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Effects of Instructional Charts and Pictures on Students' Academic Achievement in Pythagoras Rules in Abuja

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Abstract - Instructional materials such as charts and pictures are important in the teaching and learning of mathematics. This is because they help students to visualize the concepts that are being taught. In other words, they help to remove abstract nature of some concepts and make lessons learnt to be permanent. A quasi-experimental research design was adopted. Therefore, this study investigated the effect of instructional charts and pictures on students' academic achievement in Pythagoras rules in Abuja. Two research questions were answered and two null hypotheses were tested at 0.05 level of significance. A sample of 105 junior secondary two (JSS2) participated in the study. The instrument for data collection was Mathematics Achievement Test which contained 20 objective test items validated by specialists in mathematics and measurement and evaluation. The reliability index of the instrument established using Kuder Richardson 20 was 0.76. The results of the study showed that charts and pictures have significant effects on the academic achievement of students in mathematics in Abuja. It was therefore recommended among others that training, seminars and workshops should constantly be organized for mathematics teachers on the appropriate use of instructional materials for effective teaching and learning.

Keywords - Instructional materials, charts, pictures, Academic Achievement, Mathematics.

I. INTRODUCTION

The main purpose for teaching is to impart knowledge to the learners. At the centre of this impartation of knowledge to the learners is the teacher. The teacher adopts different methods of imparting knowledge to the students. The use of instructional materials is one of the methods used by the teacher to ensure that qualitative knowledge is imparted to the students. What then is an instructional material? Instructional materials are equipment, objects or facilities used during instructions to enhance learning.

They are teaching aids which enhance information reception, processing, storing and retrieval by the students. Nwankwo, (2020) referred to them as objects or devices, which help the teacher to make a lesson much clearer to the learner. Instructional materials, also referred to as teaching materials are any resources, whether human or non-human, animate or inanimate, which educators utilize to facilitate learning and help students attain specific instructional objectives (Wikipedia, 2025). In general term, instructional materials facilitate students' understanding and remembering of the concepts taught by concretizing learning. They help to demystify some concepts, arouse and sustain the students' interest in learning. These instructional materials help the mathematics teachers to convey the intended message effectively and meaningfully to the students. Instructional materials help students to understand, retain and apply the experiences gained from such learning to reach the overall goals of education, since the aim of education is to bring about the desired positive changes in the learners. Knezewich (2019) stressed the importance of having appropriate personnel plan and adequate physical facilities to support educational effort.

However, instructional materials are vital to the success and achievement of educational goal. Okpe (2018) was of the opinion that the use of instructional resource would make discovered facts glued firmly to the memory of students. Instructional materials enhance the memory level of the students. Thus, the teacher has to use instructional materials to make the teaching and learning process interesting (Amos, Eghan & Oppong, 2022). Instructional materials can be broadly categorized as print and non-print items that are designed to impart information to students in the educational process. Instructional material include items such as kits, specimen, textbooks, magazines, pictures, charts, slides, video discs, workbooks and electronic media including but not limited to music, movies, radio, software, templates, teaching guides, flowcharts and graphs.

A chart is a visual representation of data, information or ideas, designed to make complex information easier to understand at a glance. (Adekunle, 2017). A chart is a useful way to present and display information in the classroom. It facilitates the process of presentation in the class. A chart is a veritable tool that can assist students to think independently and solve problems when working to mastery level. When learning processes are broken down and displayed for students in charts, it is easier and more convenient to assimilate, master and internalize the concepts taught. For charts to be effective instructional aids, they must display contents that are current and support complex skills. The chart, its purpose and uses must be clear to the students for easy understanding. The charts should have visuals which may include symbols, pictures or photos to go with words. From the foregoing, charts help students to understand clearly what the teacher is illustrating.

