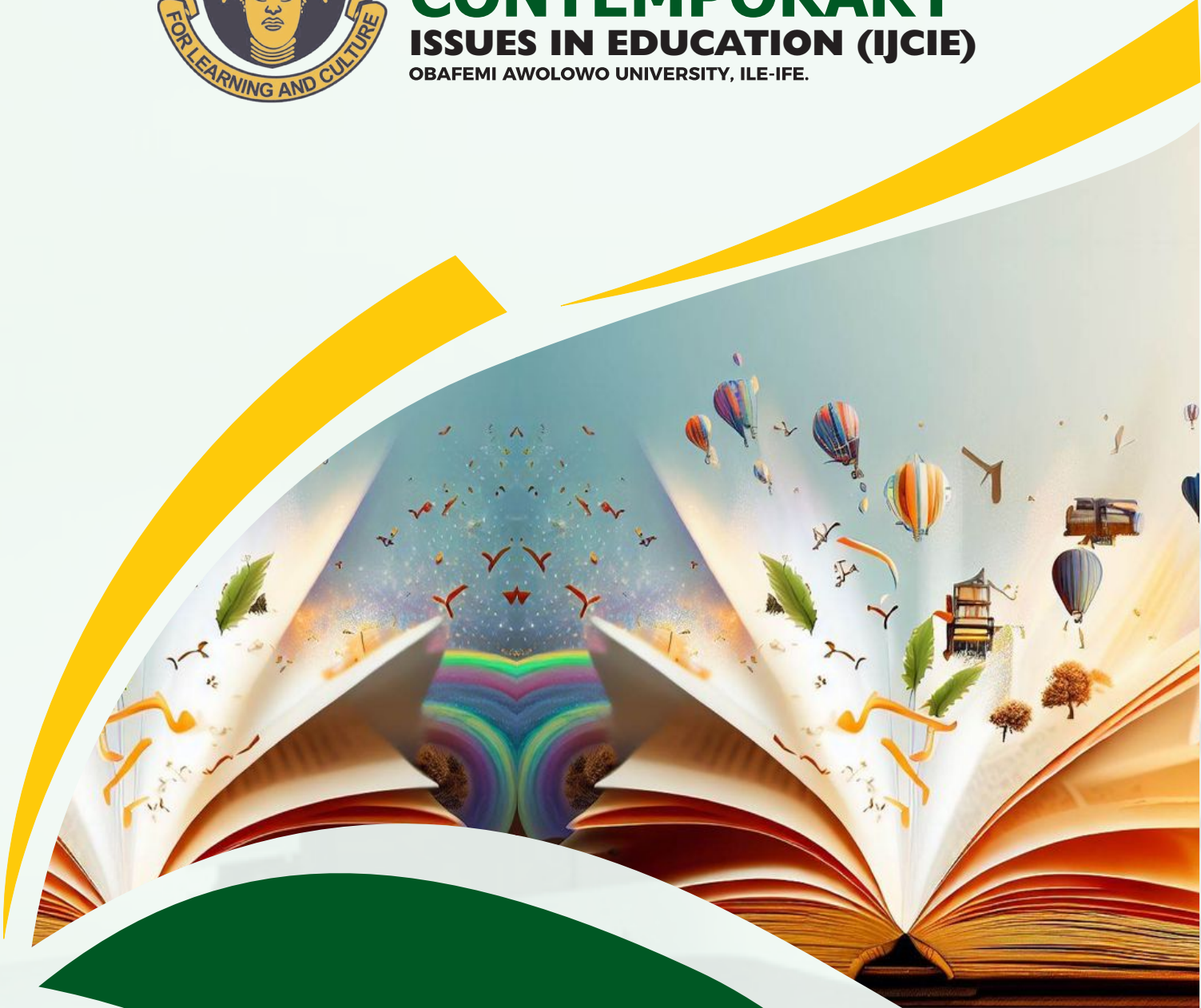




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Abstract

This study investigated the effects of station-rotation blended learning strategy on students' academic performance and attitude in Mathematics among secondary school students in Katsina metropolis, Katsina state. The study was carried out on SSS II students in Katsina Education Quality Assurance Zone in Katsina State, Nigeria. Quasi-experimental design was adopted for the study. The sample size of this study consists of ninety (90) SSS II students which were drawn from two public co-educational schools in Katsina metropolis. Purposive sampling technique was used to select two schools for the study. Mathematics Achievement Test (MAQ) and Mathematics Attitude Questionnaire (MAQ) were used as instruments for the study. The reliability co-efficient of MAT and MRS are 0.83 and 0.89 respectively. ANOVA was used to test the hypotheses at 0.05 level of significant. The finding revealed that: Students taught using station-rotation blended learning strategy and those taught using conventional strategies on performance in mathematics. [$F(2,$

