

## Effects of Jeopardy Game on Students Attitude and Performance in Probability within the Outcome-Based Education Framework

**John YEBOAH BOAMAH**, Fomena T. I. Ahmadiyya SHS, Mathematics Department, Ghana, ORCID ID: 0009-0003-7579-7368, boamahjohn731@gmail.com

**Stephen ATEPOR**, C. K. Tedam University of Technology and Applied Sciences, Department of Mathematics and ICT Education, Ghana, ORCID ID: 0000-0001-9703-3367, satepor@pcu.edu.gh

**Solomon Ohene AMOAKO ATTA**, Fomena T. I. Ahmadiyya SHS, Mathematics Department, Ghana, ORCID ID: 0009-0003-8018-8989, solomonamoakoattaohene@gmail.com

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**Abstract:** The aim of this study was to determine the effect of Jeopardy game on students' attitude and performance in probability within the context of Outcome-Based Education (OBE). Through the use of a quasi-experimental methodology, namely the pretest posttest non-equivalent control group design, the research was conducted. For the purpose of the study, a total of 120 pupils from a secondary school that was selected for its convenience participated. Two research hypotheses served as the basis for this investigation. A comprehensive statistical analysis was carried out, which included the use of a t-test for the purpose of comparing the performance in probability and an ANCOVA for the purpose of evaluating the attitude scale. According to the findings, there were changes that were statistically significant and favoured the experimental group. It was discovered that students who were taught probability with the Jeopardy game, using student-centered teaching strategies such as collaborative methods and small group activities as element OBE framework, showed a significant improvement in their attitude scores. This was discovered after experimenting to test the hypothesis that there is no significant difference in the attitudes of students who were taught probability with and without the use of the Jeopardy game. According to the findings, including the Jeopardy game into mathematics lectures, with a particular emphasis on probability, has a positive influence on the attitude and performance of Senior High School students. The study recommended that Educators must participate in professional learning community meetings and conferences in order to get knowledge on the influence that including Jeopardy games has on the attitudes and performance capabilities of students.

**Keywords:** *Jeopardy Game, Gamification, Outcome Based-Education, Attitude.*

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### 1. INTRODUCTION

In mathematics, Probability is a branch that examines the magnitude of uncertainty associated with an event occurring in reality (Baltaci, 2016). Understanding uncertainty or probability can enable students to make informed judgements in many scenarios (Yildiz & Baltaci, 2015). A comprehensive grasp of probability aids individuals in comprehending the dangers and

**\* Corresponding Author**

Fomena T. I. Ahmadiyya SHS, Mathematics Department, Ghana

potential advantages of their actions, while also promoting fairness in their daily lives' (Nunes & Bryant, 2021). Given the significance of probability, several nations incorporate it into their mathematics curriculum in schools. Furthermore, a movement emerged that included probability instruction at the elementary school level. The concept of probability influences our daily lives, thereby improving prospects for students now and in the future as they face random variations and stochastic conditions in mathematics, and other facets of life (Lee et al, 2016).

Nonetheless, students' perceptions have created a negative public image of mathematics, characterizing it as challenging, abstract, and theoretical, rather than an engaging subject, as noted by Arthur et al., (2017). Attitudes influence a student's capacity and inclination to engage with a course or undertake various given duties. Students regarded probability as inherently abstract, which frequently led to the formation of a negative attitude towards probability ideas (Baltaci, 2016). The students' perceptions of probability influence their approach to probability activities, resulting in either productive or unproductive orientations. Students often engage with probability in a procedural and formulaic manner. This impairs their ability to understand the breadth of probability and the variety of approaches that can be used to develop subject-matter expertise.

It is therefore crucial to teach probability concepts in a captivating and efficient way to help students cultivate their critical thinking abilities in the classroom (Koparan, 2022). However, Mathematics education in Ghanaian schools, with a few noteworthy exceptions, has predominantly relied on conventional and abstract methods of teaching that are only comprehended by a small portion of students (Abadiio, 2022). This has resulted in a persistent decline in students' performance in mathematics (Amoako et al., 2024). The pedagogy of mathematics instruction should incorporate experiential and cognitive approaches that engage the learner and foster a sense of enjoyment and motivation (Baah-Duodu et al., 2020). Dorji (2022) argued that a teacher's claim of having fifteen years of expertise is rendered meaningless if they persistently provide the same content without integrating any creative methods into their instruction.

Creative methods such as Games engage and inspire individuals to participate, to embrace uncertainty, to persist, to set and achieve progressively more difficult objectives, and to devote time and focus to acquiring new information and skills (Karamert & Vardar, 2021). These characteristics are essential to each person's growth and development; hence games are undoubtedly one of the primary means through which children may acquire and enhance vital abilities for their daily lives (Cohrsen & Niklas, 2019). Charles-Owaba and Samuel (2018) emphasised the significance of including probability in the mathematics curriculum for learners. This is because the advancements in technology, the prevalence of empirical science in society, the use of data for communication, and modern decision-making processes are all influenced by projected outcomes based on estimated probabilities (Graham, 2017).