Beside chart, pictures are good instructional materials that are often used by experienced teachers to make the lesson clearer. Pictures are images produced from cameras showing photographs of people or events. Pictures in comparison to charts are more details and can pass more information in complex and expressive ways. Generally speaking, pictures as visual aids constitute one of the most effective, most copious and least expensive teaching medium. A picture can be a catalyst giving rise to the production of thousands of words and a multitude of creative and analytical thoughts (Okpe, 2018). When pictures are used appropriately and sequentially, it will not only illustrate a topic but can also provide students based experience, required in order to profit from teaching and learning of mathematics and from numerous other learning experiences. Mathematics is the bedrock of all science related courses, it is the foundation of all technological advancement. Being aware of this, the federal government of Nigeria through the National Policy on Education (NPE, 2014), maintained the compulsory learning of mathematics at all levels of education up to tertiary level. Due to this, the government, at all levels is making serious effort to provide high quality mathematics education. It is worthy of note that recognizable attempts by various stakeholders, have been made in the past to enhance mathematics teaching and learning, despite the efforts made, the performance of students has not been encouraging. This is the reason the Federal Government of Nigeria is considering it necessary to employ the use of instructional materials in the teaching and learning of mathematics concepts.

The Pythagoras theorem also referred to as the Pythagorean Theorem is the most famous formula in mathematics that defines the relationship between the sides of a right triangle. This theorem is attributed to a Greek Mathematician and Philosopher named Pythagoras (569 – 500 B.C.A.). The Pythagoras theorem is a mathematical law that states that: the sum of squares of the lengths of the two (2) short sides of the right triangles (adjacent and opposite) is equal to the square of the length of the longest side (hypotenuse). Below are the properties of a right – angled triangle:

- One angle is always 900 or right angle;
- The side opposite angle of 900 is the hypotenuse;
- The hypotenuse is always the longest side;
- The sum of the other two (2) interior angles is equal to 900.

- The other two (2) sides are: adjacent to the right angle are called base (adjacent) and perpendicular (opposite) respectively

There have been several studies on instructional materials and academic achievement, For instance, Nwankwo (2020) conducted a study on the effects of instructional charts and pictures on students' academic achievement in social studies in Rivers state. The results of the study showed that charts and pictures have significant effects on the academic achievement of students in social studies in Emohua Local Government Area of Rivers State. Abel (2018) carried out a study on the effects of specimen and charts on the academic achievement of secondary school students in Physics. The post-treatment results showed that specimen and charts produced an increase in students' academic achievement in comparison to the students who were taught without any instructional materials. The gain in academic achievement was found to be significant at 0.05 probability level. Haruk (2018) conducted a study on the influence of pictures and mockups on the academic performance of students in Biology among secondary schools in central district of Suleja, Nigeria, Nigeria. The findings of the study indicated that pictures and mockups improved the academic performance of students taught using them up to the tune of 30 percent compared to those taught without instructional materials. The gain in academic performance for those taught using pictures and mockups was significant at the given 0, 05 probability level.

Most of the studies on instructional materials especially the studies involving chart and pictures are conducted outside Abuja to best of the knowledge of the researcher. It is the dearth of studies on charts and pictures as instructional materials in Abuja that prompted the researcher to embark on the present study which investigated the effects of charts and pictures instructional materials on the academic achievement of students in mathematics in Abuja.

Statement of the Problem

Instructional materials such as charts and pictures are very important in the teaching and learning of mathematics. They help make learning meaningful as they concretize learning. With charts and pictures instructional materials, internalization of the mathematics concepts learnt by the students is high. Knowledge gained using these instructional materials is permanent. Without the use of these instructional materials, students may find it difficult to understand and internalize concepts. Remembering and recall of information may also be hindered in the absence of charts and pictures. Therefore this study investigated the effects of charts and pictures instructional materials on the academic achievement of students in Pythagoras rules in Abuja.

Purpose of the Study

The purpose of this study was to find out the effects of charts and pictures as an instructional materials on the academic achievement of students in mathematics in Abuja, specifically, the study set out to determine the;

- Effects of charts on the academic achievement of students in mathematics in Abuja
- Effects of pictures on the academic achievement of students in mathematics in Abuja

Research Questions

The following research questions guided the study;

- What is the effects of charts on the academic achievement of students in Pythagoras rules in Abuja?
- What is the effects of pictures on the academic achievement of students in Pythagoras rules?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance

H01: There is no significant effects of charts on the academic achievement of students in mathematics in Abuja.

