

## **Pupils' Achievement on Perimeter and Area of Two-Dimensional Shapes in Primary School Mathematics: The Use of Counting and Mathematical Formula Approaches**

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### **Abstract**

This study examined Pupils Achievement in Two-Dimensional Shapes in Primary School Mathematics: The Use of Counting and Mathematical Formula Approaches. The study adopted quasi-experimental design specifically pretest posttest nonequivalent group. Three research questions and three hypotheses guided the study. Sample size of 95 pupils was used for the study. Achievement Test on 2-D shapes (AT2D) was validated and used for data collection. It's Reliability coefficient was 0.75. Mean and standard deviation were used to answer research questions. ANCOVA was used to test the hypotheses at 0.05. The findings of the study showed that pupils' taught perimeter and area of 2-D shapes using counting approach had higher achievement than those taught using mathematical formula and no significant difference in the mean achievement of male and female pupils. It was recommended among others that primary school teachers should use counting teaching approach in teaching of perimeter and area of 2-D shapes.

**Keywords:** Counting teaching approach, mathematical Formula approach, Primary school mathematics, poor Achievement, two-dimensional shapes.

### **Introduction**

Pupils' poor achievement in mathematics learning has become a worry to educational bodies given the roles and objectives of primary school Mathematics to development of the nation. The knowledge of mathematics is important in the success of every learner even in their day to day activities. According to Nwoye (2017), Mathematics is said to be the knowledge of shapes, numbers and operations on the shapes that helps to describe and predict things about the world around us. In order to raise safer and better people in life, more emphases must be laid on how to get more knowledge of mathematics to be able to apply the knowledge in solving real life problems (Ugwuanyi, 2015).

One of the roles of mathematics is that it prepares individuals and society through exercises acting on logical, rational, critical, accurate, honest, effective and efficient thinking, just to mention but few. The Federal Republic of Nigeria made mathematics a core, compulsory and everyday subject in the primary school level of Education (NPE, 2014). It is at the primary school level that a child is

introduced to mathematics and the skills needed in solving future mathematics problems in order to give the pupils a good background of the subject and also make them to love and have high achievement in the subject. It is also at this level that the learner learns the basic operations like addition, subtraction, multiplication and division that is constantly used in mathematics learning even in higher level of learning. Some topics are introduced to the learner at this early stage of learning, which will enable the learners have the foundational knowledge of Mathematics.

Some topics such as volume, speed, square just to mention but few are taught at this level and the combination of these topics in the primary school curriculum are known as primary school mathematics (Nwoye, 2017). According to Muranov, Polikarpov and Rudchenko (2023) defined Primary School Mathematics as those topics that are used to train learners on how to make calculations and measurements. The branches of mathematics that are taught in Primary School Mathematics are; Algebra, Number and Numeration, Arithmetic, Quantitative

Reasoning, Geometry. Geometry is a branch of mathematics that deals with shapes both two dimensional and three dimensional shapes. According to Joseph, Mirian and Kathryn (2023) 2-Dimensional shape is a geometrical concept of a flat surface with no edges or thickness. These shapes are also called plane or flat shapes and they include: square, rectangle, triangle, circle and their perimeter and areas can also be find. Danielle, Jennifer and Kathryn (2023) defines perimeter of a geometric shape as the outline, path or distance around a 2-dimensional shape particularly polygons where an area can be obtained.

The area of a figure is the number of unit squares that covers the surface of a closed figure. According to Danielle, Jennifer and Kathryn (2023), an area of a figure is the total space taken up by a flat (2-D) surface or shape of an object. Area is measures in squared units like  $\text{cm}^2$  and  $\text{m}^2$ . Finding the perimeter and area of 2-dimensional shape involves the use of Mathematical formula. But the question is: can the Pupils' be able to remember these formulae? If they can, will it be possible to substitute correctly in the formula? Can the use of mathematical formula approach enhance pupils' achievement in mathematics learning mostly in perimeter and area of 2-D shapes?

Achievement in mathematics is simply how well a learner performed in an assessment. Nwoye (2017) defined achievement as the pupils' success in meeting up of short or long mapped out goals or objectives. In Mathematics, specifically in perimeter and area of 2 -D shapes, pupils' achievement is related to the ability of pupils' learning and having a clear understanding of the topic taught and graduating with good grades in the subject. Reports on pupils' achievement in mathematics paints a disheartening picture. Earlier researchers attributed pupils' poor achievement in mathematics learning to different factors such as: pupils' negative attitude toward mathematics, fear of mathematics (Adeyemi, 2018), lack of the use of physical presentation in teaching (Nwoye, 2017), poor teaching approaches used (Okoli, 2016). Nasiba, Bunyod and Ravshan (2021) defined teaching approach as an enlightened viewpoint towards teaching. This is the form or the way the teacher teaches or how they do it, it is the overall view or ideas to face a problem (Arvind, 2017). One of the teaching approach widely use in mathematics teaching in schools is mathematical formula.

