Tutorial-Based Learning Strategy And Senior Secondary Students' Cognitive Achievement And Attitude In Geometry

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Abstract: **The study investigated the effect of tutorial-based learning strategy on senior secondary students' cognitive achievement and attitude in geometry in Obio/Akpor local government area of Rivers State, Nigeria. The study adopted the quasi-experimental research design with a population of 6,589 senior secondary class one students and a sample of 40 students. Purposive sampling technique was used to compose the sample in an intact class. Two instruments were used in the study for data collection which includes Geometry Test Item (GMI) and Geometry Attitude Inventory (GAI). The reliability coefficients of 0.91 and 0.82 were obtained for GMI and GAI respectively using Cronbach alpha. Four research questions were answered with descriptive statistics while four hypotheses were tested at 0.05 level of significance using analysis of covariance and Mann-Whitney test. Findings of the study revealed that there was no significant difference in the cognitive achievement and attitude of students in geometry between those taught with tutorial-based learning strategy and direct instruction. The study recommended among others that Mathematics teachers should blend their face-to-face classroom instruction with CD ROM-based and web-based tutorial learning strategies to improve students' cognitive achievement and attitude in Mathematics.**

Keywords: **Tutorial, learning strategy, cognitive, achievement, attitude, geometry**

I. INTRODUCTION

Mathematics is indispensable for national development because of its utilitarian values. It has been recognised as a pivot upon which social, economic, technological development, everyday practices of man and the breakthrough in the millennium development goals hinges (Unodiaku, 2014). The role of Mathematics in national development cannot be over-emphasized. National development relies heavily on Mathematics which is the foundation of technological advancements (Odili, 2006). These advancements in technology are incorporated into the educational system as instructional strategies to enhance teaching and learning. Technological-based learning refers to instructional strategies which leverage the use of information and communication technologies to enhance the teaching and learning process. George and Zalmon (2019) defined technology-based learning as technology-driven instructional strategies with such examples as ICT-based learning, computer-assisted learning and e-learning. Koller, Harvey and Magnotta (2001) as cited in Edison (2019) stated that technology-based learning has provided traditional students with opportunities to access the best programs offered by a variety of educational institutions and offer working adults greater access to education and professional development regardless of distance. Edison (2019) reported that the use of technology-based learning in post-secondary institutions is continuously growing with its application ranging from offering selected courses online as part of traditional on-campus programs to offering entire certificate, undergraduate, and graduate programs solely online as well as blended learning options. Edison (2019) recommended that educational institutions should embrace the technology-based learning which is the e-learning because it has the following benefits: it can allow students to learn on their own at their own pace without the intervention of teachers who at times are strict and unapproachable; it can facilitate teaching and learning through a modernized tool that can aid the teachers in delivering their instruction; it can improve the quality of education by providing improved informational content and learning approaches and it can improve the students' information and communications technology skills required to contribute to the knowledge-centred society. Secondary schools should not be left out in adapting technology-based learning strategies for teaching and learning because of its numerous benefits. Tutorial-based learning is another example of the technology-based learning strategy that could be used to blend learning in secondary schools.

Tutorial-Based Learning Strategy (TBLS) is a self-paced learning program delivered online or from a compact disc-ROM. The program may contain audio and video and allow learners to control the key aspect of the leaning process. They may track progress and included quizzes and a competency assessment typically; they are modular and are accessed in sequence depending on the learners need (Koller, Harvey & Magnotta, 2001). Tutorial can be defined as a combination of media (audio, video, animation, PowerPoint slide) that allows the user to control, combine, and manipulate the different type of mediums of communication which includes text, graphics steel images, and interactive features. There are two types of

tutorial-based learning strategy based on the mode of delivery: Compact Disk (CD) ROM-based tutorial and web-based tutorial. Hafidha (2018) described the two types of tutorial-based learning strategies as soft copy and hard copy CD-based delivery modes. The CD ROM-based tutorial involves the use of CD ROM software programs for instruction while the web-based tutorial incorporates interactive activity in the form of learners control, hyperlinked information, feedback which can enhance academic performance by allowing students to actively experiment with concepts on their own (self-pace) and outside the classroom (Lin, 2009). There are several advantages in using the tutorial-based learning strategy such as convenience, flexibility, individualized learning, learner-centred and expansion of pedagogical horizons. Some challenges of using tutorial-based learning strategy include digital divide, social loafing, poor internet connectivity, epileptic power supply and lack of computers or information and communication technology facilities. Investigating the effect of tutorial-based learning strategy on the cognitive achievement and attitude of students in geometry was the focus of this study. Cognitive achievement is a measure of development in the different levels of cognitive processes after instruction. Cognitive achievement is the mental process of knowing which includes aspects of remembering, understanding, applying, analyzing, evaluating and creating. Attitude is a complex mental state involving beliefs, feeling, values and disposition to act in certain ways.

