EFFECT OF STATION ROTATION MODE OF INSTRUCTIONAL DELIVERY FOR MATHEMATICS IN THE ERA OF ADVANCING TECHNOLOGY

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Abstract

Mathematics as a core subject in sciences and other aspects of human lives requires quality teaching to enhance learning and proper understanding. This idea prompted the Station Rotation Model of instruction used in this study for teaching secondary school students mathematics. From six educational districts in Lagos State, Educational District IV was selected randomly. Two senior secondary schools were purposively selected from the district being schools with well-equipped and functioning computer laboratory, and these schools were randomly assigned to experimental and control. The study adopted the pretest, posttest, control group quasi-experimental design to ascertain if there was a difference between the achievement and attitude of students taught mathematics with station rotation and those taught with conventional method. The two instruments used were Mathematics Achievement Test (MAT) and Attitude towards Mathematics Inventory (ATMI) adapted from Tapia and Marsh (2004). The data were analyzed using ANCOVA. The treatment was found to have a significant difference in achievement but not on the attitude of students. These results suggest that the station rotation model of instruction should be adopted in teaching mathematics.

Keywords: achievement, advancing technology, attitude, mathematics, station rotation model

Introduction

The proper teaching of mathematics is required to enhance understanding of the subject for proper application of the knowledge in every facet of life. Mathematics is an important subject that has its application in subjects of different kinds, various sectors, the economy, and practically every aspect of human endeavor. The discipline is very vital in the scientific and technological foundation as well as the socio-economic development of any nation. Mathematical skills are useful in entrepreneurship, and in solving problems of any kind either real-life like educational, marital, poverty, health, or generally, economic problems. Mathematics is required for any reputable or desire courses like medicine, architecture, and engineering programs. It is also an essential tool needed for all sciences and technology (Ogunleye, 2009).

However, the performance of students in secondary school mathematics is not encouraging

(Busari & Akinoso, 2020). Due to the importance attached to this subject action needs to be taken immediately with one area to be addressed being teaching strategies aimed to improve performance of students. Currently, different strategies for teaching mathematics include inquiry-based learning, personalized instruction, teamwork/collaborative learning, visualization or concrete-representation-abstract instructional strategy, cooperative learning, differentiated instruction, explicit instruction, and others. A good mathematics teacher should have knowledge of different teaching strategies and they should be able to apply the strategies according to the needs of the students. Included in this set of strategies is incorporating technology to mathematics teaching. It is the purpose of this study to look at the effectiveness of one approach of teaching mathematics with technology.

Literature Review

Akinoso (2015) has suggested that the world is so volatile, uncertain, complex, and ambiguous and that anything can happen at any time, that could interrupt the coming together of students in a classroom setting. No matter what happens, learning must continue but it might not occur that way it had previously. Students will require instructional strategies that can help improve learning with the technology-based skill to prepare for a proper understanding of the subject. An example of such occurrence is the outbreak of the present pandemic which moved the teaching of many students from the classroom settings to other settings, often online or e-learning. But students do not need a world crisis to benefit from learning via technology.

Technology and Mathematics Teaching

Information and Communication Technology (ICT) usage contributes to the building of a fast-growing society. E-learning, as stated by Shashikala (2019), comprises electronically supported learning and teaching. There is no doubt that conventional learning has its advantages but online or e-learning is properly known and practiced for distance, open and flexible education but within a given situation. Further, the combination of online learning with the traditional classroom settings, especially in case of any emergency, can be a great advantage.

Odumosu, Oluwayemi, and Olatunde (2012) have suggested that today's learners need to be exposed to modern technologies for optimal learning. For example, in computer literacy and attitude to computer as the predictors of chemistry teachers' utilization of technology, Ogunleye, (2010) believed that teaching chemistry cannot be limited to the use of traditional texts or conventional teaching which is a teacher-centered strategy but to incorporate the use of technology. The use of this technology is not limited to the teaching and learning of chemistry but to other subjects, including mathematics.

The world of education is changing, moving from traditional teaching to a combination with an online mode where students discover some facts and learn any time anywhere. The world

itself is now a global village in which both the teachers and students can reach out to any part of the world to have the ideal of their education system, access any concepts online, learn through the video lecture from different parts of the globe and ask or submit questions when necessary for clarification. For students to connect with their colleagues globally, be informed, and become responsible global citizens and for them to be closer to all parts of the globe there should be what is been referred to as globalization which promotes awareness and knowledge of global interdependence. Teaching and learning of any program cannot be limited to reading, writing, and arithmetic only. Panneer Selvam (2014) averred that the principle of globalization is to shift the teaching-learning process from reading, writing, and arithmetic to communication, collaboration, critical thinking, and creative problem-solving. Moreover, classroom teaching has been transformed from the traditional way of teaching to the use of technology, where communication, collaboration, critical thinking, and creative problem-solving are also the potential benefits of online teaching. Technology advances daily and, using the internet, students can be connected from every part of the world for virtual learning. Meetings of different kinds can be held as if students were together in a hall using different platforms like Zoom, Google, and others.

