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Instructional Practices on Students' Performance and Retention Ratings in 2 and 3 – Dimensional Shapes in Mathematics

Dr Joyce David Eduok[1], Mr Udofia S. Bassey[2]
Department of Curriculum and Teaching College of Education,Afaha Nsit, Akwa Ibom State.
Department of Political Science College of Education, Afaha Nsit, Akwa Ibom State.
Corresponding Author: Dr Joyce David Eduok

Abstract: *This project investigates the effect of instructional practices on students'achievement and retention rating in selected mathematics concepts, based on learning styles. The mathematics concepts selected include 2 and 3-dimensional shapes an aspect of geometry in mathematics. The population for the study comprised all the 1,156 Senior Secondary two (SS2) mathematics students in all the Senior Science Colleges in Akwa Ibom State. Two research questions were raised and two null hypotheses were formulated to give direction to the study. The research design adopted for this study was non-randomized pre-test, post-test, control group design. The study sample consisted of 200 SS2 students selected from three out of the five existing Senior Science Colleges in the state using purposive sampling technique. The instruments for data collection were: "Mathematics Achievement Test (MAT) and Learning Style Inventory (LSI)". Mathematics Achievement Test (MAT) had a reliability index of .70 determined using Pearson Product Moment Correlation Coefficient (PPMC), while Learning Style Inventory (LSI) had reliability index of .78 determined using Cronbach alpha reliability package in SPSS 17. The experimental group was taught 2 and 3 dimensional shape concepts with student-centred demonstration method while the control group was taught the same concepts using expository strategy. At the end, the Mathematics Achievement Test (MAT) was reshuffled and re-administered as post-test. One month later, the Mathematics Achievement Test (MAT) was reshuffled again and re-administered as retention test. Data collected were analyzed using Analysis of Covariance (ANCOVA) with pre-test scores as covariates. The findings from data analysis showed that, there were significant effects of the instructional strategies used on the achievement and retention ability of the students in geometry in favour of the students taught with Student-Centred Demonstration method; and that learning styles had no significant effect on the achievement and retention of the students in geometry. Based on these observations it is recommended among others that Mathematics teachers should adopt the use of student-centred demonstration method in teaching various concepts in mathematics at Senior Secondary School level.*

Keywords: *Instructional Practices,Student-Centred Demonstration, Geometry, Achievement and Retention.*

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I. Introduction

In modern societies world over, development in science, technology and mathematics is increasingly gaining recognition as one of the most reliable indictors for determining the socio-economic and technological development (UNESCO, 2012). Also, the development of mathematical competence is an important activity, holding a very sensitive position as the "key" for the development of the human intellect. The National Council for Teachers of Mathematics (2010) held that understanding mathematical concepts is essential for the development of mathematical competence. Mathematics according to (Nwoke & Nnaji, 2011) is the study of quantity, structures, space and change. It developed through the use of abstraction and logical reasoning from counting, calculation, measurement, and the study of the shapes and motion of physical objects. The ingredient for the effective articulation of the abstract elements of science that gives impetus to the development of technologies of any nation is based on mathematics. Hence, mathematics is seen as the bedrock of many professional courses. It is accepted in the present world of science and technology as the queen of science and the language of nature and no nation can hope to achieve any measure of scientific and technological advancement without foundation in mathematics (Moore, 2005). The pivotal position of mathematics to individual fulfilment and national developmental goals has consequently led educational policy makers to position mathematics as a compulsory subject (Ubah, 2013). In this regard, the National Policy of Education (FRN, 2014) stipulates mathematics as a core subject for primary school, junior and senior secondary school curricula in Nigeria. In spite of this importance of mathematics to the students and the nation, the achievements of students in both internal and external examinations have remained unsatisfactory for decades.