H02: There is no significant effects of pictures on the academic achievement of students in mathematics in Abuja.

II. METHODOLOGY

The students of junior secondary school Two (JSS2) were involved in this study. The study was conducted using 105 students from three intact classes of a school. There were 32 students in class A, 38 students in class B and 35 students in class C. Classes A and B made up the experimental group while class C is the control group. Students in class A were taught Pythagoras rules using charts. While students in class B were taught the Pythagoras rules using pictures. Students in class C (control) were taught the same topic without any instructional materials. Prior to the treatment, students' result in mathematics for the preceding term were obtained, which served as pretest scores.

The instrument for data collection was Mathematics Achievement Test which consisted of 20 objective test items on the Pythagoras rules. The instrument was validated by two specialists, one in mathematics Education and the other from Measurement and Evaluation. The data collected from the study was analyzed using both descriptive and inferential statistic. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. The reliability index obtained using Kuder-Richardson 20, (K-R20) was 0.76. The instrument was administered to the students by the researcher after the treatment and the students' scores were used as post-test scores. Each correctly answered question attract one mark. Therefore, the maximum point obtained by a student was 20 while the minimum mark was 0.

Results

The pretest and posttest data obtained from students' results were subjected to analysis using SPSS. The results are presented below.

Research Question One: What is the effects of charts on the academic achievement of students in Pythagoras rules in Abuja?

Table 1: Means and Standard Deviation for students taught Pythagoras rules using charts instructional materials.

Group	Before treatment			After treatment		
	N	_x	Std	N	x	Std
Control	35	5.91	1.92	35	12.26	2.01
Charts	32	5.78	2.14	32	15.63	1.62

Table 1 shows that mean and standard deviation for the 35 students taught Pythagoras rules without using any instructional materials (control group) prior to treatment are 5.91 and 1.92 respectively. For their counterparts taught the same topic using charts as instructional material, the mean prior to treatment is 5.78 and the standard deviation is 2.14 and after treatment, the mean is 15.63 while the standard deviation is 1.62. The difference in mean between the two groups after treatment is 3.37 in favour of the students taught using charts as instructional materials. Hence, the use of charts as instructional materials resulted to an increase in academic achievement in comparison to the control group.

HO1: There is no significant effect of charts on the academic achievement of students in Pythagoras rules in Abuja

Table 2: Result of Analysis of Covariance (ANCOVA) for the effect of charts on Students' Achievement in Pythagoras rules in Abuja

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	189.855	2	94.927	27.877	0.00
Intercept	1320.652	1	1320.652	387.827	0.00
Covariate	0.249	1	0.249	0.073	0.79
Group	189.853	1	189.853	55.753	0.00
Error	217.936	64	3.405		
Total	13289.0	67			

Table 2 presents the result of ANCOVA on Achievement Scores for Students taught Pythagoras rules using Charts. The Table revealed that the P value for the methods was 0.000, since $P < 0.05$, where 0.05 is the level of significance for the study. The null hypothesis that there is no significant effect between the mean achievement scores of students taught Pythagoras rules using charts and

Conventional method was therefore rejected. This means that there is a significant difference between the mean achievement score of students taught Pythagoras rules using charts and Conventional method. This implies that the students taught Pythagoras rules using charts improve on their mean achievement scores than conventional method.

Research Question Two: What is the effects of pictures on the academic achievement of students in Mathematics?

Table 3: Means and Standard Deviation for students taught Pythagoras rules using pictures as instructional materials.