In this era of technology, the conventional way of learning might not be enough, but it can provide a foundation, since there is information and communication technology through which students can be connected to others, regardless where they are. For mathematics teachers to provide global education to the students, the teacher must incorporate and allow communication, collaboration, critical thinking and creative problem solving to reflect in the teaching-learning of mathematics.

To meet the needs of this new situation, both teachers and students need to learn how to use the online space. One potential way to accomplish this goal and to make the learning of mathematics at a senior secondary level more meaningful, interesting, and efficient to students, station rotation learning can be introduced as a method of instruction to contribute actively to classroom instruction and improve learning outcomes of mathematics at senior secondary school level.

The Station Rotation Model

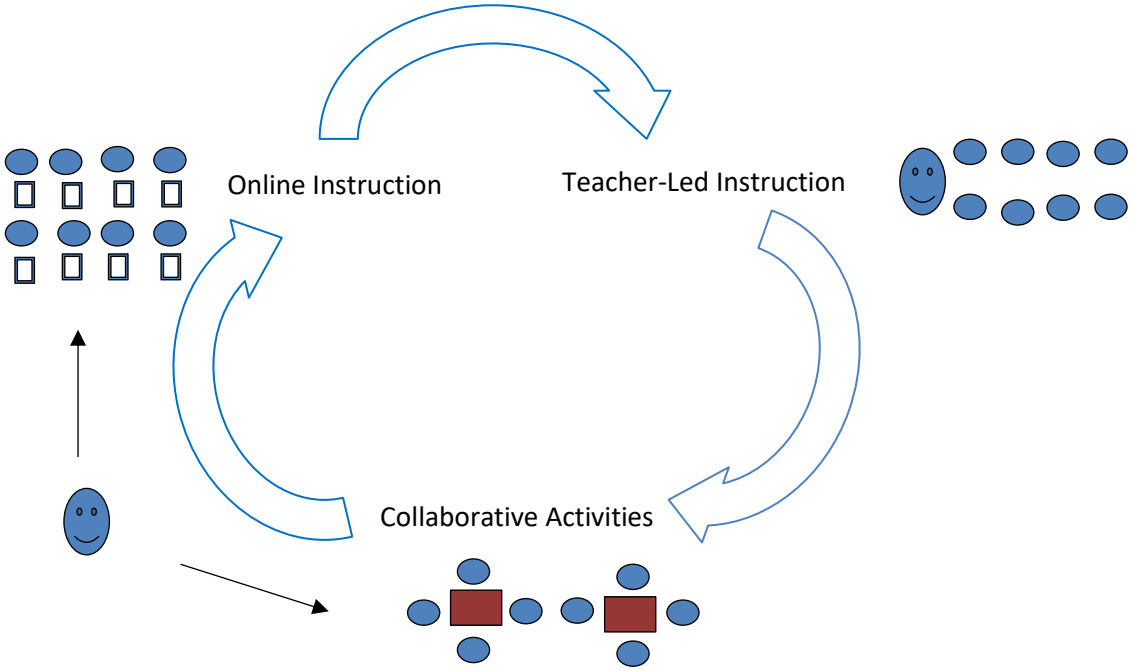
The station rotation model of instruction, a form of blended learning, involves the use of technology combining the internet with a more traditional classroom settings (Kerres & Witt, 2003). In support of the definition given above, Stacey and Gerbic, (2007) defined the station rotation model of instruction as the combination of a customary classroom teaching approach with a variety of online resources. The station rotation model of instruction requires that students are placed into different groups and, together, move from one learning division to another. The rotation stations include teacher-led instruction, collaborative activities, and online instruction. One possible configuration of the model is seen in Figure 1.