The Jeopardy game is a well-recognised and popular quiz format that provides a distinctive blend of entertainment and education (Hanggara & Qohar, 2024). By integrating this game into probability courses, teachers may create an engaging classroom atmosphere that encourages students to participate freely, compete and practically apply information in an enjoyable and collaborative context (Turgut & Turgut, 2020). This method is in line with the ideas of Outcome-Based Education since it encourages learning that focuses on the student, involves active participation, and emphasises the acquisition of practical skills. In order to optimize the efficacy of Outcome-Based Education in the instruction of probability, it is imperative to incorporate interactive and captivating pedagogical approaches. Rani (2020) posited that OBE is an educational methodology that prioritizes the establishment of explicit learning objectives and the alignment of teaching strategies and assessments to attain those objectives. Within OBE framework priority is given to students considering student learning and understanding of the innovative impact of pedagogical student support; Engagement, Active learning, Assessment alignment, Collaboration, Understanding and Retention (Herodotou et al., 2017).

Like all other facets of society, the school system will inevitably evolve in the current technological and scientific period. A change from an educator-focused strategy to a student-driven strategy is now taking place in education, as well as from a traditional educational approach to a constructivist educational approach (Türkmen & Soybaş, 2019). By employing the constructivist education approach, students are able to independently discover the truth and assimilate knowledge via various experiences. According to Aksoy (2019), technology in education effectively addresses the limitations of teaching techniques and introduces novel opportunities for learning. Given the on-going progress in technological and advancement in science, there has been a significant growth in alternative teaching methods in educational settings. Consequently, modifications in education programmes have become unavoidable (Aksoy, 2019). The Ministry of Education (MoE) has thus made the decision to modernise the subject matter currently in use at the end of the 2023–2024 school year. The new curriculum being implemented is called the Standard-Based Curriculum, which is similar to the Outcome-Based Education approach.

The persistent struggle among Senior High School students to develop positive attitudes toward probability and achieve satisfactory academic performance has been a concern for mathematics educators and researchers (Graham, 2017). Agyapong (2014) asserts that most of Senior High School students in Ghana struggle to comprehend fundamental probability concepts. Graham (2017) asserts that mathematics educators in Ghana employ a conventional, teacher-centered approach to instruction, resulting in students' deficiencies in mathematical analysis and logical reasoning; hence, mathematics pedagogy should be rendered practical. Anggara et al., (2018) opine that students encounter difficulties in comprehending and interpreting probability-related questions during tests. Chernoff and Srirman (2014) assert that schematic representations, such as Result tree diagrams for consecutive trials and Venn diagrams for complex occurrences, are essential in the resolution of probability problems.

Bornaa et al., (2023) indicate that the current literature reveals that ineffective pedagogical strategies, including the lecture method, rote memorization, and insufficient emphasis on critical thinking, substantially contribute to students' disinterest and subpar performance in mathematics. Hence, it is imperative to transition from the traditional method of instructing mathematics, particularly when it comes to probability ideas, to a more engaging and innovative approach. Mehta et al. (2021) assert that creative teaching, which incorporates learning flexibility, collaborative learning, and skill-based approaches, facilitates the attainment of Outcome-Based Education (OBE). Krisdianata and Kuswandono (2022) contended that the Jeopardy game offers an engaging learning environment in which students engage actively and derive enjoyment from the instruction. The reports indicates that the two methods share certain similarities, and given that probability is a significant topic in mathematics education necessitating active student involvement, it is essential to examine the combined effects on students' attitudes and their performance in probability (Koparan, 2022).

Specifically, the study sought to:

1. examine the effect of Jeopardy game on attitude of final year SHS students towards probability within the context of OBE.
2. investigate the effect of Jeopardy game on performance of final year SHS students in probability posttest within the context of OBE.

The following Research Hypotheses developed from the objectives above:

**Ho1:** There is no statistically significant difference between the attitude of students taught probability with Jeopardy game and without Jeopardy game within the context of OBE.

**Ho2:** There is no statistically significant difference between the posttest mean score of students taught probability with Jeopardy game and without Jeopardy game within the context of OBE.

## **2. LITERATURE REVIEW**

This review is based on three broad parts namely theoretical review, conceptual review and review of empirical studies, and the summary of the study.

### **2.1 Theoretical Review**

Constructivism is a learning philosophy positing that Students actively construct their knowledge instead of merely absorbing information passively. Individuals, via their experiences and subsequent reflections, construct personal representations and integrate new information into their current knowledge frameworks (schemas). From a methodological standpoint in the social sciences, constructivism posits that people know subjects that human behaviour is mostly purposeful, and that individuals possess a significant ability for organising knowledge (Anna et al., 2023).

Furthermore, the theory of social knowledge construction proposes that knowledge is socially and culturally constructed, and not transmitted (Vygotsky, 1978). In the process of knowledge construction, social constructivism places less emphasis on individual but more on group discuss. Students that are learning in a group are able to compare their knowledge construct while at the same time slow learners are able to be helped to understand mathematics concepts faster than when they are alone. Vygotsky, (1978) enlightens that a level of cognition is attained when students engage in social interaction. Vygotsky believe that students can improve their level of intelligence with the help of a more competent peer, and he called this “zone of proximal development” (ZPD), (Anna et al., 2023). That is, students learn better in a community of discuss. Perhaps, this is why in social constructivism mathematics instructional class students are sited in groups. This type of siting arrangement allows for easy social interaction among the group members, hence it is easy for the group members to compare their solution plans to each other.

