THE COLLOQUIUM -A Multi disciplinary Thematic Policy Journal
www.ccsonlinejournals.com
Volume 9 , Number 1 , 2021 Pages 98 - 108
 Print ISSN : 2971-6624 eISSN: 2971-6632

DICE AND SPINNER GAMES ON STUDENTS' ACADEMIC PERFORMANCE IN PROBABILITY IN OGBA/EGBEMA/NDONI LOCAL GOVERNMENT AREA, RIVERS STATE

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Abstract

This study comparatively analyzes the effects of the use of dice game and spinner game on students' academic performance in probability in junior secondary schools in Ogba/Egbema/Ndoni Local Government Area of Rivers State. Three research questions and three hypotheses were formulated to guide the study. A quasi-experimental two-group pretest–posttest design was used for the research. The population of the study comprises 19,478 Junior Secondary School students from twenty-four (24) public Junior Secondary Schools in the Study Area. The sample of the study consists of 144 students from the two schools used for the study. Two intact classes were used for the study. Probability Performance Test was used for data collection. Mean and Standard Deviation were used to answer the research questions while the hypotheses were tested using Analysis of Covariance ANCOVA at 0.05 level of significance. Reliability Coefficient of 0.88 was obtained. Findings from the study showed that, there is no significant difference between performance of students taught probability using dice game and those taught using spinner game, there is a significant difference between the performance of male and female students taught probability using dice game, and there is no significant difference between the performance of male and female students taught probability using spinner game. Based on the findings, the study recommends, among others, that secondary school mathematics teachers should be encouraged to adopt mathematical game approach as part of their teaching strategies for improved performance in Mathematics.

Keywords: *Mathematics, mathematical games, gender ,probability*

Introduction

Mathematics is a branch of science that deals with quantities, sizes and shapes as determined by numbers and signs, and is a tool whose knowledge and skills are the bedrock of all societal transformation and the transfer of ideas into reality (Odo & Ugwuda, 2014). Iji et al., (2014) viewed Mathematics as the logical language for expressing ideals, shapes, quantities, size, order change, and dynamism in educational systems and explaining the complexities of modern society in the business economic, academic, engineering and industry setting for lifelong learning as such without Mathematics there is no modern technology, there is no national development. Adah et al., (2015) stated that Mathematics is an essential course for the scientific, technological and vocational advancement of any society. According to Nwoke and Nnaji (2011), Mathematics is the study of quality, structures, space and change. It developed through the use of abstraction and

Cite this article as
Ekpeyong, L. R., & Ekwueme, C. O.E. (2021). Dice and spinner games on students' Academic performance in Probability in Ogba/Egbema/Ndoni local government Area , Rivers state. *THE COLLOQUIUM*, 9(1), 98 -108

Volume 9 , Number 1 , 2021 Pages 98 - 108
CC-BY-NC-SA 4.0 International Print ISSN : 2971-6624 eISSN: 2971-6632
logical reasoning, from counting, calculation, measurement and the study of the spaces and motion of physical object. Furthermore, Abakpa et al., (2016) described Mathematics as an indiscipline sable tool for functional educational in all nations of the world.

Probability is primarily a theoretical branch of Mathematics, which studies the consequences of Mathematical definitions (Etuk & Uchendu, 2008). Probability reveals a dual character: a statistical side was concerned with finding the objective of mathematical rules behind sequences of outcomes generated by random processes through data and experiments, while another epistemic side views probability as a personal degree of belief (Hacking, 2005). Probability is a very useful topic in secondary school Mathematics in Nigeria as it is needed in many career areas. Students therefore, need to conceptualize it as they prepare for their careers in the future. The teaching and learning of mathematics at all levels of the educational system may be described being a dismal state, students find it difficult to understand, and teachers find difficulties in teaching many topics (Abonyi et al., 2014). Teaching has been described as being ineffective (Abonyi et al., 2014). The difficulties of students and the poor teaching usually come to light through the poor performances of students. Students are seen to perform poorly in both internal and external examinations. For instance, in 2009, over 33.55% of the students failed mathematics in the Senior Secondary School Examination (WAEC Chief Examiners Report). The situation is most pathetic at the senior secondary level. Thus, every concerned mathematics educator is seeking a way out of these problems of poor performance in mathematics. One of such ways is the used of teaching aids like mathematical games.

