



# The Efficacy of Integrating the "Ogiurrise" Board Game into the Instruction of Probability and Numeracy in Junior Secondary Schools in Ebonyi State

Iro Chibuiké<sup>1\*</sup>, Godwin Aondohemba Orngu<sup>1</sup>, Nwachukwu Precious Nkechi<sup>2</sup>, Eze Kingsley Chinenye<sup>2</sup>

<sup>1</sup>Federal College of Education Technical Isu, Ebonyi State

<sup>2</sup>Dept. of Maths, Fed. Coll. of Edu. Technical, Isu Ebonyi State

\*Corresponding author: chibuikero21@gmail.com

## Abstract

The study investigated the efficacy of integrating the "Ogiurrise" board game into the instruction of probability and numeracy in junior secondary schools (JSS) in Ebonyi State. Three research questions and three null hypotheses guided the quasi-experimental study. The population of the study comprised 29,761 JSS two students, from which 240 students (108 male and 132 female) were sampled using purposive and disproportionate stratified random sampling techniques. Data were collected using the Numeracy and Probability Achievement Test for Junior Secondary Schools (NPAT-JSS), validated by three experts, with a Kuder-Richardson 20 reliability coefficient of 0.81. Data were analysed using descriptive statistics and analysis of covariance (ANCOVA). Students exposed to the Ogiurrise board game achieved significantly higher numeracy and probability scores than those taught using conventional methods ( $F = 2618.84$ ,  $p < .001$ , partial eta squared = 0.918). Gender significantly influenced students' achievement, with female students outperforming males ( $F = 25.689$ ,  $p < .001$ , partial eta squared = 0.099). A significant interaction effect of gender and treatment was also observed ( $F = 15.333$ ,  $p < .001$ , partial eta squared = 0.061). The study recommended that mathematics teachers should incorporate the Ogiurrise board game into their lessons as a supplementary teaching method, especially when covering numeracy and probability.

**Keywords:** Ogiurrise game-ethnomathematics, probability, numeracy, junior secondary school, mathematics.

## 1 Introduction

Mathematics serves as the bedrock for scientific and technological advancement, logical reasoning, problem-solving, and informed decision-making. It is expected to foster not only computational proficiency but also conceptual understanding and the application of mathematical knowledge to real-life situations (Watanabe, 2023; Perry & Len-Rios, 2019; Anggraena, 2019). Consequently, mathematics is designated as a core and compulsory subject, particularly at the Junior Secondary School (JSS) level in Nigeria (Nigerian Educational Research and Development Council [NERDC], 2013; Federal Republic of Nigeria [FRN], 2013). Within this curriculum, numeracy (number concepts, operations, fractions, decimals) builds learners' capacity to apply mathematics to practical situations, interpret statistics, and make informed decisions, and probability, which involves reasoning about uncertain events and interpreting likelihoods, proportions, and risk magnitudes (Susanto et al., 2024) are critical topic. Together, these topics provide students with essential competencies for manipulating quantities, recognising numerical relationships, interpreting uncertainty, and making logical judgments.

Despite their importance, the teaching and learning of probability and numeracy remain challenging for many Junior Secondary School (JSS) students. Research on the Basic Education Certificate Examination (BECE) in Mathematics highlights persistent weaknesses in student performance (Nathan & Umoinyang, 2022; Opesemowo et al., 2026). For instance, official data from Ondo State indicate that out of 69,622 candidates registered for the 2022 BECE, 55,566 passed Mathematics while 14,056 did not, resulting in a 20.19% non-pass rate (Ondo State Ministry of Education, Science and Technology, 2022). With respect to numeracy and probability, evidence indicates poor performance in the topics among JSS students. In Rivers State, for instance, JSS students performed less well in numeracy than in literacy (Inko-Tariah, 2014). Furthermore, Gogo et al. (2021) found that both students and mathematics teachers perceived the

JSS mathematics curriculum as difficult to learn and teach, with numeracy and probability identified as particularly challenging. These difficulties are exacerbated by factors common in developing contexts such as Ebonyi State, including large class sizes, shortages of instructional materials, reliance on lecture-based pedagogy, and limited opportunities for teacher professional development (Idakari & Agbom, 2020). More so, in Ebonyi State, like many schools in Nigeria, conventional instructional methods, often characterised by teacher-centred instruction, rote memorisation, and limited interactive participation (Ali & Ahmad, 2023), predominate. Such methods can restrict the development of reasoning, representation, and problem-solving skills required for numeracy and probability.

In response, there is growing interest in more engaging and conceptually grounded pedagogies, such as game-based learning (GBL), in mathematics instruction. GBL is an intentional educational approach that weaves together game activities, instructional content, and motivational elements to enhance learning (Eslami & Chowdhury, 2022). Rather than simply adding game-like rewards, GBL aligns play with learning objectives and mobilises cognitive, emotional, and social processes (Muñoz, 2025). Learning games can create structured environments where students engage with mathematical concepts, make decisions, receive feedback, and solve problems, all of which can enhance their learning experiences. A promising framework within GBL is the use of indigenous games as ethnomathematical resources. Ethnomathematics examines mathematical ideas and practices through the lens of culture, highlighting their educational value (Rosa & Orey, 2011). It provides a conceptual bridge between mathematics embedded in everyday cultural practices and the mathematics taught in school (D'Ambrosio, 1985). Ethnomathematics recognises that mathematical concepts are often present and fully formed in traditional games familiar to learners.