The use of Mathematical formula is teaching from complex to simple. Mathematical formula is a guide used in solving some mathematics problem. According to Dharmendra (2017) mathematical

Formula is a fact, rule, or principle that is expressed in terms of mathematical symbols. These mathematical formulae have gone a long way in the teaching and learning of mathematics, even in finding perimeter and area of 2-D shapes in the classroom, however, these formulae have caused pupils to avoid the learning of primary school mathematics because of the complication of some of mathematical formulae. Pupils do not really understand how this rules were derived (Idigo, 2019).

If an approach that is from simple to complex is used in mathematics learning, it will help the Pupils' to understand the content and also realize how the formulae were derived, it will also enable the Pupils' to understand and be able to identify how the concepts can be solved (Nasiba, Bunyod & Ravshan, 2021). Moreover, when pupils derive formula by themselves, through practical or activity based approach, a huge contribution is made to understanding the subject (Pale, 2016). Such teaching approach that is more of learning by doing and which involves the use of concrete objects such as counting teaching approach will enable the pupils to practices mathematics on their own. The use of concrete object will remove the abstractness in finding the Perimeter and Area of 2-D shapes and this will make the pupils to engage with learning activities such as counting.

Counting approach is a repeated pattern of shapes used to fill any space without any overlapping. According to Eberle (2020), counting approach is repeated patterns of geometric shapes that fill the plane surface with no gaps whereby the geometric shapes are counted to get the actual sum. According to Waters (2019) Counting approach is the arrangement of shapes to form spatial patterns, involve patterning skills and knowledge of shape, space and angle. While the angle in counting approach is a concept that can be used with older age (12 and above) group pupils', the concepts of translation, rotation, reflection, pattern skills and knowledge of shape, space can be used with younger age (7-11years) groups. Any shape given whether regular or irregular shapes can be perpetually maintained in all directions (Değer & Değer, 2019). This approach is a mathematical object as well as a mathematical approach used in teaching perimeter and area of 2-D shapes in the primary school level irrespective of gender.

Gender is an attribute used in distinguishing a male or female. According to Ewumi (2016) gender involves psychological and social-cultural development of being male or female.

Babajide (2020) opined that science subjects especially mathematics are given masculine outlook

by educational practitioners, this is due to the long held view that female are weaker vessels who cannot stand the stress and strain involved in problem solving. It has become a general feeling that mathematics is boy's domain. Anita and Mary (2023) revealed that males tend to do better on mathematics tests while Filgona (2016), Ajai and Imoko (2015), find that the females tend to have higher achievement in mathematics.

Therefore, it is important to verify whether pupils' can have higher achievement when counting approach is used in mathematics basically in perimeter and area of 2-D shapes.

### Research Questions

The following research questions were posed to guide the study.

1. What are the mean achievement scores of pupils taught Perimeter and Area of 2-D shapes using counting approach and those taught using Mathematics formula approach?
2. What are the mean achievement scores of male and female pupils' in Perimeter and Area of 2-D shapes?
3. What is the mean interaction effect of teaching approach and gender on pupils' achievement in Perimeter and Area of 2-D shapes?

### Hypotheses

The following hypotheses were tested at 0.05 level of significance.

- Ho<sub>1</sub>:** There is no significant difference in the mean achievement scores of pupils taught Perimeter and Area of 2-D shapes using counting approach and those taught using Mathematics formula
- Ho<sub>2</sub>:** There is no significant difference in the mean achievement scores of male and female pupils' in Perimeter and Area of 2-D shapes.
- Ho<sub>3</sub>:** There is no significant difference on mean interaction effect of teaching approaches and gender on pupils' achievement in Perimeter and Area of 2-D shapes.

### Design of the Study

The study adopted a quasi-experimental design. Specifically, pretest-posttest non-equivalent control groups design was used.

### Area of the Study

The study was carried out in Udi Local Government Area of Enugu state. The Local Government Area shares a common boundary with Enugu North Local Government Area by the North, Oji River Local Government Area by East, Udi Local

Government Area by the west and Ezeagu Local Government Area by South of the same state.