The Chief Examiner's report (WAEC, 2016) indicated that most students avoid problems in 2 and 3-dimensional shapes. Could it be due to lack of models and misconceptions on the part of the students or instructional strategy used by the teachers? A close look at the past WASSCE questions reveals that there is no year; questions on 2 and 3-dimensional shapes concepts in mathematics are not set in the objective and theory papers. This perhaps shows the role 2 and 3-dimensional shapes concepts plays in the development of students' cognitive domain. The teaching and learning of geometry at secondary level of education still remain a serious problem due to perceived abstract nature of the concepts.

2 and 3-dimensional shapes, an aspect of geometry is an essential part of mathematics curriculum in Nigerian senior secondary schools. School geometry focuses on the development and application of spatial concepts through which learners learn to represent and make sense of the world (Alex, 2015). It is connected to every strand in the mathematics curriculum and to a multitude of situations in real life. It knowledge remains a pre-requisite in fields such as physics, astronomy, art, mechanical drawing, chemistry, biology, etc. It is for these reasons that students are compelled to study 2 and 3-dimensional shapes an aspect of geometry. This is in order to avail a wide range of options from which students can choose appropriate occupations.

Statistics have shown difficulty in teaching and learning of mathematics and has resulted in mass failure in examination and the trend of students' performance has always been on the decline (Adolphus, 2011). According to Alex (2015), teaching begins with a teacher's understanding of what is to be learned and how it is to be taught. Therefore, emphasis should be on pedagogical content knowledge as one of the main categories of the knowledge base of teachers which tunes content to achieve pedagogical outcomes successfully.

Inappropriate use of mathematical models which would help to enhance students ability to retain and recall learnt concepts, has failed to yield any positive results in terms of students' achievement. Students must grasp the fundamentals of mathematics before they can build on and transfer mathematical ideas. Oftentimes, students lack understanding in this subject area and have negative attitudes about learning mathematical concepts.

Expository instruction, which involves direct instruction led mostly by the teacher, has been used by educators in the past and has been effective for some students in terms of computing mathematical problems (Alsup & Sprigler, 2003). Further more, with ineffective methods, instructional resources used are likely to be inadequate and inappropriate. Therefore, the desire to reach more students and increase achievement levels of students has led to an interest of mathematics educators including curriculum planners to consider reform-oriented strategies.

The use of student-centred demonstration as an effective instructional practice which involves the teacher engaging the learners in simple experimental activities such as displaying or exhibiting models with the intent of showing them their correct ways of using them would be investigated to check this problem. Models or manipulative instructional materials in this usage are concrete shapes. They are such devices like plane and solid shapes, patterns, forms and constructions produced by teachers and students to present mathematical ideas in order to make visualization and understanding clear and real. Inappropriate usage of these materials by both the teachers and the students may results in students' poor performance in mathematics.

II. Review of Related Literature

The place of mathematics in the life of any nation cannot be overemphasised because it is linked with the place of development in that nation. In Mathematics Education, teachers are powerful catalyst in the process of development. This is because no matter the calibre of infrastructure and facilities, curricular and instructional materials available in our classrooms without the mathematics teacher playing a central role, it will be difficult to achieve our goals of advancement in science, technology and mathematics education**.** The instructional/pedagogical factor is relevant because the teacher and what he does at the classroom that is, transforming curriculum (geometry content) intentions into potential exposure matters a lot.

There is quite a large body of research which offers several reasons for students' poor performance in mathematics. These studies include that of Alio and Harbor-Peter (2002), Aremu and Tella (2009), and Ubah (2013). The problems identified are in the areas of students' personality characteristics, teachers' competency, inadequate skill for effective teaching and learning and ineffective instructional practices by the teachers. These problems seem to emanate from teachers colleges, to students teachers, then to primary school pupils, and secondary school students.

According to Ubah (2013); mathematics achievement though fluctuating, seems to be predominantly and consistently poor. This poor achievement in senior school certificate examination which covers the past two decades or more has continued to be of immense concerns to educational administrators, researchers, parents and teachers. Again, several authors including Erinosho (2008), Eduok (2013) and Udousoro (2001a) reported students' poor performance in problem solving and retention of learnt concepts in secondary school mathematics examinations. They attributed the situation to teachers' negligence of exploring the problem solving strategies as alternative strategy to replace the expository method which has been the conventional method of teaching mathematics with chalkboard, drawing and sketches.