In Ebonyi State, the Ogiurrisse board game exemplifies such an indigenous resource. Ogiurrisse, also known as Ogirise, is a mancala-style sowing game with deep cultural significance among various Nigerian tribes (Idehen, 2021). The game is played on a board featuring pits and seeds, with players redistributing them based on strategic rules. It challenges players to count, anticipate outcomes, evaluate their opponents' moves, and gauge their chances of winning. In this study, the Ogiurrisse board game can be integrated with direct mathematics instruction on numeracy and probability. The movement and distribution of playing materials offer opportunities for counting, grouping, and numerical comparison, while strategic decisions provide contexts for addition and subtraction. Repeated gameplay generates observable variation in outcomes, allowing students to record results, compare frequencies, make predictions, and discuss the likelihood of different events. Thus, Ogiurrisse offers an experiential context for representing and discussing numeracy and probability content. Again, the efficacy of the Ogiurrisse board game in teaching probability and numeracy may also depend on learner characteristics such as gender. Bacang et al. (2019) define gender as a socially constructed concept encompassing the attributes and opportunities associated with being male or female. These factors may influence how learners respond to numeracy and probability instruction with the Ogiurrisse board game.

The present study is therefore crucial because, despite the cultural appeal of the Ogiurrisse board game, empirical research specifically testing its instructional efficacy is limited. This gap underscores the need for empirical investigation of the Ogiurrisse board game in enhancing numeracy and probability instruction among junior secondary school students in Ebonyi State.

## 1.1 Research Questions

1. What is the mean achievement in numeracy and probability scores of Junior Secondary School students exposed to Ogiurrisse board game and those exposed to the conventional teaching method?
2. What is the influence of gender on Junior Secondary School students' achievement in numeracy and probability?
3. What is the interaction effect of gender and treatment on Junior Secondary School students' achievement in numeracy and probability?

## 1.2 Null Hypotheses

**HO<sub>1</sub>:** There is no significant difference in the mean achievement in numeracy and probability scores of Junior Secondary School students exposed to Ogiurrisse board game and those exposed to the conventional teaching method.

**HO<sub>2</sub>:** Gender does not significantly influence Junior Secondary School students' achievement in numeracy and probability.

**HO<sub>3</sub>:** There is no significant interaction effect of gender and treatment on Junior Secondary School students' achievement in numeracy and probability.

## **2 Literature Review**

### **2.1 Empirical Review**

Empirical evidence supports the integration of indigenous games into classroom instruction to enhance learning. For instance, teachers have reported that games such as morabaraba, Tshetershere, Diketo, and Kgati support the learning of addition, subtraction, multiplication, factorisation, and quadrilaterals (Meeran, 2024). Asmaarobiyah and Arisetyawan (2024) found that ethnomathematics with congklak enhanced the mathematical critical thinking skills of Grade II students compared to traditional teaching methods. Naitili and Nitte (2023) observed significant improvement in geometry concept understanding after instruction with sikidoka. Studies of the “Toor Kyo la Nam and Ishiva-dar” games among the Tiv people in Benue State revealed various mathematical aspects tied to the games, including arithmetic, geometry, logic, statistics, mensuration, and trigonometry (Ugee & Abah, 2021). Similarly, research on the I'tche board game among the Orokam people of Benue State demonstrates that such indigenous mancala-style games embed counting, strategic addition and subtraction, and reasoning about seed distribution outcomes, suggesting that mathematics teachers can leverage these games to design culturally relevant pedagogies (Abah, 2018). These findings provide a foundation for investigating the efficacy of Ogiurrisse in numeracy and probability instruction. However, while some of the existing studies explored the mathematical characteristics and classroom applications of indigenous games, few have focused on their impact on students' achievement in numeracy and probability. Additionally, previous research has often relied on games whose cultural relevance to learners in Ebonyi State is uncertain, underscoring the need for the present study.

Research on gender differences in mathematics achievement, on the other hand, has produced mixed results: some studies (Arhin & Offoe, 2015; Ajai & Imoko, 2015) report no significant gender differences, while others (Oribhabor, 2019; Mutai, 2016) find significant disparities between male and female students. Gender may also interact with games to affect learning outcomes. For instance, Mansor and Rosly (2024) reported significant gender differences in game-based learning usage and mathematics achievement, whereas Yumak and Ardahan (2026) found that GeoGebra-based games improved achievement without significant gender differences. This variation highlights the need to examine how gender interacts with the Ogiurrisse board game in enhancing numeracy and probability instruction.