A mathematical game is a type of play that follows a set of rules, aims at a definite goal or outcome, and involves competing against other players or against barriers imposed by the nature of the game itself (Abonyi et al., 2014). A game is regarded as 'mathematical' when the players can perceive and/or influence the course of the game based on mathematical considerations (Abonyi et al., 2014). Mathematical games may be used to introduce concepts as a prelude to explicit teaching or practice skills, or consolidate a concept after explicit teaching. Educational games do lead to improved learning (Abakpa et al., 2016). Some researchers have evaluated the effectiveness of mathematical games and given reasons for their use of games. Among them are the powerful motivation, involvement, and development of positive attitudes in learning have long been recognized as being essential and necessary. Games are also valuable for encouraging social skills, stimulating discussions, helping the development of understanding, developing strategies for learning new concepts and reinforcing skills and concepts as an aid to symbolization and logic. Ascher and Ascher (1994) in Abonyi et al., (2014). asserted that mathematical games are culturally oriented and that each culture has its own sets of mathematical games. They stressed that mathematical ideas are panhuman and developed within cultures. Mathematical ideas are taken to be those that involve numbers, logic, spatial configuration and most importantly, the combination or organization of these into systems or structures. From culture to culture and within any culture, mathematical games and ideas appear in various contexts, which are either clear-cut or mutually exclusive.

Koparan (2021) revealed that formal presentations of mathematics without having sufficient real conditions of life in classes, such as games cannot provide enough support for students to learn probability. In addition, it is hard to comprehend some of the problems in school books since they are not quite interesting for students, but rather dependent on operative information, rather than real-life situations (Batanero et al, 2016). Real-life problems can be used to develop conceptual understanding and to help students connect them to formulae. Additionally, students need to improve their skills in problem-solving. Gender stereotypes also play an important role in the

Volume 9 , Number 1 , 2021 Pages 98 - 108
CC-BY-NC-SA 4.0 International Print ISSN : 2971-6624 eISSN: 2971-6632

performance of mathematics objectives. Adesoji and Babatunde (2005**)** posited that creating a conducive atmosphere characterized by freedom of speech and expression which allows classroom interaction and participation irrespective of gender will bridge gender gap. Bassey et al., (2010) also agreed that if males and females are given the same opportunity in scientific inquiry, they will produce the same result in science. In this case, teachers' pedagogical skills and knowledge become paramount. The role of a teacher is to arrange the students in heterogeneous groups, provide students with proper materials, and design a structural systematic teaching strategy. A few studies, however, explored dice and spinner game on students' performance in mathematics from different dimensions.

In a study on "Effect of the Use of Algebraic Substitution Game Approach on Students' Performance in Some Selected Concepts in Algebra", Ugwuanyi and Agwagah (2014) revealed that students who were taught Algebra with Algebraic Substitution Game achieved higher in the concept taught than those taught with the conventional approach. Also, the game favoured both male and female students equally in achieving higher in Algebra. Results from this study also disclosed that the use of Algebraic Substitution Game improves the performance of both male and female students in Algebra. Sam-Kayode and Salman (2015) revealed a significant deviation in the performance of students exposed to Ludo game and those exposed to the lecture method. It was established that there was a significant disparity in the performance of the high, medium and low-scoring students in the experimental group. The low-scoring students had the highest mean gain score and benefited more in the Ludo game method of teaching probability than the high and medium scorers. Abonyi et al., (2014) showed that the mathematical game approach is superior to the conventional method in facilitating achievement in mathematics. The study also divulged that although with Mathematics game approach males showed higher performance than the females, the disparity in the mean performance of males and females taught using the method is not statistically significant. There was no significant in the interaction between gender and instructional method on students' performance in quadratic expression.

In similar study, Kehinde et al., (2018) found out that mathematical games and orbit game in particular cannot be left out in education of exceptional children. It was also discovered that, there were adequate orientation on the handling and application of games by special educators in meeting the challenges of exceptional children. Evidence from the review of empirical studies discloses that the use of games enhances effective teaching and learning of Mathematics. Also the use of game is very effective in teaching exceptional students in Mathematics. However, such research comparing dice game and spinner game have not been performed in Mathematics(Probability) in Ogba/Egbema/Ndoni Local Government Area of Rivers State. It became necessary therefore to fill the missing gap by studying the Comparative Analysis of Dice Game and Spinner Game in teaching Probability in enhancing Students' Academic Performance in Ogba/Egbema/Ndoni Local Government Area in Rivers State.