Tavangarian, Leypold, Nölting, Röser and Voigt (2004) emphasized that, whether

networked or not, the information and communication system is a specific medium to implement the learning process. This idea suggests how important the station rotation model of instruction is in the field of teaching. In support of the combination, Yusuf, (2020) believed that with the advancement in technology, teaching is gradually moving from onsite to the online mode where the students read, watch, or listen, complete problems or answer questions, explore simulation and resources and collaborate with peers. Researchers like Žuvić-Butorac, Roncevic, Nemcanin, and Nebic (2011) concluded that the impact of the use of multimedia is low, through the use of multimedia, the offering of the self-assessment tests, accessibility of digital literature and collaborative activities. As explained further, students value the comprehensiveness, organization, and design of educational materials and teachers' online engagement especially in the good management of e-course. Continuous and careful monitoring of learner's satisfaction will ensure success for the feasibility and viability of online teaching. The station rotation model of instruction systems changes the way the learners learn and also changes the way the teachers teach, students have access to more activities, learn through teacher-led instruction, collaborate with peers, and have access to a computer with the internet.

Figure 1

Rotation station model configuration of instruction



Sands (2017) emphasized that the rotation model improves flexibility and customization which makes the learning enjoyable and engaging. With the station rotation model of instruction, flexibility is allowed in the grouping, slow learners enjoy more time and attention of the teacher, each student has direct attention of the teacher and it allows students to use technology's different applications and be more creative. Sands (2017) further identified the following as some of the benefits of using station rotation: unparalleled flexibility, modern learning approach, customized

and personalized content, and engaging for all. The station rotation model of instruction can work for students of any age and level, every subject can also be taught using a station rotation model. Communication, collaboration, critical thinking, and creative problem-solving are embedded in the station rotation model of instruction.

The station rotation model of learning, if adopted in might make a significant change in the students' academic performance by heightening the interest of the students potentially change their attitude towards the subject matter. Attitude is another important construct in learning.

Attitude

The learners' attitude can play a significant role in effective learning of a subject like mathematics. Students' achievement in mathematics is not only affected by cognitive factors, but affective variables like attitude, beliefs, and motivation also have impacts (Zan, Brown, Evans, & Hannula, 2006). Attitude is a positive or negative disposition towards learning (Zan & di Martino, 2007). If the students have a positive or affinity to learn mathematics, the effect can be positive on students' performance while the negative feelings might affect the performance negatively. Agoro, Akinoso, Oyediran, and Olafare (2017) posited that attitude, as a learned predisposition of the individual, caused a positive or negative response to the situation, object, and concept which in turn, plays a pretentious role in determining the individual reaction to a specific entity. Lipnevich, MacCann, Krumm, Burrus and Roberts, (2011) averred that the more positive students' attitudes towards a subject, the stronger the intention to perform well.

Students' attitudes towards mathematics as reported by Chagwiza, Mutambara, Tatira, and Nyaumwe, (2013), correlated with achievements in mathematics and as an important predictive factor for achievement. Akinoso and Adeniyi (2019), in a study of effectiveness and attitude of students toward e-courses at the University of Lagos, concluded that students have a positive attitude towards e-courses. Similarly, Mohd, Mahmood and Ismail (2011) found a positive relationship between students' attitude and their achievement in mathematics. Rosas et al. (2003) concluded that through the use of technologies in the classroom, there is evidence of a relationship among computer-supported recreational activities, positive attitudes towards mathematics, improvement in mathematical learning, and student performance. Akinoso, (2018), studying the effect of the use of multimedia on students' performance in secondary school mathematics concluded that the academic performance of students in mathematics was positively influenced by the use of multimedia.

As important as attitude is in learning, the teachers' attitude to teaching can also influence the students' attitude toward learning. Ngeche (2017) submitted that a connection exists between teachers' and learners' attitudes, and performance. If a mathematics teacher is indulgent, ready to listen to learners' contributions, correct learners' mistakes without abusive or insulting language, and devoted to teaching, they can have a positive effect on learners' attitudes to learning. Ngeche emphasized that teachers are to provide support, encourage students to eliminate learners'

unwanted behaviour. Ngeche also averred that a teacher's attitude towards mathematics can be measured by the emotional response to mathematics (affective), beliefs about Mathematics (cognitive), and the teacher's behaviour. Yara, (2009) asserted that many teachers rarely realize the manner in which they teach, behave and interact with learners can influence learning more than their mastery of the subject matter. This shows the importance of teachers' attitude to the learners' attitude and achievement, especially in mathematics.

Statement of the Problem

Mathematics is essential in many aspects of life. In education, the teaching and learning of this subject should be given proper attention to improving students' performance. Most of the learners still struggle to learn mathematics Thus, there is the suspicion that delivery methods and strategies might be, fundamentally, the issues to the poor performance of students in mathematics and mathematics-related subjects. Action learning and concept motivation was suggested while learning mathematics to reduce to minimal level the poor performance (Abramovich, Grinshpan & Milligan, 2019). The study, therefore, investigated the effect of the station rotation model of instructional delivery on students' achievement and attitude in senior secondary school mathematics.