### **2.2 Theoretical Framework**

The Ogiurrisse board game pedagogical approach aligns with the constructivist learning theory. According to this theory, learners construct knowledge through active engagement with meaningful experiences (Piaget, 1952). In this light, the Ogiurrisse board game offers students hands-on and relevant experiences that allow them to dive into abstract numeracy and probability content. As they play, students are faced with decisions, counting, comparing amounts, spotting patterns, predicting outcomes, and using mathematical reasoning. This process helps them link new mathematics concepts to what they already know. Additionally, the collaborative and problem-solving elements of the game encourage discussions, reflections, and peer learning, giving students a chance to deepen their understanding through social interactions and feedback. Hence, the findings of this study affirmed the tenets of the constructivist theory.

## **3 Materials and Methods**

### **3.1 Design**

The quasi-experimental design was employed in this study. Specifically, the pretest-posttest, non-equivalent control group design was adopted. Nworgu (2015) defined quasi-experimental design as an experiment where random assignment of subjects to experimental and control groups is not possible. In this case, existing groups otherwise known as intact classes are used. In this context, Junior Secondary School (JSS) two students under study in their existing classes were assigned to the control and experimental groups without randomisation.

### **3.2 Participants**

The study was carried out in Ebonyi State and targeted public JSS two students in the area. The population of the study comprised 29,761 JSS two students (12,113 male and 17,648 female) in 226 public Secondary Schools in Ebonyi State, Nigeria. A sample of 240 JSS two students (108 male and 132 female) participated in the study. Sampling was done using purposive and disproportionate stratified random sampling techniques. Purposive sampling was used to select two senatorial districts based on the prevalence of functional public secondary schools in the area. Disproportionate stratified random sampling was used to select four public secondary schools, picking two from each of the two senatorial districts sampled. Following school selection, the four schools were randomly assigned to either the treatment or control groups, with two schools in each category. To ensure adequate representation of schools in the selected senatorial districts, the disproportionate stratified random sampling technique was deemed appropriate. The public secondary schools in the selected districts served as strata, from which two schools from each were selected.

### 3.3 Instrument for Data collection

The Ogiurrisse board game instructional guide and the Numeracy and Probability Achievement Test for junior secondary school (NPAT-JSS) comprising two parts (I and II) facilitated data collection in this study. Part I of the NPAT-JSS elicited demographic data of students such as gender, name of school, register number, and location (State) of school. Part II has 30 multiple-choice items (15 for numeracy and 15 for probability) with response options lettered A, B, C, and D. The response options consist of three distracters and a key, which is the correct answer to an item. Each correct answer is worth one mark, while each incorrect answer is worth zero. The instrument was face-validated by one Measurement and Evaluation expert and two Mathematics Education experts. The internal consistency reliability of the NPAT-JSS was established using Kuder-Richardson (K-R20) formula, yielding an index of 0.81, which was considered reliable and suitable for data collection.

### 3.4 Experimental Procedure

The data collection process unfolded over six weeks: one week dedicated to baseline (pre-test) administration and orientation, followed by four weeks of active instruction for both the treatment and control groups, and wrapping up with a week for post-test administration and debriefing. The activities were structured into three distinct phases: pre-treatment, treatment, and post-treatment.

#### 3.4.1 Pre-Treatment Phase

During the first week, both the treatment and control groups took the Numeracy and Probability Achievement Test for Junior Secondary School (NPAT-JSS) as a pre-test. This test was conducted under standard examination conditions within a single school day at each school to keep scheduling consistent. The goal was to establish baseline measures of students' achievements in numeracy and probability. Additionally, the week included orientation and training for research assistants, who were JSS II mathematics teachers from the selected schools. The training workshop spanned two days. Teachers in the treatment group received training on the rules of Ogiurrisse, the specific numeracy and probability concepts that each gameplay activity aims to highlight, and how to facilitate the post-game discussion as outlined in the Ogiurrisse board game instructional manual. Meanwhile, teachers in the control group were trained to implement a conventional lesson plan developed by the researcher, which covered the same numeracy and probability content.

#### 3.4.2 Treatment Phase

The treatment group receives instruction in which Ogiurrisse gameplay is deliberately embedded in instructional content, rather than appended to direct instruction on numeracy and probability. Each session unfolds in three key steps: orientation, gameplay with embedded practice, and a structured debrief.

**Orientation (5-10 minutes per session):** At the beginning of each topic, the teacher sets the stage by introducing the day's learning objectives in conventional terms (e.g., "today we are learning to compare the likelihood of two events") and gives a quick overview of how the next round of Ogiurrisse will require students to apply that concept while playing. This part helps to connect the game to the curriculum, making it feel like an integral part of the learning process rather than standalone recreational activity.

**Structured Gameplay (20-25 minutes per session):** Students play Ogiurrisse in pairs or small groups of three to four, using boards and seeds provided by the researcher. The gameplay is designed to encourage specific target behaviours that

align with the lesson objectives. For instance, when teaching counting and number operations, students count the seeds as they sow them pit by pit, saying their running totals out loud to a partner. Meanwhile, the teacher moves around the room, prompting students to think about mental addition and subtraction as seeds are captured or moved around. After each round, students jot down the number of seeds left in each pit on a tally sheet.

**Structured Debrief (10-15 minutes per session):** Right after the gameplay, the teacher guides a whole-class discussion that clearly connects the gameplay experience to curriculum language, using a set of prompts from the lesson plan (e.g., “Out of ten rounds, how many times did Player A win? What does that tell us about the chances of winning this game?”; “Do you think this is a fair game? How do you know?”; “What operation did you use when you added seeds to a pit that already had some in it?”). This debrief phase is crucial for linking the hands-on gameplay experience back to the formal concepts of numeracy and probability.