Outcome Based Education, is an instructional paradigm that organises every element of an educational system according to defined objectives (outcomes). Upon concluding the educational experience, each student is anticipated to have achieved the aim. Outcome-Based Education (OBE) does not prescribe a singular teaching or assessment approach; rather, classes, opportunities, and assessments should collectively facilitate students in attaining the designated targets (Spady & William, 1994). The faculty's position adjusts to that of teacher, trainer, facilitator, and/or mentor depending on the desired goals.

The emphasis on outcomes establishes explicit expectations for the objectives to be achieved by the conclusion of the course. Students will comprehend their expectations, while teachers will identify the requisite information for instruction throughout the course. Clarity is crucial throughout the educational process, especially in collaborative teaching settings. Every team member, or academic year, shall possess a comprehensive understanding of the requirements for each topic or level, facilitating the development of students. Curriculum designers and planners are needed to adopt a backward design approach after establishing an objective; they must identify the necessary knowledge and skills to achieve that outcome.

Outcome-based methodologies have been implemented in educational institutions globally, at many levels. Australia and South Africa used Outcome-Based Education (OBE) programs from the 1990s to the mid-2000s, but they were discontinued due to significant community resistance (Wiltshire & Donnelly, 2014). The United States has had an OBE program since 1994, which has been modified throughout the years (Tam & Maureen 2014). In 2005, Hong Kong established an outcome-based framework for its institutions. In 2008, Malaysia implemented Outcome-Based Education (OBE) across all public schools.

Furthermore, the European Union (EU) has advocated a reform in education to emphasise results throughout the EU. The Washington Accord, established in 1989, is an international agreement recognising undergraduate engineering degrees conferred under Outcome-Based Education (OBE) methodologies. In 2017, all of the following countries were full signatories:

Australia, Canada, Taiwan, Hong Kong, India, Ireland, Japan, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Sri Lanka, Turkey, UK, Pakistan, China, and the US. Although most countries who adopted the OBE methods ultimately abandoned them, it has shown to be a beneficial approach in some other nations (Dagdag, 2019). The current study was carried out in Ghana, which lacks an Outcomes-Based Education curriculum; nonetheless, a component of OBE methodologies, specifically the collaborative learning approach, was implemented to transform the learning environment for the jeopardy probability lesson.

In this study, the researcher adopted the role of a facilitator, mediating and assisting learners in enhancing their understanding of topics, rather than positioning instructors as the exclusive possessors of knowledge who merely convey information to passive learners. The researcher acknowledges the necessity of addressing learners' individual experiences and challenges for successful instruction to occur. From an Outcomes-Based Education perspective, the educator's duty is to foster an atmosphere that encourages collaborative problem-solving, enabling students to create knowledge and derive meaning, while instructors help or lead the process (Daniel-Sharma, 2020). In teaching probability, the researcher assisted and directed the learners as they navigated the probability scale in the Jeopardy game by prompting them for justifications during group presentations with questions such as, "Why do you assert that?" or "Excellent, please elaborate further."

Moreover, within the OBE framework, teacher interventions and pedagogical strategies, such as the Jeopardy game, were employed to stimulate learners' previous knowledge and enhance their comprehension of probability. Collaborative experiences within the OBE framework are essential for the development of learners' knowledge. Consequently, performance ratings in probability improved when learners constructed their own knowledge using collaborative procedures. The researcher emphasises the attributes of critical thinking, understanding, reasoning, and the application of probabilistic information (Rani, 2020). Consequently, educators are expected to foster reflective thinking in students, since likelihood encompasses their knowledge and skills to comprehend surrounding uncertainties (CRDD, 2010). The function of an Outcome-Based Educator as a facilitator is to enquire rather than instruct, offer assistance, furnish guidelines for reaching conclusions, and facilitate on going discourse (Rhaffor et al., 2017).

## ***2.2 Conceptual Review***

This conceptual review will delve into the principles and benefits of game teaching in mathematics education. One of the key principles underlying game-based teaching in mathematics is the idea that learning can be enjoyable and interactive. By introducing jeopardy games that are specifically designed to align with mathematical concepts and skills within the OBE context, students are provided with a dynamic and immersive learning experience. Games create a sense of excitement and challenge, which can significantly enhance student engagement and participation. In recent years, Game-Based Teaching has emerged as a powerful and effective approach in mathematics education. According to Novilisa et al. (2019),

by incorporating games into the learning process, educators aim to enhance student's attitudes, motivation, and conceptual understanding among students.

### ***2.2.1 Educational Digital and Students Academic Development***

The utilisation of a computer as an instructional instrument is termed Computer Assisted Instruction (Gocheva et al., 2020). Computer-Assisted Instruction, often known as blended instruction, pertains to the use of computers or analogous technologies to deliver diverse topic content. Junn (2023) defined blended education as a pedagogical approach that combines conventional teaching techniques with technological tools. Blended instruction functions as a technique for imparting educational information and activities in a classroom setting. Recent technology advancements have made the framework and essence of CAI a more adaptable method of classroom learning. Nevertheless, some fundamental elements are requisite for its execution. Kaynar (2020) posits that a blended education model should consist of three elements: a qualified educator, the learners, and an interactive computer environment. Kaynar (2020) asserted that the components of blended teaching or Computer-Assisted teaching (CAI) represent a synthesis of traditional instructional elements with the interactive computer environment.