Research Questions

The following research questions were posed:

1. What is the achievement of students taught mathematics with the station rotation model of instruction compared with students taught with another conventional method?
2. What is the attitude of students taught mathematics with the station rotation model of instruction compared with students taught with another conventional method?

***Hypotheses*.** The following null hypotheses were measured at 0.05 level of significance
HO_1: There is no significant difference between the achievement of students taught mathematics with Station Rotation Model and students taught with conventional method.
HO_2: There is no significant difference between the attitude of students taught mathematics with the Station Rotation Model and students taught with conventional method.

Methodology

Participants

A multistage sampling technique was used to select a sample for this study. Educational District IV was selected randomly from the six educational districts in Lagos State in Nigeria. Two schools used for this study have well equipped computer laboratory and mathematics teachers are highly competent in the use of computer for instructional delivery. One intact class was selected each

from the two schools, and these schools were randomly assigned to experimental and control. The total number of students in the study is 120. Sixty-one of the participants were taught using the station rotation method, using the school's mini hall to provide sufficient space to do so. The other 59 participants were instructed using the traditional classroom methodologies generally found at the school.

Design

This study adopted a pretest, posttest, control group quasi-experimental design. The students in the experimental group were taught with a station rotation model of instruction. In the station rotation model, the students moved through three distinct types of instruction in turn: 1) teacher-led instruction in which the teacher introduced and explained the concept thoroughly; 2) collaborative activities stage in which the group came together and discussed what the teacher taught them at the teacher-led stage and 3) online instruction stage where the students were provided with the necessary technology-related tools (i.e. URL, downloaded video or specific website) for the topic. The control group followed the traditional classroom method of teaching found at the school. The topic of study for both groups was angle of elevation and depression taught for four weeks of three periods of forty-five minutes each.

The instruments used for data collection were the Mathematics Achievement Test (MAT) which consists of 25 questions taken from West African Examination Councils (WAEC) standard questions and the Attitude towards Mathematics Inventory (ATMI) adapted from Tapia and Marsh (2004) which consists information about self-confidence, the value of mathematics, enjoyment of mathematics and motivation. Both instruments were validated. The reliability coefficient of MAT was 0.85 using Kuder Richardson's formula 20 (KR-20), while the ATMI had a reliability coefficient alpha of 0.97 which was recommended for investigating attitudes of students towards mathematics. The pretest was administered one week before the treatment and the posttest one week after the treatment for both groups, the study lasted for six weeks. Data collected were analyzed using the descriptive and inferential statistics of mean and Analysis of Covariance respectively on Statistical Package for the Social Sciences (SPSS) version 20.

Results

Research Question 1. What is the achievement of students taught mathematics with the station rotation model of instruction compared with students taught with the conventional method?

The data presented in Table 1 shows that the treatment group taught mathematics with a station rotation model of instruction had a mean score of 13.90 on the pretest and a mean score of 65.25 on the posttest, showing a mean gain of 51.35. The control group taught with conventional methods had a mean score of 18.13 in the pretest and a posttest mean of 59.29 with a pretest, posttest mean gain of 41.16. With these results, students taught mathematics with station rotation

had a higher mean achievement score than those taught with a conventional method.

Table 1

Mean of Pretest and Posttest Scores of Treatment Groups taught Mathematics with Station Rotation Model and Conventional Method

Techniques	N	Pretest $\overline{X}_1$	Posttest $\overline{X}_2$	Mean Gain
Station Rotation	61	13.90	65.25	51.35
Conventional Method	59	18.13	59.29	41.16

Research Question 2. What is the attitude of students' taught mathematics with the station rotation model of instruction compared with students taught with another conventional method?

Table 2 shows that the treatment group had a mean attitude score of 84.87 on the pretest and a mean attitude score of 91.87 on the posttest, making a mean attitude gain of 7.00. The control group had a mean attitude score of 85.01 on the pretest and a posttest mean attitude score of 91.23, showing a mean attitude gain of 6.22. With these results, students taught mathematics with station rotation had a higher mean attitude score than those taught with conventional methods.

Table 2

Mean Attitude of Pretest and Posttest Scores of Treatment Groups taught Mathematics with Station Rotation Model and Conventional Method

Techniques	N	Pretest $\overline{X}_1$	Posttest $\overline{X}_2$	Mean Gain
Station Rotation	61	84.87	91.87	7.00
Conventional Method	59	85.01	91.23	6.22

The result showed that there was not statistically significant difference for either the first research questions, which leads us to accept the null hypotheses for both questions.