Hafidha (2018) revealed that majority of students (68%) had a positive attitude towards the use of CD-based instructional materials in the course of teaching and learning due to the perceived usefulness of this mode of delivery. However, few students (32%) had a negative attitude towards the use of CD-based instructional materials because of the different emerged challenges involving lack of access to computers, skills of interacting with electronic devices such as computers as well as electricity connectivity and reliability. The study recommended the use of both hardcopy and soft copy materials (CDs) to carter for learners preferred mode of delivery. Hafidha (2018) stated that learners need to be encouraged to use CD-based instructional materials to cope with the rapid changes in information and communication technology. Therefore, this study investigated the effect of tutorial-based learning strategy on the cognitive achievement and attitude of senior secondary students in geometry using direct instruction as the control strategy. Direct instruction is the face to face instructional approach. The effect of tutorial-based learning strategy on students with different cognitive abilities in geometry was also investigated.

Statement of the Problem

There have been chief examiners' reports of students' under-achievement in Mathematics in annual national examinations. This under-achievement is an indication of the poor quality of the instructional process resulting from the use of ineffective conventional instructional strategies. The conventional teacher-centred face to face teaching methods is becoming boring and monotonous thereby leading to students' negative attitude and poor learning achievement in Mathematics. This study, therefore, seeks to determine the effect of the innovative, learner-centred and technology-based tutorial learning strategy on the cognitive achievement and attitude of students in geometry.

II. AIM AND OBJECTIVES OF THE STUDY

This study was designed to ascertain the relative effectiveness of tutorial-based learning strategy on senior secondary students' cognitive achievement and attitude in geometry. The objectives of the study are to:

1. determine if there is any difference in the cognitive achievement mean scores of students taught with tutorial-based learning strategy and those taught with direct instruction.
2. ascertain if there is any effect of ability grouping on students' cognitive achievement taught geometry using tutorial-based learning strategy and direct instruction.
3. investigate if there is any difference in the attitude mean rating of students taught geometry with tutorial-based learning and those taught with direct instruction.

Research Questions

1. What is the difference in the cognitive achievement mean scores of students taught with tutorial-based learning strategy and those taught with direct instruction?
2. What is the effect of ability grouping on students' cognitive achievement taught geometry using tutorial-based learning strategy and direct instruction?
3. What is the difference in the attitude mean rating of students taught geometry with tutorial-based learning strategy and those taught with direct instruction?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance to guide the study:

H_{01}: There is no significant difference between the cognitive achievement mean scores of students taught with tutorial based-learning strategy and those taught with direct instruction.

H_{02}: There is no significant effect of ability grouping on students' cognitive achievement taught geometry using tutorial-based learning strategy and direct instruction.

H_{03}:There is no significant difference between the attitudes mean rating of students taught geometry with tutorial-based learning strategy and those taught with direct instruction.

III. METHODOLOGY

The research design was the quasi-experimental design of the pretest and posttest type. The study was conducted in Obio/Akpor local government area of Rivers State, Nigeria. Six thousand, five hundred and eighty-nine (6,589) senior secondary class one students from the twenty (20) public senior secondary schools in the area constituted the population of the study (Rivers State Senior Secondary Schools Board, 2015). The purposive sampling technique was used to select a sample of 40 students from two schools with two intact classes. The treatment group was taught with the CD ROM-based tutorial learning strategy while the control group was taught with direct instruction. The computer laboratory of the experimental school was used for the study with the instructional programs copied to all the computer systems used for the study. The researchers with the support of the Mathematics and the computer studies teachers guided the students to access the instructional package in a CD-ROM copied to the systems. The audio-visual instruction in the CD ROM covered topics in trigonometry, mensuration, proofs of some basic theorem and geometrical construction for students to watch and listen to for the duration of the lesson. The Geometry Attitude Inventory (GAI) and the Geometry Test Items (GTI) were administered to the students as a pretest (before treatment) and posttest (after treatment). The GAI consisted of 40 items questionnaire designed after the Likert scale of Strongly Agree (SA)- 4 points, Agree (A)- 3 points, Disagree (D)- 2points and Strongly Disagree (SD)- 1 point. The criterion mean was 2.50. The GTI also consisted of 25 multiple choice objective items scored over 100. The mean of the pretest of the GTI was used to categorize students into high and low ability groups. The two instruments were validated by three Mathematics Educators to ensure their contents and face validities before administrating them as pretest and posttest. A table of specification was employed to ensure that the test covers adequately the trigonometry, mensuration, proof of some basic theorem and the construction contents of geometry taught for four weeks. The reliability coefficients of 0.91 and 0.82 were obtained for GTI and GAI respectively using Cronbach alpha. Four research questions were answered with descriptive statistics while four hypotheses were tested at 0.05 level of significance using analysis of covariance and Mann-Whitney test. Since the respondents remained in their intact classes, no randomization was done during their selection; it means that one of the assumptions of the parametric statistics has been violated. To test for the significant difference in the attitude mean rating without using the pretest score, we use the Mann Whitney test.