90) = 272.645, $P = 0.000$]. Students taught using station-rotation blended learning strategy and those taught using conventional strategies on attitude in mathematics [$F(2, 90) = 203.396, P = 0.000$]. It concluded that blended learning strategy is more effective in improving the academic performance and attitude of students towards mathematics when compared with conventional method of teaching. It was recommended that teachers should be encouraged to integrate the station-rotation blended strategy in teaching secondary school Mathematics because of its positive effect on students' performance and attitude towards Mathematics.

Keywords: Station-Rotation blended Learning Strategy, Mathematics Academic Performance, and Attitude

Introduction

Mathematics as the bedrock of all sciences must be given much attention and importance. The learning of mathematics related

discipline and a mathematical science is the bedrock of technological and national development. Mathematics is considered the mother of all learning in both arts and sciences. It is not just computation but a tool for understanding structures, relationships and patterns to produce solutions for complex real life problems (Mondragon & Acelajado, 2022). Nowadays, students are intimately familiar with technology, which teachers cater to in the 21st century live in a technology-laden environment where every pieces of information is just one click away; thus, they are referred to as *digital natives* (Prensky, 2021). These arguments paved the way to different innovations that gave birth to the conception of blended learning as a powerful teaching method that enables both teachers and students to bridge the digital breach – technology knowledge gap, between what we consider as digital immigrants and digital natives (Helsper & Rebecca 2019). Therefore, digital immigrants like teachers should be able to match the characteristics of the 21st century learners or digital natives. The importance of integrating the use of technology in the classroom as a way to increase students' motivation and engagement towards learning should be stressed (Chiong et al., 2012).

Horn and Staker (2012) opined that station-rotation strategy implementation in which within a given subject (e.g., math), students rotates *on a fixed schedule or at the teacher's discretion* among classroom-based learning modalities. The rotation includes at least one station for online learning. Other stations might include activities such as small-group or full-class instruction, group projects, individual tutoring, and pencil-and-paper assignments. Some implementations involve the entire class alternating among activities together, whereas others divide the class into small group or one-by-one rotations. The Station-Rotation strategy differs from the Individual-Rotation strategy because students rotate through all of the stations, not only those on their custom schedules.

The popularity of blended learning strategy as strategy for providing diversity and improvement in students' performance in mathematics and the need for integration of technology in teaching motivated this researcher to conduct this experiment and gather baseline

information about the effects of this innovative strategy in the students' pursuit of knowledge. Blended learning refers to the mixture of using Internet and digital media with face-to-face instruction and interaction between teachers and students (Friesen, 2012). Station-Rotation strategy is that students rotate between stations in class, and at least one of these stations includes an online learning component. Students rotate around each station according to the schedule set by the teacher (Oskah et al., 2020).

In Station Rotation strategy, students move to different stations with different strategies of teaching and learning to accomplish a certain task and complete the whole cycle of activities; focusing on a single topic or competency. Station 1 is Small Group Instruction facilitated by the teacher, Station 2 consists of Independent work or Collaborative activities and Station 3 is the Online Learning (Horn, & Staker, 2014; Nur et al., 2020). In addition, since the study used blended learning as pedagogy for the instruction of the targeted skills, this study is also anchored on the Theory of Hybrids which explains how effective blended learning strategy like station rotation is in delivering the best in education by offering both the benefits of online instruction mixed with traditional teaching.

The station rotation strategy for teaching brings changes to both the learning experience of students and the teaching methods of educators. This strategy allows students to have more opportunities to engage in various activities, receive instruction from teachers, work together with classmates, and utilize computers with internet access (Akinoso et al., 2021). The station-rotation blended learning strategy has the benefit of allowing teachers to work with smaller groups of students (Alsalihi, 2019; Eddeen, 2015). This is particularly helpful for teachers who are dealing with larger class sizes. With this strategy, students can complete their learning activities at the same time and pace, as directed by their teacher or schedule.