The data presented in Table 3 shows F-calculated values for the group (station rotation and conventional) on students' achievement and attitude to mathematics. The F-calculated value for the group is 64.253 with a significance of F at .000 which is less than 0.05. The null-hypothesis one is therefore rejected at 0.05 level of significance. With this result, there was a significant difference between the achievement of students taught mathematics with a station rotation model of instruction and those taught with the conventional method. The F-calculated value for attitude is 124.216 with a significance of F at 0.060 which is greater than 0.05. This indicates that there was no significant between the attitude of students taught mathematics with the station rotation model of instruction and those taught with the conventional method. Therefore, the null hypothesis two was not rejected at 0.05 level of significance.

Table 3

Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Treatments (Station Rotation) and Attitude on Students' Achievement in Mathematics

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2299.756[a]	2	514.939	87.476	.000
Intercept	15844.331	1	15832.331	2.411E3	.000
Pretest	59.814	1	59.814	9.101	.003
Group	435.452	1	425.452	64.253*	.000
Attitude	882.469	1	812.469	124.216*	.060
Error	861.001	117	6.573		
Total	532787.000	120			
Corrected Total	3160.757	119			

Notes. *Significant at sig of F< .05

Discussion

The results of this study showed that students taught mathematics with station rotation had a higher mean achievement score than those taught with the conventional method. Also, a significant difference existed in achievement between students taught with a station rotation model of instruction compare with those in the conventional method of teaching in mathematics. In the station rotation model of the instruction group, there existed interaction and active learning which allowed students to use more senses. The different stages used in station rotation allowed students to interact with their colleagues, and the technology tools which allow manipulation of some of the materials which boost the interest of the students towards the learning of mathematics. This kind of interaction with involvement of the learners in learning has a positive effect on students' results in mathematics. Although, there are interaction in conventional method, the results suggest that they may not be as effective as the one in station rotation due to the structured stages used throughout instruction.

The results suggest that learners in the treatment group could recall material more effective due to a greater sense of learning than happened in the control group. This result corroborated the results from Akinoso's (2018) study that concluded that the academic performance of students in mathematics was positively influenced by multimedia. The results also negate the findings of Žuvić-Butorac, Roncevic, Nemcanin and Nebic (2011) who reported that the lower level of agreement was obtained on the use of multimedia, self-assessment tests, accessibility of digital literature and collaborative activities. The station rotation included the use of technology that potentially contributes to the performance of students in mathematics.

It was also discovered that students taught mathematics with station rotation had a higher mean attitude score than those taught with the conventional method. However, the difference in

the mean attitude of both groups was not significant. This implied that the attitude of the student towards learning does not change but remained the same with the use of the station rotation model of instruction as well as a conventional teaching method. Although previous studies (Akinoso & Adeniyi 2019; Chagwiza, Mutambara, Tatira, & Nyaumwe, 2013; Mohd, Mahmood, & Ismail, 2011) concluded that students have a positive attitude towards learning mathematics through technology, the findings of this study suggested that the use of technology in the station rotation did not change the attitude of students about mathematics. One reason might have been the already frequent use of technology in the lives of the participants, leading them not to think that technology in learning as being special or different.

Conclusion

It was discovered and concluded from this study that the station rotation model of instruction improved the learning of mathematics, and; therefore, represented an effective teaching approach for mathematics. The use of a station rotation model of instruction in teaching can improve students' achievement in learning. It is activity-based and interactive way of teaching which creates one-to-one interaction with the teacher. However, it was also concluded that the use of the station rotation model of instruction did not change the students' attitudes toward the learning of mathematics.

Recommendations

Based on the findings and conclusion above, the following recommendations were suggested:

1. Special training programs should be arranged for the teachers on the use of computers and teachers should develop the skills in the use of the internet and how to use the station rotation model of instruction while teaching. This will help improve the teaching and learning of mathematics and improve the learning of sciences which will bring out more benefits in this era of advancing technology.
2. Although the current study did not bear this out, others have suggested that mathematics teachers should learn about more strategies that can change the negative attitude of some students to positive to improve their interest in the subject.
3. The stakeholders in the education sector should make available the facilities needed for the effective use of online learning.
4. This study was limited to the schools with well-equipped and functioning computer laboratory in the selected district, precisely district (IV) in Lagos State. Every school should be provided with functioning computer for effective teaching especially for the use of the methods that involves online teaching.

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