### Population of the Study

The population of the study comprised 1,769 primary five pupils in the fifty-four (54) public primary schools in Udi Local Government Area of Enugu State of which 965 are males and 804 are females. The choice of primary school was because the content of the study is first introduced at this level and it is further taught at the upper basic and senior secondary school.

### Sample and Sampling Technique

The sample size for the study was 95 primary five (5) pupils which were drawn purposively from two (2) public primary Schools. Purposive sampling technique was used to select two schools in the Local Government Area since the researcher considered schools with two or more streams of class so that the two teaching approaches can be effectively used. Then, simple Random Sampling Technique (balloting without replacement) was used to select four (4) classes (two classes from each of the two schools) in order to give the pupils' equal opportunity and for the purpose of effective result during the experiment.

### Instruments for Data Collection

The instrument developed by the researcher was used for data collection, namely; Achievement Test on Perimeter and Area of 2-D shapes (ATPA). Three experts validated the instrument, the experts were asked to check the sentence formation and content of the instrument if it's in line with primary 5 curricula. The reliability coefficient of ATPA obtained using Kendall's coefficient of concordance (W) was found to have a reliability index of 0.75. The choice of Kendall's coefficient of concordance (W) was due to the fact that the marking and scoring of the test items were ranked since it was an essay test type,

### Experimental Procedure

The experiment which lasted for four weeks had its first week used for seeking permission for the selected school authorities, training of research assistants and also administering pretest to the pupils'. The research treatment commenced in the second week and lasted for two weeks. The fourth week was used to administer the posttest. The pretest and posttest on Achievement test on perimeter and area of two dimensional shapes (ATPA) questions were administered to both experimental group A and B. The data collected for the pretest and posttest on the instrument were analyzed separately for the two groups, which were used to answer the research questions and hypotheses for the study. The total duration for the study was four weeks.

### Data Analysis Technique

Data collected were analyzed using Statistical Package for Social Science (SPSS). Mean and Standard deviation was used to answer all research questions while Analysis of covariance

(ANCOVA) was used to test the hypotheses at 0.05 level of significance. If the probability value is less than the .05 then the hypotheses will be rejected but if its greater than 0.05, the hypotheses will be accepted.

### Results

This section presents the results of data analysis in line with the research questions and hypotheses.

**Table 1: Mean analysis of the mean achievement scores of pupils taught Perimeter and Area of 2-D shapes using counting approach and those taught using Mathematics formula approach**

Treatment Group	N	Pretest		Posttest		Mean gain
		Mean	Std. Deviation	Mean	Std. Deviation	
Counting approach	47	24.26	12.65	60.72	14.91	36.46
Mathematical formula	48	23.71	12.52	36.10	20.19	12.39

Table 1 shows that pupils who were taught perimeter and area of 2-D shapes using counting approach had mean achievement scores of 24.26 (SD = 12.65) at pre-test and 60.72 (SD = 14.91) at posttest. Similarly, pupils who were taught perimeter and area of 2-D shapes using Mathematics formula approach had mean achievement scores 23.71 (SD = 12.52) at pretest and 36.10, (SD = 20.19) at posttest. Mean gain scores of 36.46 and 12.39 for the pupils taught perimeter and area of 2-D shapes using counting approach and those taught using Mathematics formula approach respectively, indicate that the

pupils taught perimeter and area of 2-D shapes using counting approach had higher posttest mean achievement score than their counterparts taught using mathematical formula approach. Moreover, the posttest standard deviations of 14.91 and 20.19 for the pupils taught area and perimeter of 2-D shapes using counting approach and those taught using Mathematical formula approach respectively, show that the individual achievement scores of pupils taught using mathematical formula approach varied widely from their group mean than those taught using counting approach.

**Table 2: Analysis of covariance of the effect of teaching approach on pupils' Achievement in Perimeter and Area of 2-D shapes**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	15491.145 <sup>a</sup>	4	3872.786	12.323	.000	.354
Intercept	57348.641	1	57348.641	182.483	.000	.670
Pretest	753.245	1	753.245	2.397	.125	.026
Treatment	13831.837	1	13831.837	44.013	.000	.328
Gender	295.802	1	295.802	.941	.335	.010
Treatment * Gender	23.468	1	23.468	.075	.785	.001
Error	28284.181	90	314.269			
Total	265255.000	95				
Corrected Total	43775.326	94				

Table 2 reveals that there is a significant difference in the mean achievement scores of pupils taught Perimeter and Area of 2-D shapes using counting approach and those taught using Mathematics formula in favour of the pupils taught using counting approach,  $F(1, 90) = 44.013, p = .000$ .