A mathematical game is characterised by explicit mathematical factors governing its rules, strategies, and outcomes. Plato (427 BC – 347 BC), as referenced in Richeson and Davidson (2021), advocated for the use of games in teaching in his writings, Republic and Laws. Frequently, these games possess uncomplicated rules and standardised techniques, shown as tic-tac-toe and dots and boxes. Mathematical games do not have to be cognitively complex to possess profound computational foundations (Hwang & Chen, 2022). Although the rules of mancala are very simple, the game may be meticulously examined using combinatorial game theory. Mathematical games contrast significantly with mathematical puzzles, since the latter need specialised mathematical knowledge for resolution, while the former do not demand extensive mathematical understanding for participation (Novilisa et al., 2019). The arithmetic foundation of mathematical games is frequently not obvious to players who lack training in recognising the statistical or mathematical components.

Moreover, mathematical games embody an intriguing amalgamation of two ostensibly disparate realms - the abstract domain of mathematics and the engaging sphere of games. These games are intended to test our mathematics abilities while also offering fun and cognitive engagement. They have been integral to human history for ages, with beginnings traceable to ancient civilisations. Mathematical games, ranging from traditional board games such as chess and Sudoku to contemporary digital puzzles and strategic card games, provide a varied and stimulating means to investigate mathematical topics, enhance problem-solving abilities, and develop logical reasoning. In-depth investigation of mathematical games indicates that diverse educational games provide advantages; illustrating that enjoyment and learning may harmoniously coexist in the mathematics classroom.

Charles-Owaba and Samuel (2018) revealed in a study titled "Effects of Traditional Games on Students' Achievement" that the data indicate games benefit students who participated in the intervention. The research comprised two hundred eighty-nine (289) junior secondary one (JS1) mathematics students. The study was directed by three research topics and corresponding hypotheses. The research utilised a non-equivalent pre-test, post-test control group design. The study utilised a Mathematics Achievement Test (MAT) produced by a researcher. The acquired data were examined using mean scores, standard deviation, and analysis of covariance (ANCOVA).

In a similar study, by Ariani (2022), titled "Utilisation of Jeopardy Games Using PowerPoint to Improve Students' Learning Outcomes," indicates that students exposed to the Jeopardy game shown a substantial improvement in their posttest mean scores compared to those subjected to conventional techniques. The study employed the experimental methodology known as "Pretest-Posttest Control Group Design." The results demonstrated a considerable disparity in learning outcomes between the usage of Jeopardy games and the absence of such games. The pretest findings of the experimental and control classes indicated that the calculated t-value of -1.3534 is less than the t-table value of 2.262 at a significance level of 5% with 8 degrees of freedom. This indicates that the two groups were in equilibrium and exhibited no disparity. The posttest computation indicates that  $t \text{ count} = -7.2152$ , which exceeds the t-table value of 1.86 at a significance level of 5% with  $DF = 8$ . Consequently, a substantial disparity existed between the experimental group and the control group following the intervention. However, Savic and Adzic (2023) assert that the time a student dedicates to gaming may adversely impact their academic performance. The duration of study throughout the examination period is somewhat correlated with a student's average performance.

Also, Abonyi et al, (2014) sought to investigate the influence of mathematical games on students' performance in quadratic expressions, employing a non-equivalent control group quasi-experimental design. The study sample comprised one hundred and ten J.S.S II students. The study was conducted at six secondary schools: two for boys, two for girls, and two coeducational institutions. The schools were chosen via a stratified random sampling approach. A whole class was chosen from each school for the study by simple random sampling. Among the six schools, three (one male, one female, and one co-educational) were assigned to the treatment group, and the remaining three were classified as the control group. The treatment group was instructed on quadratic expressions using a game-based approach, whereas the control group got training via conventional means. The study was guided by three research questions and three hypotheses. The Quadratic Expression Achievement Test was employed to collect data on student performance. The data were analysed using mean, standard deviation, and analysis of covariance (ANCOVA). The results demonstrated that the mathematical game method surpasses the conventional approach in improving students' performance in mathematics.

### 2.2.2 Nature of the Jeopardy Game

The present study employed a PowerPoint format for these jeopardy-style exercises. This is a competitive group activity involving teams of students, often including two or more participants, inside a classroom environment. A computerised Jeopardy game board displays up to five mathematical concepts, each linked to a spectrum of point values underneath. A higher point number generally signifies an increased level of difficulty for the subject or job (Kurniati et al., 2021). Upon the selection of a point value by a team of students, the succeeding screen presents the relevant topic or question. Upon the presentation of the question, the team members must cooperate to devise an answer. Upon providing a successful answer, participants are awarded the corresponding point value; conversely, a wrong response results in a deduction of that point value from the final score. A group that reaches the correct answer must thereafter propose the solution to the class.

DICE	COINS	BALLS	MARBLES	CARDS
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400
500	500	500	500	500

Figure 1. Jeopardy Game Board

Figure 1 shows the interface of the jeopardy game designed by the researcher for the study. The main board shows points ranging from 100 to 500, beneath it are questions which are reveal when the category is selected. The level of difficulty of the questions depends on the points.

### 2.2.3 Concept of Attitude Formation

Atepor (2020) states that the measuring of attitudes towards mathematics originated with Thurstone's assessment approach in 1929. With the advent of several instruments, mathematics instructors possess multiple methods for evaluating students' attitudes. To comprehend how these diverse tools might assess attitudes towards mathematics, it is important to analyse the elements of the idea of attitude.