Educational researchers have tried to experiment with the innovative methods of instruction, inspired by the scientific interventions and technological development in every aspect of life. Alio and Harbor Peters (2002) stated that teachers' non-utilization of the necessary technique in teaching mathematical problem solving is a contributing factor to students' poor achievement in mathematics. Students' characteristics such as learning styles and teacher variables like teachers' instructional practices, competence and appropriate use of resources, are also significant predictors.

Learning style indicates an individual preferred environment for learning through his/her personal cognitive style or habits for processing information to be learned. Learning style indentifies the stimuli most conducive to the effective use of cognitive style. It is therefore an individual's way of learning or approach to learning in which it determines how the individual will utilize his/her various learning abilities to solve problems. Differences in approach in solving problems come as a result of instructional practices and learning styles. It has been established that there are a variety of learning styles present in the classroom such as visual, auditory, tactile, active, reflective, sensing, etc. (Wehrwein, 2006), but the preferred learning style of a student varies from topic to topic and concept to concept. Students have specific learning styles that may influence their academic achievement. According to Yamazaki (2005) many learners fail to achieve an acceptable level of success in mathematics because teaching methods/instructional practice do not cater for their learning styles, suggesting that they can, to some extent, be modified. Learning style is an individual's way of learning or approach to learning in which it determines how the individual will utilize his various learning abilities to solve problems.

Learning style theory is grounded in the works of Van Hiele, Piaget and some other researchers. These theorists were concerned primarily with the developmental aspects of individual differences and learning constructs of intelligence (Keefe, 1982). A comprehensive definition of learning style was adopted by a natural task force of teaching theorists in the field and sponsored by the National Association of Secondary School Principals. This group defined "learning styles" as the composite of characteristic cognitive, affective and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with and respond to the learning environment (Keefe, 1997). The learning process is conceived as environmental, emotional, sociological and physiological. Teachers today are faced with students of varying abilities who differ in the ways they process information. The fostering of diverse styles of learning has been neglected in the teaching of Mathematics. According to Honey (2010), a significant numbers of theorists and researchers have argued that learning styles are not determined by inherited characteristics, but developed through experience. Styles are therefore not necessarily fixed, but can change overtime, sometimes based on instruction practices, even from one situation to the next. Learning style is therefore an individual's way of learning or approach to learning. Students in the class may have more than one learning style. The students who have other learning styles expect instruction appropriate to themselves. Students learning styles vary among individuals, and it is important that teaching methods support a wide variety of learning styles in order to facilitate the best education possible. In this study, only three (3) learning styles would be considered, they are Visual, Auditory and Tactile.

Visual learnersdescribe students whose primary learning preference is to read or observe materials to be learned. When these students are questioned, they usually close their eyes and visually recall the information from diagrammatic or printed materials. Auditory learnersdescribes students whose primary learning preference is listening to verbal interaction such as lectures, discussion or recording. Auditory learners are characterised as learners' who say aloud the information to be learned.Students with tactile perceptual strength need to underline as they read, take notes when they listen to a lecture and keep their hands busy by demonstrating with models/manipulatives.

Maris and Ahmad (2013) investigated learning styles of students on Basic General Mathematics (GSE 212) achievement of students from the school of Arts and Social Sciences and students from the School of Languages in College of Education, Zuba-Abuja. Twenty items on Basic General Mathematics Achievement Test and the Index Learning Styles inventory were used to collect data. The sample size comprised 130 (52%) students from school of Arts and Social Sciences and 120 (48%) students from school of Languages. It was discovered that students from school of Arts and Social Sciences and students from school of Languages with tactile learning style do not achieve equally well in GSE 212 test when exposed to expository teaching strategy compared with students having visual/auditory learning styles. It was discovered that students from school of Arts and Social Sciences and students from school of Languages in the experimental group perform better in terms of achievement and retention irrespective of their learning style.