Thus, the null hypothesis is rejected since the probability value of .000 is less than the .05 level of significance. Besides, the effect size of .328 implies that 32.8% improvement in pupils' achievement in perimeter and area of 2-D shapes is as result of their exposure to tessellation approach.



**Table 3: Mean analysis of the mean achievement scores of male and female pupils in Perimeter and Area of 2-D shapes**

Gender	N	Pretest		Posttest		Mean gain
		Mean	Std. Deviation	Mean	Std. Deviation	
Male	54	23.61	12.52	50.48	20.83	26.87
Female	41	24.46	12.65	45.39	22.45	20.93

Table 5 shows that male pupils had mean achievement scores of 23.61, ( $SD = 12.52$ ) at pretest and 50.48, ( $SD = 20.83$ ) at posttest. Similarly, female pupils had mean achievement scores of 24.46, ( $SD = 12.65$ ) at pretest and 45.39, ( $SD = 22.45$ ) at posttest. Mean gain scores of 26.87 and 20.93 for the male and female pupils respectively, indicate that the male pupils had higher posttest mean achievement scores than their female. Moreover, the posttest standard deviations of 20.83 and 22.45 for male and female

pupils respectively, show that the individual achievement scores of female pupils varied widely from their group mean than the male pupils.

Table 2 reveals that there is no significant difference in the mean achievement scores of male and female pupils in perimeter and area of 2-D shapes,  $F(1, 90) = .941$ ,  $p = .335$ . Thus, the null hypothesis is not rejected since the probability value of .335 is greater than the .05 level of significance.

**Table 4: Mean analysis of the achievement scores of male and female pupils' taught perimeter and Area of 2-D shapes using counting approach and those taught using Mathematics formula approach**

Treatment	Gender	N	Pretest		Posttest	
			Mean	Std. Deviation	Mean	Std. Deviation
Counting approach	Male	28	24.11	12.80	62.61	11.23
	Female	19	24.47	12.78	57.95	19.10
Mathematical formula	Male	26	23.08	12.45	37.42	21.03
	Female	22	24.45	12.85	34.55	19.52

Table 4 shows that male pupils who were taught perimeter and Area of 2-D shapes using counting approach had mean achievement scores of 24.11, ( $SD = 12.80$ ) at pretest and 62.61, ( $SD = 11.23$ ) at posttest while male pupils' who were taught area and perimeter of 2-D shapes using mathematical formula approach had mean achievement scores of 23.08, ( $SD = 12.45$ ) at pretest and 37.42, ( $SD = 21.03$ ) at posttest. Similarly, female pupils who were taught area and perimeter of 2-D shapes using counting approach had mean achievement scores of 24.47, ( $SD = 12.78$ ) at pretest and 57.95, ( $SD = 19.10$ ) at posttest while female pupils who were taught area and perimeter of 2-D shapes using mathematical formula approach had mean achievement scores of 24.45, ( $SD = 12.85$ ) at pretest and 34.55, ( $SD = 19.52$ ) at posttest. This means that male pupils taught area and perimeter of 2-D shapes using counting approach and male pupils taught using Mathematics formula approach had higher posttest mean achievement scores than their female counterparts.

Table 2 reveals that there is no significant interaction effect of teaching approach and gender on pupils' achievement in perimeter and area of 2-D

shapes,  $F(1, 90) = .075$ ,  $p = .785$ . Thus, the null hypothesis is not rejected since the probability value of .785 is greater than the .05 level of significance. Thus, the effect of teaching approach on pupils' achievement in perimeter and area of 2-D shapes is independent of their gender.

### Discussion of the Findings

The findings of the study indicate that the Pupils' who were taught Perimeter and Area of 2-D shapes using counting approach had higher posttest mean achievement score than those taught using mathematical formula approach. The null hypothesis is rejected since the probability value of .000 is less than the .05 level of significance. This is because the pupils' gain more knowledge and understanding of the topics when exposed to the approach. The counting approach is more of pupils' centered and it also removes the abstractness in mathematics thereby making the Pupils' to stop the cramming of formula. Further analysis revealed that, Pupils' who were taught Perimeter and Area of 2-D shapes using counting approach had higher adjusted mean gain than those Pupils' who were taught Perimeter and

Area of 2-D shapes using mathematical formula approach. This implied that the achievement scores of Pupils' taught perimeter and area of 2-D shapes using counting approach had increased due to their exposure to counting approach during the lesson. Since this approach is more of pupils centered and the use of concrete object, it brought the pupils closer to mathematics thereby removing the abstractness in mathematics which enhance their achievement.