Attitude towards mathematics can be characterised as a favourable or negative emotional inclination towards the subject. Likert scale surveys are frequently employed to assess attitudes towards mathematics, with studies utilising several terminologies to quantify this attitude through three components: Like Mathematics (LM), Value Mathematics (VM), and Confidence in Mathematics (CM) (Hwang & Son, 2021). The Attitude Scale towards

Mathematics and Statistics is a concise self-report instrument designed to evaluate pertinent characteristics of attitudes towards these subjects (Kim & Lee, 2024).

Researchers have investigated the determinants influencing attitudes towards studying mathematics, encompassing anxiety, self-efficacy, and intrinsic motivation (Moussa, 2022). The disposition towards mathematics is shaped by cognitive, emotional, and behavioural components that interrelate. The cognitive component encompasses beliefs or thoughts regarding mathematics, the emotional component pertains to feelings or emotions towards mathematics, and the behavioural component refers to the inclination to engage with mathematical learning (Atepor, 2020).

#### ***2.2.4 Games and Attitude Development***

A study by Karamert and Vardar (2021) titled "The Effect of Gamification on Young Mathematics Learners' Achievements and Attitudes" attempted to examine the impact of gamification on the academic accomplishments and attitudes of fifth-grade pupils towards mathematics. The instructional procedure for the topic of "fractions" within the mathematics curriculum was enhanced using gamification components. The quasi-experimental design was selected as the research methodology. Achievement tests and attitude scales were employed as devices for data gathering. The study's participants were 46 fifth-grade pupils. The study favoured the Pyramidal Design Model as the gamification design framework. The components of this model were tailored to the participants' class level in the study. The investigation revealed no significant difference in the outcomes of the attitude scale.

A study conducted by Öztürk and Korkmaz (2020) titled "The Effect of Gamification Activities on Students' Academic Achievements in Social Studies Course, Attitudes Towards the Course, and Cooperative Learning Skills" sought to evaluate the influence of educational games on students' academic performance, attitudes towards the subject, and collaborative learning skills. The research utilised a semi-experimental design with a pre-test and post-test control group. The research cohort consisted of 60 fifth-grade secondary school students. The experimental group employed instructional games to reinforce the emphasised topics, whereas the control group applied conventional methods for six weeks. Data for the research were collected using the Social Studies Course Attitude Scale (Cronbach's  $\alpha=0.61$ ), the Cooperative Learning Scale ( $\alpha=0.80$ ), and the Social Studies Course Academic Achievement Scale ( $\alpha=0.78$ ). Mean, standard deviation, and ANOVA analyses were performed. Thus, gamification-enhanced Social Studies Education significantly enhances students' perceptions of the social studies curriculum in comparison to conventional techniques.

Research indicates that Game-Based Learning (GBL) enhances students' self-efficacy, cognitive understanding, and skill development in science and many academic disciplines (Zheng & Wang, 2023). A quasi-experimental study by Chung and Chang (2017) shown that employing Game-Based Learning as a pedagogical approach through non-digital gaming activities enhanced spatial mathematics learning results for Grade 9 students in Taiwan. The authors observed that GBL facilitates enhanced contacts among students and fosters

collaboration. GBL also improves pupils' decision-making and information assessment abilities. The atmosphere fostered by GBL facilitates the acquisition of these abilities, hence enhancing student learning. Research indicates that game-based learning (GBL) fosters good attitudes towards education, cultivates growth mind-sets, and enhances work ethic among primary students.

A study by Turkmen and Soybas (2019) which investigated, the effect of gamification methodology on 5th grade students' achievement and attitude in Mathematics classes. In accordance with this purpose, the subject of fractions has been prepared as game based and Educational Informatics Network games and applications have been used as teaching materials. In this study, mixed method was used by combining quantitative research and qualitative research method. For the quantitative part, pretest - posttest control group quasi-experimental design was employed. Quantitative data was supported by qualitative data, obtained from in-class observations and unstructured interviews with students. Findings show no statistically significant difference between attitude scores of the students in the experimental and control groups. However, it has been observed that the achievement of the students in the experimental group increased more than that of the students in the control group.

Research by Luo et al. (2022) titled 'Examining the Impact of Online Math Games on Student Performance and Attitudes' was released. The research aimed to examine the impact of skill-based online mathematics games on students' mathematical performance, attitudes, and perceptions of the games. Thirty-eight students from fifth to eighth grade engaged in the research. The findings demonstrated a diverse impact of online gaming on mathematical proficiency and perceptions. This study project utilised a mixed-methods approach, integrating quantitative data from standardised exams, skills-based online practice, and attitude surveys, as well as qualitative data derived from open-ended questions and interviews (Creswell & Hirose, 2019). The statistics suggest that students who obtained a higher number of correct answers on online gaming platforms were likely to receive superior scores in NPR.

Based on recommendations from various literatures, the current study employed innovative strategy (Jeopardy Game) within an engaging teaching framework of Outcome-Based Education, to impact student attitudes and academic performance in learning probability within the framework. Likewise, research has indicated that the majority of investigations, including the current one, utilised a comparative strategy. Although the majority of these studies utilised a mixed methodologies approach, the current study applied a quantitative research methodology.