Olufemi and David (2013), investigated the impact of learning styles on the academic achievement of secondary school students in Ogun State. The Kolb Learning Style Inventory was administered in eight public schools. The mean of test scores in five subjects, namely English, Science, Mathematics, History and Geography, was calculated for each student and used as a measure of academic achievement. A total of 285 students were randomly selected as sample of this study. The results of the analyses of variance show that there is a statistically significant difference in the academic achievement of students that correspond to the three learning styles in mathematics ($F(3, 285) = 9.52$, $p < .05$]; in particular, the mean scores for the tactile group in mathematics was significantly higher than for the visual and auditory groups in mathematics. The overall academic achievement and retention scores of visual, auditory and tactile learners in the experimental group were significantly higher than those in the control group. This shows that, the experimental group students performed better than their control group counterparts in terms of performance and retention irrespective of their learning styles.

Research on learning style demonstrates that individuals differ in their learning style and that no single delivery system is optimal for all students (Yamazaki, 2005). Mathematics teachers should, therefore, use different styles of teaching to match their students learning styles in order to enhance their performance in mathematics (Zinyahs, 2010). The researchers are concerned because learning styles are related to students' performance in mathematics. It seems current instruction and assessment techniques favour certain learning styles of students in different cultures.

Karras (2010) studied a Diagrammatic Reasoning Skills of Pre-Service Mathematics Teachers. The study attempts to explain a possible relationship between diagrammatic knowledge of pre-service mathematics teachers. Diagnostic skill involved a sequence of steps from visuality, to interpretation to formation, are all at the core of teachers content covered for teaching. 2 and 3-dimensional shapes, an aspect of geometry is the area of mathematics curriculum that develops diagnostic reasoning. A group of volunteers of teachers Representation were presented with 'visual proofs' of certain theories and asked to explain the theorem by diagnosing from diagram. The findings were analyzed with respect to the participants Van Hiele level. The study found that, participants who attained higher Van Hiele level were more skilled at recognising visual theorem and ''proving''. The study found a correspondence between participants' diagrammatic reasoning skills and certain behaviours attributed to Van Hiele levels. However, the Van Hiele levels attained by the participants was consistently higher than diagrammatic reasoning skills will indicate.

Researches have found that diverse students benefit immensely when they have the opportunity to interact with materials, participate in activities, and manipulate objects and equipment (Carrier, 2005; Prpric & Hadgraft, 2009). Through laboratories, demonstrations, educational games, simulations, field trips, and other interesting activities, students in secondary school classes have many opportunities to be engaged actively in the learning process (Blair, Schwartz, Biswas, & Leelawong, 2007). Demonstration method are no substitute for laboratory exercise or for learning proper techniques of handling laboratory equipment, but are effective means of supplementing and clarifying the material being taught for effective learning and better retention when considering the students' different learning styles in mathematics instruction.

This research work focused on the use of iconic models in teaching and facilitating students' performance in 2 and 3-dimensional shapes concept in mathematics and retention of learnt concepts. Curriculum developers have been emphasizing on the importance of curriculum materials to learning. These materials are meant for the teachers to make teaching and learning more meaningful and effective. They facilitate the teaching and learning process when properly used and cater for individual differences.

Evidence abound to show that failure of some of the efforts put in place to improve the standard of mathematics education in Nigeria has not necessarily emanated from poor planning or design but mostly from the dearth of competent and creative mathematics teachers in schools (Lewis, 2007). It is unfortunate to note that most of the students in secondary schools fear the study of mathematics. They believe that mathematics is difficult and somehow only reserved for the intellectually gifted, despite the fact that the subject is very important in ones daily life. Thus a pragmatic and conscientious step should be taken to arrest these incidents of mass failure in mathematics so that the nation's desire and expectations may not sink beyond remedy.