Statement of the Problem

For a country to excel in technological and scientific fields, the performance of students in mathematics especially in probability should be excellent. Despite the importance of mathematics as a fundamental preparation of learners for full participation and functioning members of the society, the students' performance in the subject has been very poor in Nigeria, as seen in the past West African examination Council's reports. This could affect and slow down the pace of industrialization in Rivers State and hinder Nigeria at large from achieving her vision regarding advancing in innovation and technology. One of the major reasons for poor performance in probability is the teachers' use of ineffective teaching strategies. However, there is inadequate documented information in research conducted in Nigeria in general and in Ogba/Egbema/Ndoni local government area of rivers state in particular on the comparative analysis of dice and spinner games on students' academic performance in probability. There is a need therefore to establish whether the use of dice and spinner could improve the performance of students in probability in junior secondary school in Ogba/Egbema/Ndoni Local Government Area, Rivers State.

Table 1: Statistics of students in Nigeria that obtained credit and above (A1- C6) pass and below (D7- F9) in the May/June WASSCE in general mathematics between 2010 and 2018

Year	Total Sat	Pass at Credit level and Above (A1-C6)		Pass at below (D7-F9)	
		Number	%	Number	%
2010	1,351,557	453,447	33.55	898,110	66.45
2011	1,540,250	587,630	38.93	952,620	61.07
2012	1,675,224	819,390	49.00	852,834	51.00
2013	1,543,683	555,726	36.00	987,957	64.00
2014	1,692,435	529,732	31.30	1,162,703	68.70
2015	1,593,442	544,638	34.18	1,048,804	65.82
2016	1,544,234	597,310	38.68	946,924	61.32
2017	1,559,162	923,486	59.23	635,676	40.77
2018	1,572,396	786,016	49.98	786,380	50.02

Source: Test Development Division, West African Examination Council (WAEC) Lagos, Nigeria.

Aim and Objectives of the Study
The aim of this study was to determine comparatively analyze the effect of dice and spinner games on students' academic performance in probability in junior secondary schools in Ogba/Egbema/Ndoni Local Government Area of Rivers State. Specifically, the objectives of the study were to:

1. compare the mean performance of students taught probability using dice and those taught using spinner games.
2. compare the mean performance of male and female students taught probability using dice game.
3. Compare the mean performance of male and female students taught probability using spinner games.

Research Questions
The following research questions were raised to obtain the results of the study:

1. What is the difference in the mean score of students taught probability with dice to those taught with spinner game?
2. What is the difference between mean performance scores of male and female students taught probability using dice game?
3. What is the difference between mean performance scores of male and female students taught probability using spinner games?

Hypotheses

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

H_{01} : There is no significant difference between performance of students taught probability using dice and those taught using spinner game

H_{02} :There is no significant difference between performance of male and female students taught probability using dice game

H_{03} : There is no significant difference between performance of male and female students taught probability using spinner game

Methodology

The study employed quasi-experimental design. The population for the study consists of 19,478Junior Secondary School Students from twenty-four (24) public Junior Secondary Schools in Ogba/Egbema/Ndoni. A sample of 144 students (66 males and 78 females) was utilized for the study. Purposive random sampling techniques was used to select two Junior Secondary Schools from the twenty (24) schools in the Local Government Area. The two JSS2 intact classes were randomly assigned to experimental and control groups by balloting. All together there were 76 students in the experimental group and 68 students in the control group. The two groups of students were made to respond to items on the Probability Performance Test (PPT) before and after being taught by dice and spinner games. The instrument used for collection of data was face validated by three experts (two from mathematics education and one from measurement and evaluation). The content validity was established using table of specification. The reliability estimated for stability of the instrument was determined using test-retest method. The correlation of scores from first and second administration of the test was calculated using Pearson's Product Moment Correlation Coefficient (r). The correlation coefficient (r) of the instruments was 0.88. The data collected were analyzed using mean and standard deviation to answer the research questions and Analysis of Covariance (ANCOVA) to test the hypotheses at 0.05 level of significance

Results

Research Question 1: What is the difference in the mean score of students taught probability with dice to those taught with spinner game?

Table 1: mean and standard deviation of the difference in the mean score of students taught probability with dice and those taught with spinner game.