### **3. METHODOLOGY**

The study employed the Positivism research paradigm, which posits that the truth of phenomena can only be accurately assessed and concluded when its affecting conceptions are exposed to quantitative analysis (Saunders et al., 2015). This scientific methodology facilitates the acquisition of quantitative data and its verification via analysis, which is expected to provide generalizable results (Creswell & Creswell, 2017). This study employed quantitative

assessments of constructs and examines their interconnections to identify patterns and correlations (Leavy & Patricia, 2022). The objective of quantitative research is to achieve impartiality in conclusions, mitigate mistakes, and acquire precise measurements of the investigation. Hirose & Creswell (2023) asserts that quantitative research is fundamentally based on a positivist philosophy, which posits the existence of social truths characterised by a singular objective reality, independent of individual emotions and perspectives.

### **3.1 Research Design**

The design employed in the study is a quasi-experimental group design which is a form of experimental research aimed at assessing the causal effects of an intervention on a particular population, in which participants are not randomly assigned to groups (Hirose & Creswell, 2023). Specifically, the study employed Non-Randomized Pretest Posttest Control Group design. The research strategy utilised non-random assignment of individuals into two groups: the treatment (experimental) group and the control group.

**Table 1.** *Non-Randomised Pre-test Post-test Control Group Design*

Non Randomised	Experimental group	Pre-test 1&2	Jeopardy game intervention	Post-test 1&2
	Control group	Pre-test 1&2	Conventional teaching method	Post-test 1&2

From Table 1, pre-test 1 represents pre-attitude test and pre-test 2 denote pre-performance test. Conversely, post-test 1 represent post-attitude test and post-test 2 represent post-performance test. Kgopane (2021) asserts that employing quantitative and evaluative procedures in the analysis of research phenomena enhances the understanding of what constitutes the objective reality of events. Hence all the data collected were analysed quantitatively to make meaning out of it.

### **3.2 Population and Sample**

The target population was all final-year Senior High School students from the designated institution in the Adansi North District, Fomena, Ashanti Region of Ghana. The accessible population comprised 128 students from two chosen final year Senior High School classes, selected via purposive sampling. However, due to absenteeism, only 120 participants engaged in the study. The classes 3Art1 and 3Art2 served as the control and treatment groups, respectively.

### **3.3 Data Collection Instrument**

The study carefully chose two research information gathering instrument that could adequately answer the research objectives (Saunders et al 2015). These instruments were the Probability Performance Test (PPT) design by the researcher and Attitude Test Inventory (ATI) adapted from Afari (2012). Both instruments were used to collect quantitative data for this research. The PPT was used to collect information on the students' performance in Probability whereas

the ATI was used to collect information on students' attitudes towards Probability. A probability performance test is a type of teacher made achievement test that measures the level of knowledge, skill, or understanding that a student has in the area of probability. A pre-test and post-test probability achievement test was used to evaluate the progress or improvement of student's probability performance over a period of three weeks.

The test items were developed in line with the Ghana Education Service Core Mathematics syllabus for senior high schools (CRDD, 2012). The pre-test was administered before the students receive the instruction or Jeopardy game intervention in probability, and the post-test was administered after the students completes the instruction or Jeopardy game intervention. The difference between the pre-test and post-test scores indicates the change in the student's performance in probability as a result of the instruction or Jeopardy game intervention.

The Pre-test consisted of twenty (20) multiple choice items. The test items were taken from the sample space of simple experiments and sample space of compound experiment. Also, the items comprised of calculating probability of an event. The twenty (20) test items were all objectives test items which were carefully selected from the core mathematics textbook for senior high school. Each test item comes with four (4) alternatives which comprises one possible answer and three detractors. Students were expected to choose the correct answer by circling the right alternative. The students were given sixty (60) minutes in answering the questions. The entire questions were marked out of twenty (20). The same test items were given to the experimental group and the control group to gather a baseline data on the participating students in the study. This information was to help the researcher understand the uniformity between the control and the experimental group. It is therefore necessary to understand the entry performance level of the two groups.

Moreover, the post-test contains twenty (20) test items which were of the same difficulty level as the pre-test. All the twenty (20) objective test items contained four alternatives with one possible answer and three destructors. The test items were set around determining the sample space for simple and compound experiment, and calculating the probability of an event. Both pre-test and the post-test items were designed to test the student's ability to apply and associate the basic operations in solving probability problems. Students were to answer all of them within duration of sixty (60) minutes. The items were scored out of twenty (20) marks. The test items were formulated with the syllabus as a guide, experts input and guidance to ensure that items were valid and Kuder Richardsons reliability test used for the Probability performance test was  $KR-20 = .78$ .

The Attitude Test Inventory (ATI) is a questionnaire used to measure students' attitude towards mathematics. This instrument was adapted from Afari (2012); it consisted of two scales, namely Enjoyment of mathematics lessons and Academic efficacy. The Enjoyment of Mathematics Lessons scale, used in mathematics by Afari (2012) has eight items with a five-point frequency response of Almost Always, Often, Sometimes, Seldom and Almost never. The wordings of all the eight items were maintained, but probability replaces mathematics and the frequency response format was changed to Strongly Agree (SA), Agree (A), Neutral (N),

Disagree and Strongly Disagree. These changes were necessary to make sure the items were meaningful when used with this response format. Also, the second scale, Academic Efficacy was based on the Morgan Jinks Student Efficacy Scale (MJSES; Afari, 2012) developed by Jinks and Morgan (1991) and adapted by Afari (2012). Self-efficacy is the belief that one has the ability to perform a specific task or achieve a certain goal (Chapman, 2015). The Academic Efficacy scale, used in this study consisted of eight items, all the of which were positively worded and have a five-point frequency response scale of Strongly Agree (SA), Agree (A), Neutral (N), Disagree and Strongly Disagree. A scale description and sample item for the Enjoyment of Probability Lessons and Academic Efficacy is presented in Table 2.