Statement of the Problem

The pictures emerging from research reports show that students have difficulty in solving mathematics problems especially those that require mental manipulation. Mathematics education is at the forefront of concern in Nigerian education system. Mathematics is a service subject that is made compulsory in primary schools, junior and senior secondary schools in Nigeria. This indicates that Mathematics is the bedrock of many professional courses and no nation can hope to achieve any measure of scientific and technological advancement without foundation in mathematics. The expository method of teaching which is the dominant method employed does not appear to yield satisfactory results in terms of school achievement and retention of learnt materials. Again, with ineffective methods, instructional resources used are likely to be inadequate and inappropriate.

There is an abundant evidence of poor performance in mathematics in Nigerian school system particularly at the junior and senior secondary school level because of its perceived difficult and abstract nature. To make such difficult and complex ideas less abstract, teachers could adopt various instructional practices and materials. This realization informs the need to employ student-centred demonstration method as an instructional practice, using some models to teach mathematical concepts. The potency of such student-centred method requires empirical evidence, hence this study. The question that can be posed therefore is: Would students' performance and retention of concepts in 2 and 3-dimensional shapes mathematics differ significantly when taught using student-centred demonstration and expository methods given their learning styles?

III. Objectives of the Study

The main objective of this study was to investigate the effect of instructional practices in facilitating students' performance and retention in 2 and 3-dimensional shape concepts under geometry in mathematics in senior science colleges in Akwa Ibom State, given their learning styles.

The specific objectives were:

1. To determine the difference in students' performance in 2 and 3-dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style;
2. To examine the difference in the retention of students in 2 and 3-dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style.

Research Questions

The following research questions were raised.

1. What is the difference in students' performance in 2 and 3-dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style?
2. What is the difference in students' retention in 2 and 3-dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategiesbased on learning style?

Hypotheses

The following null hypotheses were postulated at .05 probability level for the study.

Ho_1: There is no significant difference in students' performance in 2 and 3-dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style

Ho_2: There is no significance difference in students' retention in 2 and 3-dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategiesbased on learning style.

Design of the Study

This study was conducted in Senior Science Colleges in Akwa Ibom State, Nigeria. The research design adopted for this study was non-randomized pre-test, post-test, control group design. The design was considered appropriate as the subjects were used in their intact class setting.

Population of the Study

The population of this study consisted of all the 1,156 students in Senior Secondary two in the five Senior Science Colleges in Akwa Ibom State during the 2016/2017academic session.

Sample and Sampling Technique

The study sample consisted of 200 SS2 students comprising 106 males and 94 females selected from three (3) out of the five (5) existing Senior Science Colleges in the state. Purposive sampling technique was used in the selection of the schools used for the study.

The criteria for selecting the schools were:

i. Schools with functional and separate mathematics laboratory and library.
ii. Schools that have won prizes in mathematics and science competitions.
iii. Schools with graduate teachers consistently, with at least B.Sc degree in Mathematics Education.

The three schools that met the above criteria were purposively selected. Five intact classes were randomly selected from the three schools. This was done in order not to interrupt the normal Mathematics class since the same teacher was to teach the same group of students for the research purpose. The schools were assigned such that two schools had experimental groups and the other one had control group. There were no interactions by the students of the different schools throughout the period of the study to ensure non-interference of the experiences given to each group. The schools were sufficiently far apart with boarding facilities.

Instrumentation

Two instruments were used in gathering data. The instruments were: "Mathematics Achievement Test (MAT) and Learning Style Inventory (LSI)".

Mathematics Achievement Test was a researcher - developed instrument designed to measure students' performance and retention in the selected concept areas. It consisted of 15 – multiple choice items with 4 options A – D. It covered the main topics of 2 and 3 – dimensional shapes in Senior Secondary Two mathematics. To ensure content coverage the items were selected based on Bloom's taxonomy of educational objectives in the cognitive domain as shown in Table 1. A reshuffled version of the instrument was used for retention measurement.