Method		pretest	posttest	Mean gain
Dice Game	Mean	20.00	46.55	26.55
	N	76	76	76
	Std. Deviation	5.79	11.30	7.99
Spinner	Mean	19.15	42.00	22.85
	N	68	68	68
	Std. Deviation	6.46	15.05	11.22

Table 1 shows the difference in the mean score of students taught probability with dice and those taught with spinner game. The result showed that there is a Mean Gain of 26.55 (Pretest = 20.00, Posttest = 46.55) for student taught probability using dice game. Also, for student taught

Volume 9 , Number 1 , 2021 Pages 98 - 108
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probability using spinner game; Mean Gain of 22.85(Pretest = 19.15, Posttest = 42.00). The implication of this result is that student performed better when taught probability with dice game than with spinner game.

Research Question 2: What is the difference between mean performance scores of male and female students taught probability using dice game?

Table 2: Mean and standard deviation of the difference in the pre-test and post-test performance score of male and female students taught probability with dice game.

Gender		Pretest	posttest	Mean gain
Male	Mean	20.03	43.76	23.73
	N	33	33	
	Std. Deviation	6.13	12.15	
Female	Mean	19.98	48.70	28.72
	N	43	43	
	Std. Deviation	5.58	10.23	

Table 2 shows the difference in the pre-test and post-test performance score of male and female students taught probability with dice game. The result showed mean gain of 23.73 (Pretest = 20.03, Posttest = 43.76) for male student taught probability using dice game. The female student taught probability using dice game has the mean gain of 28.72 Pretest = 19.98, Posttest = 48.70). This implies that female student performed better when taught probability with dice game than their male counterpart.

Research Question 3: What is the difference between mean performance scores of male and female students taught probability using spinner games?

Table 3: mean and standard deviation of the pre-test and post-test performance score of male and female students taught probability with spinner game.

Gender		pretest	posttest	Mean gain
Male	Mean	18.24	42.24	24.00
	N	33	33	
	Std. Deviation	5.41	15.74	
Female	Mean	20.00	41.77	21.77
	N	35	35	
	Std. Deviation	7.29	14.61	

Table 3 shows the difference in the pre-test and post-test performance score of male and female students taught probability with spinner game. The result shows mean gain of 24.00 (Pretest = 18.24, Posttest = 42.24) for male student taught probability using spinner game. The female student taught probability using spinner game has a mean gain of 21.77(Pretest = 20.00, Post test = 41.77). This implies that male student performed better when taught probability with spinner game than their female counterpart.

Hypothesis H_{01}: There is no significant difference between performance of students taught probability using dice and those taught using spinner game.

Table 4: Summary of Analysis of covariance (ANCOVA) on the difference in the performance of student taught probability using dice and those taught using spinner.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14089.521[a]	2	7044.760	87.078	0.000
Intercept	2215.539	1	2215.539	27.386	0.000
pretest	13345.671	1	13345.671	164.962	0.000
Method	365.759	1	365.759	4.521	0.035
Error	11407.118	141	80.902		
Total	309408.000	144			
Corrected Total	25496.639	143			

Table 4 shows that there is significant difference in the performance of student taught probability using dice and those taught probability using spinner game ($F(1,141)= 4.521$, $p< 0.05$). Hence, null hypothesis was rejected at 0.05 significant level. This implies that the difference between the performances of students in the two groups (Dice and Spinner method) differs significantly.

Hypothesis H_{02}: There is no significant difference between performance of male and female students taught probability using dice game

Table 5: summary of Analysis of covariance (ANCOVA) on the difference in the performance of male and female students taught probability using dice game.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5759.141[a]	2	2879.571	55.149	0.000
Intercept	1705.588	1	1705.588	32.665	0.000
pretest	5303.482	1	5303.482	101.571	0.000
Gender	470.118	1	470.118	9.004	0.004
Error	3811.648	73	52.214		
Total	174274.000	76			
Corrected Total	9570.789	75			

Table 5 shows that there is no significant difference in the performance of male and female students taught probability using dice game ($F(1,73)= 9.004$, $P < 0.05$). Hence, null hypothesis is rejected at 0.05 significant level. This implies that difference between the performances of male and female students taught probability using dice method differs significantly.

Hypothesis H_{03}: There is no significant difference between performance of male and female students taught probability using spinner game.