**Table 2.** *Sample of Attitude Test Inventory (ATI)*

<b>Attitude scale</b>	<b>Attitude scale description</b>	<b>Item on the Scale</b>
Enjoyment of probability Lesson	The extent to which students enjoy their probability lessons.	Lessons in probability are fun
Academic Efficacy	Students' beliefs about their Academic competence	I find it easy to get good grades in probability

The validity of the instrument was check by expert in field Mathematics education whiles reliability was Cronbach alpha. The Cronbach's alpha for the Attitude test inventory was .75 this value was high enough to attest to the reliability of the test items (Klu et al., 2023).

### **3.4 Data Collection Procedures**

The data collection process started with gathering data on pre-test for both the Attitude Test Inventory (ATI) and Probability Performance Test (PPT) before the intervention was administered. The intervention was given to the experimental group whiles the control receives the conventional method. The study was structured in order to allow the control group starts a week before the experimental group took their intervention (jeopardy game within the context OBE). Moreover, the same content was taught but the experimental group lesson was incorporated with Jeopardy game with collaborative teaching method of OBE coupled with student centered learning approach as specified by curriculum (CRDD, 2012), whiles the control group uses only the student centered. The intervention lasted for three weeks after which the post-test data was collected on both the control and the experimental group for the two instruments.

The jeopardy game was used as a formative assessment tool. The researcher creatively designed the Jeopardy Game using the Microsoft PowerPoint; this means that the game can be played offline, even though several websites offer Jeopardy templates that you can customized to fit your needs. The game consists of different categories and question values, ranging from easy to difficult. The category values or question values ranging's from 100 to 500. The students were put into seven groups and each group is made to select a question from each category. All the groups work at the same time any group who finishes with any of the questions

raises the hand and give the answer. If the answer is right a member of the group comes to present the answer on the board for everyone, then the facilitator provides further clarification by projecting the answer to class and his comment.

The data collected were scrutinized several times to ensure that all the data have been rightly processed in order to minimized errors. The first research hypothesis (there is no significant difference between the attitudes of students taught probability with and without the Jeopardy game within the context of Outcome-Based Education) was analysed using Analysis of Covariance (ANCOVA) to evaluate the overall impact of the Jeopardy game on the attitudes of the experimental group in comparison to the control group. The Independent sample T-test was employed to investigate Research Hypothesis two, which posits that there is no significant difference in the post-test mean scores of students taught probability with and without the Jeopardy game in the context of Outcome-Based Education (OBE).

## 4. FINDINGS

### 4.1. Hypothesis One

**Ho1:** There is no significant difference between the attitude of students taught probability with and without Jeopardy game within the context of OBE.

**Table 3.** *Descriptive Statistics of Post-attitude Scores*

Test	Group	N	Mean	Std. Deviation
Post-attitude test	Experimental	58	2.93	.231
	Control	62	2.80	.269
Pre-attitude test	Experimental	58	2.82	.321
	Control	62	2.83	.340

Table 3 indicates that, the post-attitude scores of the experimental group (with M=2.93 and SD=.231) was relatively higher than that of its pre-attitude scores (with M=2.82 and SD=.321). This indicates that the experimental group improves on their mean attitude scores. Also, the post-attitude scores of the Control group (with M=2.80 and SD=.269) was relatively smaller than its pre-attitude score (with M=2.83 and SD=.340). Therefore, the experimental group improved relatively on their attitude towards probability lesson while the control group showed a decline in their attitude. Table 4. presents tests of between-subjects effects for a One-way ANCOVA analysis.

**Table 4.** *Test of Between-Subject Effects (ANCOVA Results)*

Dependent Variable: POST-ATTITUDE SCORE						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Square
Corrected Model	1.233 <sup>a</sup>	2	.617	10.674	.000	.154
Intercept	7.529	1	7.529	130.327	.000	.527
Pre-attitude	.689	1	.689	11.922	.001	.092
Group	.559	1	.559	9.673	.002	.076
Error	6.759	117	.058			
Total	991.977	120				
Corrected Total	7.992	119				

a. R Squared = .154 (Adjusted R Squared = .140)

As presented in Table 4, the results indicated a statistically significant main effect of group,  $F(1, 117) = 9.673, p = .002$ , partial  $\eta^2 = .076$ , suggesting that students who were taught using the Jeopardy game performed significantly better on the posttest than those taught using traditional methods. Therefore, the study rejects the null hypothesis and concludes that there is a significant difference in the attitude of students based on whether they were taught probability with or without the jeopardy game within the context of Outcome-Based Education.

The covariate pretest scores was a significant predictor of posttest scores,  $F(1, 117) = 11.922, p = .001$ , partial  $\eta^2 = .092$ , indicating that students' initial performance significantly influence their posttest outcomes. The overall ANCOVA model was statistically significant,  $F(2, 117) = 10.674, p < .000$ , and explained approximately 15.4% of the variance in posttest scores. These results showed that the Jeopardy game intervention within the OBE framework was an effective instructional tool for improving students' academic performance in probability.