Table 1: A Test Blue Print on 2 and 3 – dimensional Shape

Concept	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Total	%
Perimeter of figures	1	1	-	-	1	1	4	27
Area of plane figures	-	-	1	1	1	-	3	20
Area of solid shapes	1	1	1	1		1	5	33
Volume of solid shapes	-	-	1	1	1	-	3	20
Total	2	2	3	3	3	2	15	100
%	13	14	20	20	20	13	100	-

The Learning Style Inventory (LSI) designed for measuring the respondents' learning styles was adapted from Odessa College Student Success Centre Inventory. The Learning Style Inventory (LSI) was a 17 item four option questionnaire with Strongly Agree; Agree; Disagree; and Strongly Disagree response categories. The items were organized under three subsections:Visual; Auditory; and Tactile. The Strongly Agree; Agree; Disagree and Strongly Disagree response categories were scored 4, 3, 2, and 1 respectively. The positively worded items were scored starting from Strongly Agree as 4, and Strongly Disagree as 1. The highest score, 4 indicate the most positive response while 1 represents the most negative response which suggests the students' most preferred learning style.

The Mathematics Achievement Test (MAT) had a reliability index of .70 while Learning Style Inventory (LSI) had reliability index of .78. The two instruments were considered reliable and capable of measuring the intended constructs with consistency.

Research Procedures

The researcher first visited the sampled schools for conducting the study and presented a letter of introduction from Department of Mathematics, Akwa Ibom State College of Education, Afaha Nsit to the schools' management for permission to use Senior Secondary Two (SS2) students and their mathematics teachers for the study. With permission granted, the research assistants were first randomly assigned to experimental groups and control groups. They were intensively trained for one month in their respective strategies of teaching using the instructional package developed by the researcher. This was followed by the administration of the Mathematics Achievement Test (MAT) as pre-test and Learning Style Inventory (LSI) before the teaching of the selected concepts commenced. The experimental group was taught 2 and 3 – dimensional Shape concepts with student-centred demonstration method while the control group was taught the same concepts using expository strategy - that is, chalkboard drawings and sketches of triangles, rectangles, squares, circle, rhombus, kite, cube, cuboids, cone, pyramids, cylinders, and sphere. They were given the formulae to determine the areas, volumes and perimeters of these figures.

The classroom investigation which lasted for six weeks was strictly supervised by the researcher. At the end the Mathematics Achievement Test (MAT) was reshuffled and re-administered as post-test. One month later the Mathematics Achievement Test (MAT) was reshuffled again and re-administered as retention test. At the end of each test the scripts were collected by the research assistants and handed over to the researcher for scoring and analysis. The data collected were analyzed using Analysis of Covariance (ANCOVA) with pre-test scores as covariates. All hypotheses were tested at .05 level of significance.

IV. Results

Research Question 1: What is the difference in students' performance in 2 and 3-dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style?

Table 2: Summary of mean and standard deviation scores of the students classified by treatment groups and learning styles

Instructional Strategies (Treatment)	Learning Style	Mean	Standard Deviation	N
Student-centred Demonstration (*Experimental*)	Visual	49.20	14.41	40
	Auditory	49.57	14.50	37
	Tactile	46.26	15.47	23
Expository (*control*)	Visual	33.74	13.11	43
	Auditory	24.92	4.54	27
	Tactile	29.93	12.81	30

In answer to research question 1, the mean scores of 49.20; 46.26 ; 49.57 and standard deviation of 14.41; 15.47; and 14.50 for the students with visual, auditory and tactile learning styles respectively, in student-centred demonstration group; and 33.74; 24.93; 29.93 and standard deviation of 13.11; 4.54 and 12.81 respectively, for their counterparts in expository strategy group displayed in Table 2 show that the students with tactile learning styles taught concepts in 2 and 3 – dimensional Shapes using student-centred demonstration had the best performance followed by those with visual learning style in the same group and lastly by those in auditory learning style.

Research Question 2: What is the difference in students' retention in 2 and 3-dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style?