Table 6: summary of Analysis of covariance (ANCOVA) on the difference in the performance of male and female students taught probability using spinner game.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8351.388[a]	2	4175.694	39.736	0.000
Intercept	506.470	1	506.470	4.820	0.032
pretest	8347.620	1	8347.620	79.436	0.000
Gender	208.444	1	208.444	1.984	0.164
Error	6830.612	65	105.086		
Total	135134.000	68			
Corrected Total	15182.000	67			

Table 6 shows that there is no significant difference in the performance of male and female students taught probability using spinner method ($F(1,65)= 1.984$, $p> 0.05$). Hence, null hypothesis three is retained at 0.05 significant level. This implies that difference between the performances of male and female students taught probability using spinner method do not differ significantly.

Discussion of Findings

The result in table 1 showed that student performed better when taught probability with dice game than with spinner game. Furthermore, the result of table 4 show that there is significant difference in the performance of student taught probability using dice and those taught probability using spinner. This finding is in agreement with the study conducted by Ezeugwu et al., (2016). They carried out a study on the effect of game-based instructional technique on achievement and interest of students in Algebra at the basic educational level. Their findings indicated that; the use of Game-based instructional technique in teaching affects students' achievement and interest in Algebra. Consequently, from the findings of this study, it was deduced that when probability is taught using dice game and spinner game method, the performance of students will significantly differ, inferring that student's performance in probability will be influenced by the type of game (dice or spinner game) in learning probability. Also, the result in Table 2 shows that female student performed better when taught probability with dice game than their male counterpart. Furthermore, the result of table 5 show that there is significant difference in the performance of male and female students taught probability using dice method. This finding is contrary to the findings of Abonyi et al., (2014). They investigated the effect of mathematical game on student's achievement in quadratic expression, their findings revealed that although with mathematical game approach males showed higher achievement than the females, the difference in the mean achievement of males and females taught using the method is not statistically significant. However, from the findings of this study, it was deduced that when probability is taught using dice game method, the performance of male and female students significantly differs, inferring that student's gender influence the performance of student use of dice game in learning probability.

Finally, the result in Table 3 shows that male student performed better when taught probability with spinner game than their female counterpart. Furthermore, the result of table 6

Volume 9 , Number 1 , 2021 Pages 98 - 108
CC-BY-NC-SA 4.0 International Print ISSN : 2971-6624 eISSN: 2971-6632
show that there is no significant difference in the performance of male and female students taught probability using spinner method. This finding is consistent with the findings of Abonyi et al., (2014). They investigated the effect of mathematical game on student's achievement in quadratic expression, their findings revealed that although with mathematical game approach males showed higher achievement than the females, the difference in the mean achievement of males and females taught using the method is not statistically significant. Therefore, it could be deduced that when probability is taught using spinner game method, the performance of male and female students will not significantly differ, inferring that students' gender do not influence the performance of student use of spinner game in learning probability.

Conclusion

Based on the result of the findings, the researcher concludes that there is significant difference in the performance of student taught probability using dice and those taught probability using spinner. This is as a result of the captivating influence of Mathematics games to students understanding of mathematical concepts. Hence, student's performance in probability will be influenced by the type of game (dice or spinner game) in learning probability. Also, there is significant difference in the performance of male and female students taught probability using dice method. This is as a result of the captivating influence of Mathematics games to students understanding of mathematical concepts. Hence, that student's gender influences the performance of student use of dice game in learning probability. Therefore, it is imperative to consider the type of Mathematics games to be used when teaching a class with mixed-students.

Finally, there is no significant difference in the performance of male and female students taught probability using spinner method. This is as a result of the captivating influence of Mathematics games to students understanding of mathematical concepts. Hence, that student's gender does not influence the performance of student use of spinner game in learning probability. Conclusively, this study informed that Mathematics games, even though being more simplistic, still significantly enhance students' Mathematics learning. In addition, participants have performed committed and effortful on-task learning when playing certain games where Mathematics drills were integral to the game play and appropriately challenging.

Recommendations

In view of the above findings, the followings are recommended:

1. Secondary school Mathematics teachers should be encouraged to adopt mathematical game approach as part of their teaching methods.
2. State and the Local Government should establish, equip and fund mathematical resource centres in each education zone. This will ensure that teachers can go to these centres and learn how to use the games in teaching mathematical concepts.
3. Workshops and seminars should be organized from time to time for teachers in secondary schools so as to keep them abreast of modern teaching strategies such as dice or spinner game instructional strategies.
4. The Government in collaboration with curriculum developers and Mathematics teachers should review the existing curriculum and integrate the basic tenets of the game approach in the curriculum.

5. Teachers should be gender sensitive when using dice and spinner game in teaching probability in secondary schools.

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Cite this article as
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