On the flip side, the control group received instruction on the same numeracy and probability content, following the same four-week topic sequence and total contact time, but through traditional teaching methods. In this group, no game materials were introduced at any point during the lessons. Teachers working with the control group were specifically instructed to refrain from using manipulatives or group activities that might blur the lines between the two teaching approaches.

### 3.4.3 Post-Treatment Phase

In the final week of the experimental procedure, both groups (treatment and control) took a reshuffled NPAT-JSS as posttests under conditions similar to the pretest. This was done to ascertain the efficacy of the Ogiurrisse board game on JSS II students’ achievement in numeracy and probability. The students’ scores from both the pretest and posttest were recorded for data analysis.

### 3.4.4 Control of Extraneous Variables

The following measures were employed to control extraneous variables in this study:

*Researcher Effect:* To avoid bias emanating from the researcher, the researcher avoided involving himself directly in the teaching process and rather employed research assistants who were mathematics teachers in the sampled schools.

*Variability of the Teachers:* To maintain uniformity and reduce the impact of this variable, the research assistants were trained on how to administer the treatment and conventional instruction.

*Subject Interaction:* To control this variable, no school received both experimental treatments at the same time. In other words, students in the treatment group received instruction embedded with the Ogiurrisse board game while those in the control group received instruction using the conventional teaching method. As a result, students from the different experimental groups could not easily meet and interact among themselves concerning the treatment conditions.

*Inter-Group Differences:* Because the study utilised intact classes, the experimental groups were not equal from the beginning of the data collection process in terms of key characteristics. To control this group inequality, the researcher used analysis of covariance (ANCOVA) for data analysis. In the ANCOVA analysis, students’ pretest achievement scores were entered as a covariate to help control for any pre-existing differences in their numeracy and probability skills. This way, the estimated treatment effect shows the difference in adjusted posttest achievement between the Ogiurrisse and conventional experimental groups, taking into account their initial achievement levels and the other factors (gender and the interaction between gender and treatment) included in the model.

*Experimental Mortality:* To control this variable, the researcher ensured that the duration of the study was not too long. Additionally, the lesson duration was incorporated into the normal school period to avoid burnout among the students. With this, the participants were not tired of the experimental process and avoided dropping out.

## 3.5 Data Analysis

Data gathered was analysed using the Statistical Package for Social Sciences (SPSS) version 27. Research questions were answered using means and standard deviations, while the null hypotheses were tested using analysis of covariance (ANCOVA) at the 0.05 significance level. The decision rule was to reject the null hypothesis if the exact probability value is less than ( $P < 0.05$ ) the level of significance, and to accept if otherwise.

## 4 Results

Table 1

*Independent sample t-test of the difference in the mean numeracy and probability achievement scores of JSS students at pretest*

| Treatment    | N   | $\bar{X}$ | SD   | Df  | t-val. | P-value | Remarks |
|--------------|-----|-----------|------|-----|--------|---------|---------|
| Ogiurrisse   | 120 | 13.93     | 3.88 | 238 | -1.23  | 0.22    | NS      |
| Conventional | 120 | 14.54     | 3.81 |     |        |         |         |

Result in Table 1, shows that junior secondary school (JSS) students exposed to the Ogiurrisse board game had a mean numeracy and probability achievement score of  $\bar{x}=13.93$  and  $SD = 3.88$  in pretest while those exposed to the conventional teaching had a mean numeracy and probability achievement score of  $\bar{x} =14.54$  and  $SD = 3.81$  in pretest. This indicates that prior to treatment, students in the conventional or control group slightly outperformed those in the treatment group, demonstrating nonequivalence among the groups. However, the difference between the groups was not statistically significant ( $p < 0.05$ ). This result further justifies the use of analysis of covariance (ANCOVA) for further inference.

Table 2

*Mean and standard deviation of numeracy and probability achievement scores of JSS students exposed to Ogiurrisse board game and those not exposed to it*

| Treatment    | Pretest |           |      | Post-test |      | Mean Difference |
|--------------|---------|-----------|------|-----------|------|-----------------|
|              | N       | $\bar{x}$ | SD   | $\bar{x}$ | SD   |                 |
| Ogiurrisse   | 120     | 13.93     | 3.88 | 23.83     | 3.75 | 9.90            |
| Conventional | 120     | 14.54     | 3.81 | 16.47     | 4.34 | 1.93            |

Results in Table 2 shows that junior secondary school (JSS) students exposed to the Ogiurrisse board game had a mean numeracy and probability achievement score of  $\bar{x}= 13.93$  and  $SD = 3.88$  in pretest and a mean numeracy and probability achievement score of  $\bar{x}= 23.83$  and  $SD = 3.75$  in the posttest with a mean difference of 9.90, whereas those in the conventional or control group had a mean numeracy and probability achievement score of  $\bar{x}= 14.54$  and  $SD = 3.81$  in pretest and a mean numeracy and probability achievement score of  $\bar{x}= 16.47$  and  $SD = 4.34$  in the posttest with a mean difference of 1.93. The results show that JSS students exposed to the Ogiurrisse board game recorded higher mean difference than those in the control or conventional group after posttest. This indicates that the Ogiurrisse board game was effective in enhancing numeracy and probability instruction among JSS students.