IV. RESULTS

Research question 1: What is the difference in the cognitive achievement mean scores of students taught with tutorial-based learning strategy and those taught with direct instruction?

Table 1: Mean and Standard Deviation (SD) on the difference in the cognitive achievement mean scores of students taught with Tutorial-Based Learning Strategy (TBLS) and Direct Instruction (DI)

		Pretest		Posttest		Effect size	Difference
Strategy	n	Mean	SD	Mean	SD	Mean	SD Mean SD
TBLS	20	20.60	1.76	26.35	2.13	5.75	0.37 0.80 0.02
DI	20	21.20	1.96	26.15	1.57	4.95	0.39

Data in table 1 showed that the difference in the cognitive achievement mean scores of students taught with tutorial-based learning strategy (M= 5.75; SD= 0.37) and those taught with direct instruction (M= 4.95; SD= 0.39) was 0.80; SD= 0.02 in favour of the group taught with tutorial-based learning strategy.

Research question 2: What is the effect of ability grouping on students' cognitive achievement taught geometry using tutorial-based learning strategy and direct instruction?

Table 2: Mean and standard deviation on the effect of ability grouping on students' cognitive achievement taught geometry using tutorial-based learning strategy

			Pretest		Posttest		Effect size	Difference
Strategy	Ability	n	Mean	SD	Mean	SD	Mean	SD Mean SD
TBLS	High	11	21.64	1.75	26.64	2.34	5.00	0.59 1.65 0.85
	Low	9	19.33	0.50	26.00	1.94	6.67	1.44
DI	High	13	22.31	1.25	26.08	1.66	3.77	0.41 3.36 0.12
	Low	7	19.14	1.21	26.29	1.50	7.15	0.29

Data in table 2 revealed that the difference in the cognitive achievement mean scores of the high ability and low ability students taught geometry using tutorial-based learning strategy is (M =1.65; SD =0.85) and those taught with direct instruction is (M =3.36; SD =0.12) in favour of the group taught with tutorial-based learning strategy. It implies that the use of tutorial-based learning strategy reduces the cognitive achievement gap between the high and low ability students than the direct instructional strategy.

Research question 3: What is the difference in the attitude mean rating of students taught geometry with tutorial-based learning strategy and those taught with direct instruction?

Table 3: Mean, standard deviation and mean ranks on students' attitude towards geometry taught with tutorial-based learning strategy and direct instruction

	n	Mean	SD	Minimum	Maximum
Attitude	40	70.50	11.37	32.00	94.00
Ranks	Strategy	n	Mean	Sum of	Difference

			Rank	Ranks	
	TBLS	20	22.93	458.50	4.85
Attitude	DI	20	18.08	361.50	
	Total	40			

Data in table 3 showed that the difference in the attitude mean rating of students taught geometry with tutorial-based learning strategy and those taught with direct instruction is 4.85 in favour of the tutorial-based learning group.

H_{01}: There is no significant difference between the cognitive achievement mean scores of students taught with tutorial based-learning strategy and those taught with direct instruction.

H_{02}: There is no significant effect of ability grouping on students' cognitive achievement taught geometry using tutorial-based learning strategy and direct instruction.

Table 4: Summary of ANCOVA on the difference between the cognitive achievement mean scores of students taught with tutorial based-learning strategy and those taught with direct instruction

Source	Type III Sum of Squares	df	Mean Square	F	P-value.
Corrected Model	8.633[a]	4	2.158	.605	.662
Intercept	151.651	1	151.651	42.507	.000
Pretest	6.030	1	6.030	1.690	.202
Treatment	.035	1	.035	.010	.922
Ability	5.071	1	5.071	1.422	.241
Treatment * Ability	.755	1	.755	.211	.648
Error	124.867	35	3.568		
Total	27696.00	40			
Corrected Total	133.500	39			
a. R Squared =	.065 (Adjusted R Squared =			-.042)	

Data in table 4 showed that there is no significant difference between the cognitive achievement mean scores of students taught with tutorial based-learning strategy and those taught with direct instruction ($F_{(1, 35)}$ = 0.010, p>.05). Therefore, the null hypothesis one was retained at 0.05 alpha level. Data in table 4 also indicated that there is no significant effect of ability grouping on students' cognitive achievement taught geometry using tutorial-based learning strategy and direct instruction ($F_{(1, 35)}$ = 1.422, p>.05). Hence, the null hypothesis two was retained at 0.05 alpha level.