#### 4.2. Hypothesis Two

**Ho2:** There is no statistically significant difference between the posttest mean score of students taught probability with Jeopardy game and without Jeopardy game within the context of OBE.

Prior to testing the hypothesis two an independent sample t-test was run to determine the cognitive entry level of the control and the experimental group. This was aimed to classify students into groups as control or experimental before the intervention (Enu et al., 2015).

**Table 5.** *Independent Sample T-Test for Control and Experimental Group Pretest*

Test	Group	Mean	Std. Dev.	t	df	Sig.(2 tailed)
Pretest	Experimental	7.81	2.296	.557	118	.578
	Control	7.92	2.328			

Table 5, the results of the independence sample t-test indicates that there was no significant difference between the pretest scores of the Control and Experimental groups ( $t_{118} = .557, p = .578 > .05$ ). It was therefore, established that, the two groups going the intervention had the same cognitive entry abilities based on their prior knowledge probability. Also, independent sample t-test was employed to analyzed the second hypothesis which and answers the research objective two as shown in Table 6.

**Table 6. Independent Sample T-Test Results for the Control and Experimental Group**

Test	Groups	Mean	Std. Dev	t	df	Sig. (2-tailed)
Posttest	Control	14.45	2.359	-3.952	118	<.001
	Experimental	16.03	2.000			

Table 6 reveal that there is significant difference in the posttest mean scores of the control group and the experiment group ( $t_{118} = -3.952, p < .001$ ). Hence the null hypothesis that “There is no statistically significant difference between the post-test mean score of students taught probability with Jeopardy game (experimental) and without Jeopardy game (control) within the context of OBE” was rejected. The study posit that there was significant improvement in the mean score of students taught probability using jeopardy game within collaborative learning, small and mixed ability grouping setting (OBE framework).

## 5. RESULTS AND DISCUSSION

The results for the research hypothesis one revealed that there was significant difference between post-attitude scores of the Control and Experimental groups. Thus, the Experimental group showed improvement on the post-attitude scores after the intervention. This finding seems to contradict the results of a study in Turkey by Turkmen and Soybas (2019) which found no significant difference in students’ attitude in both the control and experimental group in a gamified mathematics lesson.

The results of this study other hand confirm the findings by Apostolos and Katmada, (2017). In the study Apostolos and Katmada examine the effect of simulation games on attitude of secondary school students and found that, there is significant improvement in attitude of the experimental group. Also, the results of this agrees with Karisdianata and Paulus (2022), who reported that students who were exposed to Jeopardy game got motivated and showed improvement in their reading skills. When Jeopardy game was used to enhanced the reading skills of high school students.

The analysis of the second hypothesis showed a significant difference between the post-test mean score of the student who were taught without jeopardy game and students who were taught using jeopardy game whiles employing elements of Outcome-Based Education elements such as mixed ability grouping and collaborated learning strategy. Hence, the study affirms that when students are allowed to collaborate with their peers whiles working on a task, learners become active and hence grasp the concept they are learning more than working alone. The

OBE framework emphasizes group collaboration and individual accountability. Thus, individual members are expected to account for their learning after going through the intervention. Due to high improve in the individual score the experimental group within the framework observed significant difference in means score over the control group.

The result of this study resonates with the Constructivist theory which is of the believe that creating an enabling learning environment for learners, contribute to learner's ability to construct their own knowledge on the concept and hence improve in their performance. In this case Jeopardy game was used to provide an enabling learning environment for the final year students in learning probability and the result showed a significant improvement in the post test performance scores. Hence, the change in performance of the Experimental can be attributed to the Jeopardy game intervention. The result of this study was in consonance with a study done by Turkmen and Soybas (2019), which reported a significant improvement in mathematics achievement of the experimental group after the simulation game intervention. In a similar studies by Owaba and Samuel (2018), Maryana et al. (2024), who reported that students in the experimental group improved significantly in mathematics achievements scores after game based intervention This study's results corroborate prior research by Kim and Casteli (2021) and Karamert and Vardar (2021), which indicated that the experimental group utilising gamification elements exhibited a significantly greater increase in achievement test scores compared to the control group that did not employ such elements.

Students who were taught probability with Jeopardy game within the context of OBE improve in their attitudes as compared to their counter-part in the traditional learning environment; hence the Jeopardy game was seen to be effective in influencing students' attitude in mathematics. The Jeopardy game within the OBE framework engages the students within the learning environment and significantly improved upon the performance of the students in the experimental group as compared to the traditional method, irrespective of the how under achieving the students were.

## **6. RECOMMENDATIONS**

In light of the findings of the study, the following recommendations that;

1. Professional Learning Sessions on how to develop basic ICT skills like the use of MS tools (MS power-point, excel and word) should be organised to help mathematics teachers developed 21<sup>st</sup> ICT skills for developing instructional aids.
2. Mathematics teachers integrate game-based learning approaches, most especially Jeopardy games, into their teaching of probability and other abstract mathematical concepts. Such interventions not only increase student engagement but also enhance conceptual understanding by offering a more interactive and enjoyable learning experience.
3. New studies should be targeted at Basic school level to ascertain if the findings will be the same.
4. A mixed method approach could be employed in future research to explore the opinions of participants within the game learning environment.

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