Table 3

*Analysis of covariance (ANCOVA) of the efficacy of Ogiurrisse board game on numeracy and probability instruction*

| Source             | Type III Sum of Squares | df  | Mean Square | F       | p-value | Partial Squared | Eta |
|--------------------|-------------------------|-----|-------------|---------|---------|-----------------|-----|
| Corrected Model    | 6827.594 <sup>a</sup>   | 4   | 1706.90     | 1178.72 | .000    | .953            |     |
| Intercept          | 507.636                 | 1   | 507.636     | 350.555 | .000    | .599            |     |
| Pretest            | 2241.651                | 1   | 2241.65     | 1548.00 | .000    | .868            |     |
| Treatment          | 3792.330                | 1   | 3792.33     | 2618.84 | .000    | .918            |     |
| Gender             | 37.200                  | 1   | 37.200      | 25.689  | .000    | .099            |     |
| Treatment * Gender | 22.204                  | 1   | 22.204      | 15.333  | .000    | .061            |     |
| Error              | 340.302                 | 235 | 1.448       |         |         |                 |     |
| Total              | 104573.000              | 240 |             |         |         |                 |     |
| Corrected Total    | 7167.896                | 239 |             |         |         |                 |     |

The result in Table 3 shows the F-ratio ( $F(1, 235) = 2618.84, p=0.000, \eta_p^2 = 0.918$ ) obtained for the difference in the mean in numeracy and probability scores of Junior Secondary School students exposed to Ogiurrisse board game and

those exposed to the conventional teaching method. Since the exact probability value of 0.000 is less than the 0.05 level of significance, there is a significant difference in the mean achievement in numeracy and probability scores of junior secondary school (JSS) students exposed to Ogiurrisse board game and those exposed to the conventional teaching method. The result further showed an effect size of ( $\eta^2_p = 0.92$ ), which indicates that the Ogiurrisse board game instructional approach accounted for approximately 92% of the variance in students' numeracy and probability achievement scores after controlling for unexplained error variance. This suggests that the Ogiurrisse board game is efficacious in enhancing numeracy and probability instruction.

Table 4

*Mean and standard deviation of male and female JSS students on numeracy and probability achievement scores*

| Gender | Pretest |           |      | Post-test |      | Mean Difference |
|--------|---------|-----------|------|-----------|------|-----------------|
|        | N       | $\bar{x}$ | SD   | $\bar{x}$ | SD   |                 |
| Male   | 108     | 14.24     | 3.53 | 19.64     | 6.95 | 5.40            |
| Female | 132     | 14.23     | 4.11 | 20.56     | 3.86 | 6.33            |

Results in Table 4 shows that male junior secondary school (JSS) students had a mean numeracy and probability achievement score of  $\bar{x} = 14.24$  and  $SD = 3.53$  in pretest and a mean numeracy and probability achievement score of  $\bar{x} = 19.64$  and  $SD = 6.95$  in the posttest with a mean difference of 5.40, whereas the female students had a mean numeracy and probability achievement score of  $\bar{x} = 14.23$  and  $SD = 4.11$  in pretest and a mean numeracy and probability achievement score of  $\bar{x} = 20.56$  and  $SD = 3.86$  in the posttest with a mean difference of 6.33. The results show that female JSS students recorded higher mean difference than their male counterparts. This indicates that gender influences numeracy and probability achievement scores of JSS students.

Additionally, the result in Table 3 shows the F-ratio ( $F(1, 235) = 25.689, p=0.000, \eta^2_p = 0.099$ ) obtained for the influence of gender on Junior Secondary School students' achievement in numeracy and probability. Since the exact probability value of 0.000 is less than the 0.05 level of significance, gender significantly influence junior secondary school students' achievement in numeracy and probability. The result further showed an effect size of ( $\eta^2_p = 0.099$ ), which indicates that gender accounted for approximately 9.9% of the variance in students' achievement scores after controlling for other sources of variance in the model. This indicates that gender is a substantial determinant of JSS students' achievement in numeracy and probability.

Table 5

*Interaction effect of gender and Ogiurrisse board game on JSS students' achievement in numeracy and probability*

| Gender | Treatment    | Pretest |           |      | Posttest  |      | Mean Difference |
|--------|--------------|---------|-----------|------|-----------|------|-----------------|
|        |              | N       | $\bar{x}$ | SD   | $\bar{x}$ | SD   |                 |
| Male   | Ogiurrisse   | 53      | 16.26     | 2.92 | 26.00     | 2.70 | 9.74            |
|        | Conventional | 55      | 12.29     | 2.92 | 13.51     | 3.27 | 1.22            |
| Female | Ogiurrisse   | 67      | 12.09     | 3.56 | 22.10     | 3.58 | 10.01           |
|        | Conventional | 65      | 16.45     | 3.42 | 18.97     | 3.50 | 2.52            |