Table 3: Mean and standard deviation scores of the students'retention scores classified by treatment groups and learning styles

Instructional Strategies (Treatments)	Learning Style	Mean	Standard Deviation	N
Student-centred Demonstration (Experimental group)	Visual	49.78	13.91	40
	Auditory	49.57	14.51	37
	Tactile	46.26	15.47	23
Expository (control group)	Visual	36.47	13.95	43
	Auditory	24.93	4.5	27
	Tactile	29.93	12.81	30

In answer to research question 2, the retention mean scores of 49.78; 46.26;49.57; and standard deviation of 13.91; 15.47; and 14.51 for the students with visual, auditory and tactile learning styles respectively, in student-centred demonstration group; and 36.47; 24.93; 29.93; and standard deviation of 13.95; 4.5; and 12.81 respectively, for their counterparts in expository strategy group displayed in Table 3 show that the students with visual learning style taught concepts in 2 and 3 – dimensional Shapes using expository strategy had the best retention followed by those with tactile learning style in student-centred demonstration method group.

Ho_1: There is no significant difference in students' performance in 2 and 3-dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style.

Table 4 Result of one way Analysis of Covariance (ANCOVA) of students' post test scores classified by treatment groups and learning style with pre-test as covariates.

Source	Type III sum of Squares	df	Mean Square	F	Sign.
Corrected model	21995.21	6	3665.87	23.64	.00
Intercept	16180.25	1	16180.25	104.32	.00
Pretest performance	3525.75	1	3525.75	22.73	.00
Instructional strategies	11598.66	1	11598.66	74.78	.00
Learning style	5.86	2	2.93	.02	.98
Instructional strategies *					

Learning style	1693.94	2	846.97	5.46	.01
Error	29934.07	193	155.10		
Total	363032.00	200			
Corrected Total	51929.28	199			
R squared = .42 (Adjusted R squared = .41)					

* Indicate joint / interaction effect

Entries in Table 4 show that the interaction effect which is the main effect is significant at .05 alpha level. At this level of significance, the calculated F-value of 74.78 at 1,193, for the effect of instructional strategies on the performance of students in 2 and 3-dimensional shapeis greater than the critical F- value of 3.84 at .05 alpha, its calculated level of significance is .00, indicating that the instructional strategies used had statistical significant effect on the performance of students in 2 and 3-dimensional shapesbetween those taught using student-centred demonstration and those taught using expository strategy. However, the calculated F-ratio for the influence of learning style on the performance of students at 2,193 is .02, while its corresponding calculated level of significant is .98 alpha. Since the F-value, .02 is less than the F-critical, 2.99, at .05 alpha, it therefore indicates that learning style had no statistically significant effect on the performance of student. Hence, the null hypothesis which assumedthere is no significant difference in the performance of students in 2 and 3 -dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style, isretained. This implies that instructional strategies influence students' performance in the concept and not learning style. Besides, the R^2 of .41 imply that 41% variation on students' performance based on learning style in plane and solid shapes in student-centred demonstration and expository group is explained by treatment in each group.

Ho_2: There is no significance difference in students' retention in 2 and 3-dimensional shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style.

Table 5 Result of one way Analysis of Covariance (ANCOVA) of students' retention scores classified by treatment groups and learning style with pre-test as covariates.

Source	**Type III sum of Squares**	**df**	**Mean Square**	**F**	**Sign.**
Corrected model	20976.85	6	3496.14	21.98	.00
Intercept	16844.10	1	16844.10	105.89	.00
PretestRetention	3157.68	1	3157.68	19.85	.00
Instructional Strategies	9989.49	1	9989.49	62.80	.00
Learning style	279.67	2	139.83	.88	.42
Instructional Strategies *					
Learning style	2448.30	2	1224.15	7.70	.00
Error	30701.23	193	159.07		
Total	373922.00	200			
Corrected Total	51678.08	199			
R squared = .41 (Adjusted R squared = .39)					

* Indicate joint / interaction effect

Entries in Table 5 show that the interaction effect which is the main effect is significant at .05 alpha level. At this level of significance, the calculated F-values of 62.80 at 1,193, and .88 at 2,193 for the effect and influence of instructional strategies and learning style, respectively; on retention of students in 2 and 3 -dimensional shapesis greater thanthe critical F- value of 3.84 at .05 alpha**,** its calculated level of significance is .00.This level of significance is less than .05, indicating that the Instructional strategies and learning styles used had a statistically significant effect on the retention of students in 2 and 3 - dimensional Shapes when taught using student-centred demonstration and when taught using expository instructional strategies.