Another indicator of learning effectiveness is attitude which is a learned predisposition to respond positively or negatively to a specific object, situation, institution, or person (Mondragon & Acelajado, 2022; Minaz & Metanie, 2019). Moreover, the use of blended learning helps to diversify the instructional

delivery in mathematics curriculum, while exploring the benefits of web-based technologies in mathematics education. The study conducted by (Iozzi & Osimo, 2014; Lin, 2010). It is revealed that using a blended learning approach improved students' achievement scores as compared to other approaches and had improvement effects on students' attitudes toward mathematics.

A research conducted by Ocaik (2010) found that the academic achievement levels of the group that was taught using the learning stations were significantly higher than the group taught using the conventional education methods. Similarly, the study of (Demirörs, 2017; Ceylan & Kesici, 2017) found that there was a significant positive difference in the achievement levels of the students so with the attitudes towards studying with the learning stations. It was somehow evident that the researchers found the same positive effects of blended learning using interactive applications in teaching mathematics in secondary schools. Dewa (2020) findings show a significant difference between students with blended learning rotation strategy and students' academic performance.

Statement of the Problem

The issue of low attitude towards learning and poor performance among students offering Mathematics in secondary schools have continued to affect the academic achievement in external examinations like West African Examination Council (WAEC) and National Examination Council (NECO) despite the importance of the subject to nation building and development. Studies of Charles-Oga (2014) asserted that students' performance is less than fifty percent in mathematics for the past decades. Also, the Chief Examiner report for WAEC (2023) expressed worries over the low achievement of students in Mathematics for it's important in gaining admission into tertiary institutions.

However, students have been challenged and developed a negative attitude towards Mathematics learning through the traditional lecture method. They perceived that Mathematicians do not have a normal way of life as another person, they generally dislike the subject. Overall, they have developed a phobia towards any Mathematics learning. In connection

to this, Mazana et al. (2019) reported that learners' attitudes towards mathematics and teaching methods that teachers employ affect their learning and performance. Blended learning, with its incorporation of online resources and interactive activities, has the potential to improve students' attitude and academic performance. In the light of the preceding arguments, this study will be conducted to confirm the findings of other researchers and to contribute to the existing studies on blended learning done in public secondary schools and eventually utilize the results to devise ways and means by which students' performance in and attitude towards Mathematics can be improved. Therefore, the study is designed to investigate the effects of station-rotation blended learning strategy on students' academic performance in and attitude toward mathematics among secondary school in Katsina metropolis, Katsina state.

Objectives of the Study

The study is designed to achieve the following objectives:

- i. determine if there exist any significance difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on performance in Mathematics.
- ii. examine if there exist any significance difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on attitude in Mathematics.

Hypotheses

The following hypotheses were tested in this study:

H₀1: There is no significant difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on performance in Mathematics.

H₀2: There is no significant difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on attitude in Mathematics.

Methodology

The research adopted quasi-experimental research design particularly the pre and post-test design. The experimental group (EG) taught using the blended station rotation strategy while the control group (CG) was taught by using the conventional method where the teacher delivered the teaching and led the students in understanding the lessons in the classroom. The choice of the design is because the researcher does not intend to distort the normal academic activities of the sampled schools.

The population of this study consisted of all SS II students in all the public senior secondary schools in Katsina Metropolis with the total number of one thousand and ninety-four (1,094). The sample size of this study consisted of seventy-three (73) SSS II Mathematics students which were drawn from two intact classes in two selected co-educational senior secondary schools in Katsina metropolis. Purposive sampling technique was used to select two schools that have internet facilities and at least two streams of SSS II Mathematic of inter-class from the total number of schools in the metropolis.

Two research instruments were used to collect data for this study. The instrument, were tagged Mathematics Achievement Test (MAT) and Mathematics Attitude Questionnaire (MAQ). MAT consisted of 50-item multiple choice questions with four options adapted from West African Senior School Certificate Examination (WASSCE) to serve as pretest to ascertain equivalence of ability of subject and as post-test to determine the effect of the treatment on students' performance based on factorization, quadratic equation and probability. Mathematics Attitude Questionnaire (MAQ) was used to determine the attitude of the students towards the Mathematic subject before the application and to see whether there is significant difference in their attitude towards the Mathematics as a result of implemented method. This instrument is a modified Fennema-Sherman Mathematics Attitude Questionnaire (MAQ) which consists of twenty (20) items and was adapted from Doepken et al. (2011). The questionnaire consists 20 items which was based on a four-point Likert type Scale ranging from Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD).