The result in Table 5 shows that the mean difference between the pretest and posttest mean achievement score of male JSS students in numeracy and probability exposed to the Ogiurrisse board game was 9.74, whereas those in the control or conventional group had a mean difference of 1.22. Similarly, the mean difference between the pretest and posttest mean achievement score of female JSS students in numeracy and probability exposed to the Ogiurrisse board game was 10.01, whereas those in the control or conventional group had a mean difference of 2.52. More so, the result shows that female students exposed to the Ogiurrisse board game slightly recorded a higher mean gain than their male counterparts. The result shows that the efficacy of Ogiurrisse board game over the control or conventional group was consistent irrespective of gender, although female students appear to slightly outperform their male counterparts when exposed to Ogiurrisse board game.

Furthermore, the result in Table 3 shows the F-ratio ( $F(1, 235) = 15.333, p=0.000, \eta^2_p = 0.061$ ) obtained for the interaction effect of gender and Ogiurrisse board game on JSS students' achievement in numeracy and probability. Since the exact probability value of 0.000 is less than the 0.05 level of significance, there is a significant interaction effect of gender and treatment on Junior Secondary School students' achievement in numeracy and probability. The result further showed an effect size of ( $\eta^2_p = 0.061$ ), which indicates that the interaction between gender and instructional treatment accounted for approximately 6.1% of the variance in JSS students achievement in numeracy and probability after controlling for other sources of variance in the model.

## 5 Discussion

The finding reveals that Junior Secondary School (JSS) students exposed to the Ogiurrisse board game recorded a higher mean difference than those in the control or conventional group, showing a significant difference in the mean achievement scores of students in the two groups. This finding is feasible because a board game can offer repeated chances to practice numeracy and probability in a hands-on, interactive, and goal-driven learning environment. Rather than passively receiving explanations through conventional teaching, students playing the Ogiurrisse game can actively make decisions, perform calculations, predict outcomes, adapt to changing game scenarios, and receive instant feedback. These features can transform abstract numeracy and probability concepts into meaningful learning experiences, ultimately enhancing students' achievement. This finding lends credence to Meeran (2024), who reported that games such as morabaraba, Tshetershere, Diketo, and Kgati support the learning of addition, subtraction, multiplication, factorisation, and quadrilaterals. The finding is also consistent with Asmaarobiyah and Arisetyawan (2024), who found that ethnomathematics with congklak enhanced the mathematical critical thinking skills of Grade II students compared to traditional teaching methods. The interactive aspect of ethnomathematics games, such as the Ogiurrisse board game, enhances students' chances for meaningful practice while minimizing the passivity often seen in conventional instruction. In another study, Naitili and Nitte (2023) observed significant improvement in geometry concept understanding after instruction with the sikidoka game, which aligns with the present finding. Therefore, this study suggests that incorporating a locally relevant Ogiurrisse board game into teaching can serve as an effective alternative or complement to traditional mathematics instruction.

The finding reveals that female JSS students recorded higher numeracy and probability achievement scores than their male counterparts, with a significant difference between the groups. This suggests that gender is a significant determinant of achievement in numeracy and probability among JSS students. This finding is plausible, as female students often demonstrate more self-discipline, focus, and consistency when it comes to completing classroom tasks compared to their male counterparts (Gunzenhauser et al., 2017). This aligns with existing research that highlights gender differences in mathematics achievement. For instance, Oribhabor (2019) revealed a significant difference in the mathematics achievement of male and female students. In another study, Mutai (2016) revealed that gender was strongly associated with mathematics achievement, which agrees with the present finding. Conversely, the present finding diverges from studies that have shown a preference for male students in mathematics achievement. For instance, Ajai and Imoko (2015) revealed that male and female students taught algebra using problem-based learning (PBL) did not significantly differ in achievement, favouring the males. Instead of suggesting that one gender is inherently better at mathematics, these differences can be attributed to variations in learning behaviours. Therefore, the present finding should not be interpreted as evidence of a fixed, biological gender gap in mathematics achievement, but rather, it indicates that, under the specific teaching conditions of this study, female JSS students scored higher in numeracy and probability than their male counterparts.

Findings further reveal that female students exposed to the Ogiurrisse board game slightly recorded a higher mean gain than their male counterparts. This suggests that the efficacy of the Ogiurrisse board game was consistent for both male and female students, with female slightly outperforming their male counterparts. Regardless, there was a significant interaction effect of gender and treatment on JSS students' achievement in numeracy and probability. One plausible explanation is that male and female students may have responded differently to certain aspects of the Ogiurrisse board game. The repeated gameplay, along with feedback and chances to make and correct decisions, might have given an edge to the females, who often display greater self-discipline, sustained attention, and consistency in completing classroom tasks compared to males. The finding is consistent with existing literature. For instance, Mansor and Rosly (2024) reported significant gender differences in game-based learning usage and mathematics achievement. Additionally, Salami and Spangenberg (2024) found that game-based mathematics instruction was particularly beneficial for female students' acquisition of basic mathematical skills, which agrees with the present finding. This suggests that the interactive and

engaging nature of Ogiurrisse gameplay may have disproportionately benefited female students compared to what would typically be expected from traditional teaching methods. On the contrary, Yumak and Ardahan (2026) found that GeoGebra-based games improved achievement without significant gender differences, which disagrees with the present findings. Such differences could stem from variations in intervention design, duration, sample characteristics, classroom dynamics, and mathematical content. The present finding therefore indicates that the benefits associated with Ogiurrisse may differ based on gender.