Group	Before treatment			After treatment		
	N	_x	Std	N	x	Std
Control	35	5.91	1.92	35	12.26	2.01
Pictures	38	6.29	2.03	38	17.29	1.21

Table 3 shows that mean and standard deviation for the 35 students taught Pythagoras rules without using any instructional materials (control group) prior to treatment are 5.91 and 12.26 respectively. For their counterparts taught the same topic using pictures as instructional material, the mean prior to treatment is 6.29 and the standard deviation is 2.03 and after treatment, the mean is 17.29 while the standard deviation is 1.21.

The difference in mean between the two groups after treatment is 5.03 in favour of the students taught using pictures as instructional materials. Hence, the use of pictures as instructional materials resulted to an increase in academic achievement of students in Pythagoras rules.

HO2: There is no significant effect of pictures on the academic achievement of students in Pythagoras rules in Abuja

Table 4: Result of Analysis of Covariance (ANCOVA) for the effect of pictures on Students' Achievement in Pythagoras rules in Abuja

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	462.158	2	231.079	85.255	0.00
Intercept	1407.772	1	1407.772	519.385	0.00
Covariate	0.769	1	0.769	0.284	0.60
Group	453.561	1	453.561	167.337	0.00
Error	189.732	70	2.71		
Total	16808.000	73			

Table 4 displays the result of ANCOVA on Achievement Scores for Students taught Pythagoras rules using pictures. The Table revealed that the P value for the methods was 0.000, since P < 0.05, where 0.05 is the level of significance for the study. The null hypothesis that there is no significant effect between the mean achievement scores of students taught Pythagoras rules using pictures and conventional method was therefore rejected. This means that there is a significant difference between the mean achievement score of students taught Pythagoras rules using pictures and Conventional method. This implies that the students taught Pythagoras rules using pictures improve on their mean achievement scores than conventional method.

Discussion of Findings

It was discovered that the use of charts and pictures in this study enhanced the academic achievement of students in Pythagoras rules, while those taught without the instructional materials did not have any appreciable increase in their academic achievement. The finding that charts and pictures have significant effects on the academic achievement of students is similar to the findings of Nwankwo (2020), Popoola (2010), Moronfolu (2018) and Haruk (2020). The study conducted by Nwankwo, (2020) asserted that charts and pictures have significant difference on the academic achievement of students in socials studies in Emohua Local Government Area of Rivers State from those taught without instructional materials. Amos, Eghan & Oppong, (2022) reported a significant difference between students taught using charts and models instructional materials and those taught without instructional materials, in favour of students taught with instructional materials.

Moronfolu (2018) carried out a study on the effects of pictures and video on the academic achievements of students in Ilorin, found a significant effect of picture and video on the academic achievement of students. Haruk (2018) conducted a study on the influence of pictures and mockups on the academic performance of students in Biology among secondary schools in central district of Suleja, Nigeria and reported that pictures and mockups improved the academic performance of students to the tune of 30 percent compared to those taught without any instructional materials.

The findings that the use of charts and pictures have significant effect on the academic achievement of students can be explained from the fact that charts and pictures as good instructional materials help the students to visualize the concepts being taught. They assist the students to form mental images of concepts, thereby helping to concretize the concept. With these instructional materials, the possibility of concretizing learning is high. They make learning easy, interesting, refreshing and enjoyable. They help to remove the abstract nature of some concepts and at the same time make learning long lasting. With these instructional materials, the students can process, store retrieve or recall information easily. Hence, the students taught Pythagoras rules using these instructional materials internalize concepts making it easy to remember the concepts taught for a long time.

III. CONCLUSION

The use of charts and pictures in the teaching of Pythagoras rules is very important, as these instructional materials have been found in this study to enhance the academic achievement of students, they help to remove the abstract nature of some concepts and at the same time make learning long lasting.

Recommendation

Based on the findings of this study,

- It is therefore recommended that mathematics teachers should imbibe the culture of using charts and pictures in the teaching of Pythagoras rules.
- Trainings, seminars and workshops should constantly be organized for mathematics teachers on the appropriate use of instructional materials for effective teaching and learning.
- Governments and educational institutions should ensure an adequate and consistent supply of instructional materials for schools.

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