The MAT and MAQ contains 50 multiple

choice and 20 items respectively. The test items were given to Mathematics teachers and expert from the Department Educational Psychology and Counselling, Federal University, Dutsin-ma, Katsina State, to establish the face and construct validity of instrument, also to correctness of questions and options. They evaluated the instrument for its validity for accuracy and clarity of the test items for the study. The instruments were subjected for pilot testing to a group of 20 students in a school outside the scope of the study. The instrument was administered using test-retest method with interval of two weeks. The scores were subjected to Cronbach Alpha statistical analysis, the reliability co-efficient of MAT and MAQ are 0.83 and 0.89 respectively.

The study involved two groups of subjects. A pre-test was administered to two classes was assigned to groups (Experimental group and Control group). This enabled the researcher determine the performance status of the subjects before treatment. In the conduct of the experiment which used the station- rotation model, no alteration would be done in the physical environment of learning and face-to-face instruction would be enhanced by mixing it with interactive online activities. The use of technology was maximized with online learning while students go through different stations, where students are given varied ways to learn specific competency or skill.

The study was conducted in three phases: pre-experimental activities, experiment proper and post-experimental activities: The first phase consists of administering the pretests on the topics included in the study and the attitude questionnaire after securing permission from the school principal. In the second phase, the experimental group was exposed to the blended learning station-rotation on (geometry and construction) and the control group to the conventional teaching method. The final phase of the study was the administration of the post-tests. The same assessment procedure was used for both groups. To be able to ensure objectivity in the conduct of the study and to remove the effect of the teacher factor, classes was handled by this researcher. Both groups were taught by the researcher using appropriate lesson plan. Post tests were administered to both groups after the completion of treatment. The whole exercise

lasted for eight weeks.

The instruments for data collection for this study were administered to the students before the treatment. Scores obtained at this stage served as pre-test scores. After treatment, a post-test (MAQ and MAT) was administered to all the subjects in both groups. Data for the tests were recorded separately for each of the groups. The scores obtained from the pre and post-tests were analyzed using mean, standard deviation. To

determine if significant difference exists between the pretest and posttest mean scores of each group, the Analysis of Variance (ANOVA) was employed for the research study. All the hypotheses were tested at 0.5 level of significance.

Results

Data were presented, analyzed and interpreted based on the research questions and hypotheses.

Research Question 1: What is the difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on performance in Mathematics?

Table 1: Means, Standard Deviations and Mean Gain of students' mean performance in Mathematics for taught using station-rotation blended learning strategy and those taught using conventional strategies

Groups

Groups		Pretest	Posttest	Mean Gain
Station-rotation blended learning strategy	Mean	49.27	75.67	26.40
	N	73	73	
Conventional Strategies	Mean	48.59	59.60	11.01
	N	82	82	
	Std. Dev.	9.02	10.56	

Table 1: shows that the mean achievement performance score of station-rotation blended learning strategy (experimental group) students of pre-test and post-test are 49.27 and 75.67 respectively while conventional strategies

(control group) of pre-test and post-test are 49.90 and 65.06 respectively. It appears that from the difference in the mean scores that experimental group students scored higher in the MAT than the control group.

Research Question 2: What is the difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on attitude in Mathematics?

Table 2: Means, Standard Deviations and Mean Gain of students' mean attitude in Mathematics for taught using station-rotation blended learning strategy and those taught using conventional strategies

Groups		Pretest	Posttest	Mean Gain
Station-rotation blended learning strategy	Mean	51.07	72.07	21.60
	N	90	90	
Conventional Strategies	Mean	49.90	65.06	15.16
	N	82	82	
	Std. Dev.	8.29	9.23	

Table 2: shows that the mean mathematics attitude score of station-rotation blended learning strategy (experimental group) students of pre-test and post-test are 51.07 and 72.07 respectively while conventional strategies (control group) of

pre-test and post-test are 49.90 and 65.06 respectively. It appears that from the difference in the mean scores that experimental group students scored higher in the MAQ than the control group.

Hypothesis 1: There is no significant difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on attitude in Mathematics.