## 6 Conclusion

The study examined the efficacy of integrating the "Ogiurrisse" board game into the instruction of probability and numeracy in junior secondary schools in Ebonyi State. Based on the findings, it was concluded that the Ogiurrisse board game is an effective ethnomathematics resource for numeracy and probability instruction. The interactive, engaging, and hands-on nature of the game gives students a fantastic chance to dive deeper into numerical and probabilistic concepts. The study also established that gender is an important determinant of students' probability and numeracy in junior secondary schools. Again, the study demonstrated that the effectiveness of the Ogiurrisse board game instructional approach varies across gender. This underscores the need to take into account the characteristics of learners when applying game-based learning strategies like the Ogiurrisse board game.

## 7 Recommendations

As a result of the findings and conclusion, the following recommendations were made:

1. Mathematics teachers should incorporate the Ogiurrisse board game into their lessons as a supplementary teaching method, especially when covering numeracy and probability.
2. Curriculum developers and educational resource developers should consider adding culturally relevant and familiar board games like Ogiurrisse to mathematics teaching materials.
3. Teachers should promote equal participation among male and female students during game-based lessons with the Ogiurrisse board game, ensuring that everyone has a fair chance to engage and receive feedback.

## 8 References

- Abah, J. A. (2018). Mathematics in the cultural practices of the Orokam people of Nigeria: Insights into the educational relevance of the i'tche game. *International Journal for Innovative Research in Multidisciplinary Field*, 4(6), 164–171.
- Ajai, J.T. & Imoko, I.I. (2015). Gender differences in mathematics achievement and retention scores: A case of problem-based learning method. *International Journal of Research in Education and Science*, 1(1), 45- 50. <https://doi.org/10.21890/ijres.76785>
- Ali, A., & Ahmad, I. (2023). Traditional teaching methods and their impact on student learning outcomes. *Journal of Educational Research*, 15(2), 123-135.
- Anggraena, Y. (2019). Pengembangan kurikulum matematika untuk meningkatkan kemampuan siswa dalam penalaran dan pemecahan masalah. *Alifmatika: Jurnal Pendidikan Dan Pembelajaran Matematika*, 1(1), 15-27. <https://doi.org/10.35316/alifmatika.2019.v1i1.15-27>
- Arhin, A. K. & Offoe, A. K. (2015). Gender differences and mathematics achievement of senior high school students: A case of Ghana national college. *Journal of Education and Practice*, 6(33), 67-74.
- Asmaarobiyah, R., & Arisetyawan, A. (2024). Efektivitas permainan congklak berbantuan etnomatematika terhadap kemampuan berpikir kritis matematis kelas ii sekolah dasar. *AR-RIAYAH: Jurnal Pendidikan Dasar*, 8(2), 283-300. <https://doi.org/10.29240/jpd.v8i2.11482>
- Bacang, B., Rillo, R., & Alieto, E.,( 2019). The gender construct in the use of rhetorical appeals, hedges and boosters in ESL writing: A discourse analysis, *Asian EFL Journal*, 25(5.2), 210-224.