Hence, the null hypothesis which assumed that there is no significant difference in students' retention in 2 and 3 - dimensional Shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style,is rejected. The alternative hypothesis that there is significant difference in students' retention in 2 and 3 - dimensional Shapes between those taught using student-centred demonstration and those taught using expository instructional strategies based on learning style,is retained. This implies that the use of student-centred demonstration enhances students' retention in 2 and 3 - dimensional shapes irrespective of the students' preferred learning style than the use of expository strategy. Besides, the R^2 of .39 imply that 39% variation of students' retention based on learning style in 2 and 3 -dimensional shapes in student-centred demonstration and expository strategy is explained by treatment in each group.

Summary of the Findings

The findings were as follows:

1. The Student-centred Demonstration instructional strategy used had statistically significant effect on the performance of students in 2 and 3 - dimensional Shapes.
2. There was no significant effect of learning styles on students' performance in 2 and 3-Dimensional shapes when taught with student-centred demonstration strategy.
3. The Student-centred Demonstration instructional strategy used had statistically significant effect on the retention of students in 2 and 3- dimensional shapes.
4. There was significant effect of learning styles on students' retention in 2 and 3 - dimensional shapes when taught with Student-Centred Demonstration strategy.

V. Discussion of Findings

The study showed that the use of student-centred demonstration strategy significantly enhanced student's achievement and retention in learning 2 and 3 dimensional shapes in mathematics over and above those taught using the expository strategy. This result could be attributed to the fact that when the student-centred demonstration is employed, the students themselves get involved in the creation of the shapes and so understand the steps and the processes the shapes are formed. The shapes are therefore no more abstract but are real. Further-more, the use of student-centred demonstration strategy provides the students the opportunity to employ multi-sensory perception involving the cognitive, reasoning skills, the psychomotor- manipulative skills and perhaps the affective skills- the feelings or disposition.

The use of these multi-sensory perceptions deepens understanding and consolidates learning which manifest in performance and retention. The finding of this study is in consonance with that of Prpric and Hadgraft, (2009) who found that diverse students benefit immensely when they have the opportunity to interact with materials, participate in activities and manipulate objects and equipment.

The study further revealed that learning styles had no significant effect on student performance but had significant effect on their retention in 2 and 3 dimensional shapes in mathematics when taught with either students - centred demonstration strategy or the expository strategy. This result could be explained by the fact that in the actual learning situation the students do not necessary use only one learning style in total exclusion of the others but employs a combination of learning styles. It therefore means that when the instructional strategy is right the so called dominant or most preferred learning styles of the individual student would have little or no effect on the overall learning concept.

This finding collaborates that of Olafemi and David (2013) who found that the overall academic achievement and retention scores of visual, auditory and tactile learners in the experimental group - student-centred demonstration group, were significantly higher than those in the control group - expository group. This further underscores the fact that when appropriate instructional strategy is adopted by the teacher, the student would learn, perform and retained better irrespective of their learning styles.

VI. Conclusions

Based on the findings of this study, it is concluded that the use of student-centred demonstration using models in teaching and learning of plane and solid shapes enhances Senior Secondary Two (SS2) students' performance and retention better than the expository strategy irrespective of their learning styles.

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Recommendations

Based on the findings and conclusion drawn, the following recommendations are made:

1. Mathematics teachers should adopt the use of student-centred demonstration strategy in teaching various mathematical concepts at Senior Secondary School level.
2. All students should be encouraged by their teachers and parents to study mathematics irrespective of their learning styles.
3. The government and school proprietors should consider establishment of well equipped mathematics laboratory in every school as a priority as this is necessary for effective practical demonstration and active involvement of learners in the teaching learning process.
4. Conferences, workshops and seminar should be organized for employers and Mathematics Teachers Association to acquaint them with the use of student-centred demonstration strategy.

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