Table 3: ANCOVA, Analysis of the Mean Scores for Pre & Post Test of MAQ

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	2349.541 ^a	2	1174.771	153.240	.000
Intercept	361.718	1	361.718	47.183	.000
ATTITUDE	8.641	1	8.641	1.127	.291
GROUPS	1559.276	1	1559.276	203.396	.000
Error	666.959	87	7.666		
Total	25579.000	90			
Corrected Total	3016.800	89			

a. R Squared = .779 (Adjusted R Squared = .774)

Table 3 revealed that the F value analyzed was 203.396 and the p-value of 0.000 was observed. Since the obtained p-value of 0.000 is less than the alpha value of 0.05, the null hypotheses is rejected, thus the alternative hypothesis is there is

significance difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on attitude in Mathematics. {F (2, 90) = 243.512, P = 0.000}.

Hypothesis 2: There is no significance difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on performance in mathematics

Table 4: ANCOVA, Analysis of the Mean Scores for Pre & Post Test of MAT

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	2347.840 ^a	2	1173.920	152.740	.000
Intercept	715.880	1	715.880	93.144	.000
ATTITUDE	6.940	1	6.940	.903	.345
GROUPS	2097.785	1	2097.785	272.645	.000
Error	668.660	87	7.686		
Total	25579.000	90			
Corrected Total	3016.800	89			

a. a.R Squared = .778 (Adjusted R Squared = .773)

Table 4 revealed that the F value analyzed was 272.645 and the p-value of 0.000 was observed. Since the obtained p-value of 0.000 is less than the alpha value of 0.05, the null hypotheses is rejected, thus the alternative hypothesis is there is significance difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on performance in mathematics {F (2, 90) = 272.645, P = 0.000}.

Discussion of the Findings

The findings of the study revealed that there is significance difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on academic performance in mathematics. This finding strengthens the claim of Lin, et al., (2016) who found that the academic achievement levels of the group that was taught using the learning stations are significantly higher than those of the group taught using the conventional educational methods. This supports the findings of *Marianne and Maxima*

(2019) who found that there is a significant positive difference in the achievement levels of the students as well as in their attitudes toward Mathematics in studying with the stations-rotation blended learning strategy. Also, Nur et al (2020) findings agree that blended learning station – rotation strategy had positive impacts on students' academic achievement in mathematics when properly utilized by facilitators. Alsalhi, et al (2019) found that stations-rotation learning had a positive effect on the science test scores of intermediate school students. Ceylan and Kesici (2017); Eddeen et al (2015) who lamented that there is significant effect shown in students' academic achievement for the experimental group, that their scores are greater than the control group's test scores, it had a positive impact on academic achievement of the students. In this learning strategy the students were able to interact with the teacher and friends. Students experiences increase when involves in various activities at a different station which involved active learning through proper projection of learning material via online using internet facilities. However, students who learned via blended learning (experimental group) rated their levels of learning more highly than those in the conventional group.

The findings of the study revealed that there is significance difference between the mean scores of students taught using station-rotation blended learning strategy and those taught using conventional strategies on attitude in Mathematics. The findings support the findings of Minaz and Melanie (2019) who found that *there exist significant differences in the mean gain scores of the two groups as well as in their attitude toward mathematics in favor of the experimental group*. This supports the findings of Lin, et al., (2016) who found that the blended learning method is more effective than the conventional method in terms of improving attitude toward mathematics. Therefore blended learning of station-rotation was more effective in facilitating growth in math learning as compared to meeting grade level criteria. These findings indicate that schools can benefit from implementing station-rotation blended learning particularly for students who are behind academically. Station-Rotation Model in teaching mathematics improved the students' attitude toward the subject.

Conclusion

A station-rotational blended learning pedagogic framework was designed and conducted with integrated internet-based e-learning, In the light of the findings of the study, it can be concluded that although the relationship between the variables of the study is positive significant, integration of blended station rotation strategy in teaching mathematics is more effective than the conventional method of teaching in improving the performance and attitude toward mathematics of secondary school students.

Recommendation

From the finding of this study, the following are recommended for this study:

1. Teachers should be encouraged to integrate the station-rotation blended strategy in teaching secondary school Mathematics because of its positive effect on the students' performance and attitude toward Mathematics.
2. Seminars, Conferences and workshops should be conducted by the Mathematics Improvement Project under Ministry of Education to expose the teachers to different blended learning strategies and get them ready to implement this innovative teaching strategy.

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