- D'Ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics*, 5(1), 44–48.
- Eslami, Z. R., & Chowdhury, M. (2022). Digital game-based learning. In *Research Questions in Language Education and Applied Linguistics: A Reference Guide* (pp. 621-625). Cham: Springer International Publishing.
- Federal Republic of Nigeria. (2013). National policy on education (6th ed.). NERDC Press.
- Gogo, Z. I., Ojmba, D. P., & Odoemenem, C. (2021). Difficult contents in the Nigerian junior secondary mathematics curriculum: Comparative analysis between perceptions of students and teachers. *International Journal of Research and Innovation in Social Science*, 5(3), 376–383.
- Gunzenhauser, C., Saalbach, H., & von Suchodoletz, A. (2017). Boys have not caught up, family influences still continue: Influences on executive functioning and behavioral self-regulation in elementary students in Germany. *PsyCh journal*, 6(3), 205-218. <https://doi.org/10.1002/pchj.180>
- Idakari, N. S., & Agbom, A. P. (2020). Strategies for reducing mathemaphobia among secondary schools students in Ebonyi state of Nigeria. *American Journal of Educational Research*, 8(4), 194–199. <https://doi.org/10.12691/education-8-4-1>
- Idehen, F. O. (2021). An ethnomathematical exploration of the game of ogiurrisse—a traditional edo game in Nigeria schools. *Ghana Journal of Education: Issues and Practice (GJE)*, 7, 82-113.
- Inko-Tariah, D. C. (2014). Assessment of Literacy and Numeracy Levels of Junior Secondary School Students in Rivers State of Nigeria. *Journal of Education and Practice*, 5(19), 150-155.
- Mansor, N. S., & Rosly, N. S. (2024). A study on the relationship between game based learning and secondary school students mathematics achievement in SMK Kompleks Gong Badak. *Malaysian Journal of Computing (MJoC)*, 9(1), 10. <https://doi.org/10.24191/mjoc.v9i1.26081>
- Meeran, S. (2024). Decolonising mathematics education: Teachers' initial experiences of using ethnomathematical games in the intermediate phase. *Interdisciplinary Journal of Sociality Studies*, 4(s1), 1-14. <https://doi.org/10.38140/ijss-2024.vol4.s1.03>
- Muñoz, M. Á. T. (2025). Classroom Play: Key to Active Learning. *Mused. Revista de Investigación Musical y Educación*, (1). <https://doi.org/10.25115/mused.1.10973>
- Mutai, C. C. (2016). *Gender differences in mathematics performance among secondary school students in Bureti sub-county, Kericho County Kenya* (Unpublished master's thesis). Kenyatta University, Kenya.
- Naitili, C. A., & Nitte, Y. M. (2023). Efektivitas pembelajaran etnomatematika menggunakan permainan sikidoka terhadap pemahaman konsep geometri bagi siswa sekolah dasar. *HINEF: Jurnal Rumpun Ilmu Pendidikan*, 2(1), 42-48. <https://doi.org/10.37792/hinef.v2i1.857>
- Nathan, N. A., & Umoinyang, E. I. (2022). Differential item functioning in basic education certificate examination in mathematics in Akwa Ibom State, Nigeria. *Journal of Research in Education and Society*, 13(3), 136-146
- Nigerian Educational Research and Development Council. (2013). *Basic education curriculum*. NERDC Press.
- Nworgu, B. G. (2015). *Educational research: Basic issues and methodology* (3<sup>rd</sup> ed.). University of Nigeria Trust Publishers.
- Ondo State Ministry of Education, Science and Technology. (2022). *Basic Education Certificate Examination*. In *Education sector report* (Table 2.5.5.2). Examination Department, Ondo State Ministry of Education, Science and Technology.
- Opesemowo, O. A. G., Opatunji, K. O., Babatimehin, T., & Opesemowo, T. R. (2026). Analysis of 2022 and 2023 Osun State basic education certificate examination mathematics items using item response theory: Implications for large scale assessment. *Social Sciences & Humanities Open*, 13, 102381. <https://doi.org/10.1016/j.ssaho.2025.102381>
- Oribhabor, C. B. (2019). The Influence of gender on mathematics achievement of secondary school students in Bayelsa State. *African Journal of Studies in Education*, 14(2), 196-206.

- Perry, E. L., & Len-Ríos, M. E. (2019). Conceptual understanding. In M. E. Len-Ríos & E. L. Perry (Eds.), *Cross-cultural journalism and strategic communication: Storytelling and diversity* (2nd ed., pp. 3–19). Routledge.
- Piaget, J. (1952). *The origins of intelligence in children*. International Universities Press.
- Rosa, M., & Orey, D. C. (2011). Ethnomathematics: the cultural aspects of mathematics. *Revista Latinoamericana de Etnomatemática Perspectivas Socioculturales de La Educación Matemática*, 4(2), 32-54.
- Salami, O. O., & Spangenberg, E. D. (2024). Exploring the gender-based impact of mathematical games on the academic performance of senior secondary school students. *Interdisciplinary journal of sociality studies*, 4, 1-15. <https://doi.org/10.38140/ijss-2024.vol4.10>
- Susanto, E., Mahmudi, A., & Sereyvuth, C. (2024). Enhancing Students' Numeracy Skills in Solving Probability Problems through Realistic Mathematics Education. *Jurnal Didaktik Matematika*, 11(1). <https://doi.org/10.24815/jdm.v11i1.36712>
- Ugee, T. T., & Abah, J. A. (2021). Ethnomathematical aspects of the Toor Kyo la Nam and Ishiva-dar indigenous games of the Tiv people of Mbayom Village of Gwer-East Local Government Area of Benue State, Nigeria. *VillageMath Educational Review*, 2(1), 132–155. <https://doi.org/10.5281/ZENODO.5526283>.
- Watanabe, K. (2023). Fostering fundamental computational skills, a global challenge. *Open Access Government*, 40(1), 274-275. <https://doi.org/10.56367/OAG-040-10986>
- Yumak, Y., & Ardahan, S. (2026). The Contribution of Technology-Assisted Game-Based Teaching to Middle School Mathematics Achievement. *Cumhuriyet Uluslararası Eğitim Dergisi*, 15(1), 440-455. <https://doi.org/10.30703/cije.1712205>

### Publisher's Note

The views, interpretations, and conclusions expressed in this article are solely those of the author(s) and do not necessarily reflect the views or policies of the Journal of Studies in Science and Mathematics Education (JOSSME), its publisher, editorial board, editors, reviewers, or the authors' affiliated institutions. The publisher remains neutral with respect to jurisdictional claims in published maps, institutional affiliations, and other representations. Any products, materials, methods, or manufacturers mentioned or evaluated in this article are presented solely for scholarly purposes and do not constitute endorsement, recommendation, or guarantee by the publisher.