The finding is in line with the findings of some researchers such like; Abimbade and Afolabi (2021) investigated the pedagogical approaches of mathematics teaching. The researcher reported that pupils achieve more when an appropriate teaching approach is used in mathematics teaching. Also, the findings agree with Clement and Ernest (2023) who investigated on the Pupils' recognition of geometric Tessellation as pattern of traditional culture. The results of the findings showed that pupils' learning interest increases when concrete object is used to teach an abstract concept such as geometry, thereby enhancing their achievement. Furthermore, the study's findings also showed that the male and female Pupils' had higher mean Achievement scores in the posttest than the pretest. The improvement in achievement scores of the Pupils' could be as a result of exposure of the Pupils' to the counting approach. This approach which is teaching from simple to complex helps the pupils to get a clearer understanding of the mathematical formulae and also how to derive each formulae and even understand how to interpret the variables of the formula. counting teaching approach enables the pupil to use concrete objects in learning and also interact with their learning environment.

It was observed from the findings of the study that both male and female pupils' taught perimeter and area of 2-D shapes using counting teaching approach had a posttest mean achievement score that is higher than those male and female Pupils' taught using mathematical formula approach. This shows that the pupils' (both male and female) gets to understand the concept better and faster the moment they were introduced to a more practical approach that may involve use of concrete object. The implication of this result is that, the gender of pupil is not a factor in mathematics learning; moreover, the Pupils' who were exposed to counting teaching approach tend to achieve more than those who were exposed to mathematical formula approach. This means that, the counting teaching approach have more effect on their learning of mathematics where it gives no room for cram work, in using counting approach you must know a step before you can move to the next step. From the finding it shows that Pupils

have high achievement in perimeter and area of 2-D shapes is as a result of their exposure to a friendlier teaching approach.

This finding agrees with that of some researchers such as Godspower and Sopuruchi (2017) who researched on gender impact on the interest and academic achievement of learners in Mathematics. The results showed that gender has a major impact on interest but has no important impact on the achievement score of the learners. This implied that the teaching approach has no significant effect on gender of the Pupils'. Pupils' irrespective of their gender can achieve highly in mathematics especially in perimeter and Area of 2-D shapes when appropriate teaching approaches are used. It is also in agreement with Adeneye, Awofala, Abisola and Lawani (2020) who investigated on increasing Mathematics Achievement Among School Pupils' through Differentiated instruction reports that there was no significant interaction effect of treatment and gender on pupils' achievement in mathematics.

From the findings of the study, it was observed that both male and female pupils' taught perimeter and area of 2-D shapes using counting teaching approach had a posttest mean achievement score that is higher than those male and female Pupils' taught using mathematical formula approach. This shows that the pupils' (both male and female) gets to understand the concept better and faster the moment they were introduced to counting approach. This approach which is teaching from known to unknown brings the pupils' closer to mathematics, the approach completely removes the abstractness in mathematics specifically in perimeter and area of 2-D shapes. As the pupils uses concrete objects during mathematics learning, their achievement was also enhanced irrespective of their gender.

This means that, the counting teaching approach have more effect on their mathematics learning where it gives no room for cram work. This finding is in agreement with Adeneye, Awofala, Abisola and Lawani (2020) who investigated on increasing Mathematics Achievement Among School Pupils' through Differentiated instruction reports that there was no significant interaction effect of treatment and gender on pupils' achievement in mathematics. Thus the effect of teaching Approach on pupils' Achievement in perimeter and area of 2-D shapes is independent of their gender.

## Conclusion

Following the findings of this study on pupils' achievement on perimeter and area of two-dimensional shapes in primary school mathematics: the use of counting and mathematical formula

approaches. It was concluded that counting teaching approach significantly increased Pupils' achievement in Perimeter and Area of 2-D shapes among Primary School Pupils'. Male and female Pupils' had high achievement when exposed to counting teaching approach. Moreover, there was no significant interaction effect of the Teaching approaches and gender on Pupils' achievement in Perimeter and Area of 2-D shapes.

### Recommendations

Based on the findings of this study and the implications of the study to education, the following recommendations are made:

1. Primary School teachers should improve their Pupils' achievement in Perimeter and Area of 2-D shapes by adopting counting teaching Approach while teaching.
2. Primary school teachers should always use an activity based approach just like the counting teaching approach.

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