H_{03}: There is no significant difference between the attitude mean rating of students taught geometry with tutorial-based learning strategy and those taught with direct instruction.

Table 5: Mann-Whitney test on difference between experimental and control group over attitude towards learning geometry.

Test Statistics	Attitude
Mann-Whitney U	151.500
Wilcoxon W	361.500
Z	-1.315
Asymp. Sig. (2-tailed)	.188
Exact Sig. [2*(1-tailed Sig.)]	,192[b]

a. Grouping Variable: Treatment
b. Not corrected for ties.

Table 5 showed that there is no significant difference between the attitude mean rating of students towards learning geometry when taught using tutorial-based learning strategy and those taught using direct instruction (Z= -1.315, p=.188). The null hypothesis three was retained at 0.05 alpha level.

V. DISCUSSION OF FINDINGS

Tutorial-based learning strategy and students' cognitive achievement in geometry

Data in table 1 showed that the difference in the cognitive achievement mean scores of students taught with tutorial-based learning strategy (M= 5.75; SD= 0.37) and those taught with direct instruction (M= 4.95; SD= 0.39) was 0.80; SD= 0.02 in favour of the group taught with tutorial-based learning strategy. Data in table 4 showed that there is no significant difference between the cognitive achievement mean scores of students taught with tutorial based-learning strategy and those taught with direct instruction ($F_{(1, 35)}$ = 0.010, p>.05). The present result is in agreement with the findings of Retta and Millicent (2013) and Margolis, Grediagin, Koenig and Sanders (2009). However, the study by Lin (2009) revealed a finding that is not consistent with the finding of this study.

Ability group, tutorial-based learning strategy and students' cognitive achievement in geometry

Data in table 2 revealed that the difference in the cognitive achievement mean scores of the high ability and low ability students taught geometry using tutorial-based learning strategy is (M =1.65; SD =0.85) and those taught with direct instruction is (M =3.36; SD =0.12) in favour of the group taught with tutorial-based learning strategy. It implies that the use of tutorial-based learning strategy reduces the cognitive achievement gap between the high and low ability students than the direct instructional strategy. Data in table 4 also indicated that there is no significant effect of ability grouping on students' cognitive achievement taught geometry using tutorial-based learning strategy and direct instruction ($F_{(1, 35)}$ = 1.422, p>.05). This finding corroborated with past research findings by Adodo and Agbayewa (2011) and Anna (2014).

Tutorial-based learning strategy and students' attitude towards learning geometry

Data in table 3 showed that the difference in the attitude mean

rating of students taught geometry with tutorial-based learning strategy and those taught with direct instruction is 4.85 in favour of the tutorial-based learning group. Table 5 showed that there is no significant difference between the attitude mean rating of students towards learning geometry when taught using tutorial-based learning strategy and those taught using direct instruction (Z= -1.315, p=.188). Studies by Singh, Ahluwalia and Verma (1991) and Kulik and Kulik (1991) revealed that students that are in the experimental group showed a significantly higher favourable attitude to learning. These findings are not consistent with the result of this study. However, the finding of this study is consistent with that of Wong and Fong (2014). Hafidha (2018) reported that the use of CD-based learning delivery mode enhances the attitudes of students.

VI. CONCLUSION

This study on tutorial-based learning strategy and senior secondary students' cognitive achievement and attitude in geometry revealed that there is no significant difference between the cognitive achievement and attitude of students taught geometry using tutorial-based learning strategy and direct instruction. Tutorial-based learning strategy was also found to close the learning gap between the high and the low ability students in Mathematics.

VII. RECOMMENDATIONS

1. Mathematics teachers should blend their face-to-face classroom instruction with CD ROM-based and web-based tutorial learning strategies to improve students' cognitive achievement in Mathematics.
2. Tutorial-based learning strategy should be utilized by teachers to enhance the cognitive achievement of the low ability students through individualized learning.
3. Tutorial-based learning strategy and direct instruction are good instructional strategies for improving the attitude of students towards learning Mathematics.

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