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# EDITORIAL

Journal of Science Education and Research (JSER) is a peer-reviewed published Bimonthly. It aimed at advancing knowledge and professionalism in all aspects of educational research, including but not limited to innovations in science education, educational technology, guidance and counselling psychology, childhood studies and early years, curriculum studies, evaluation, vocational training, planning, policy, pedagogy, human kinetics, health education and so on. JSER publish different types of research outputs including monographs, field articles, brief notes, comments on published articles and book reviews.

We are grateful to the contributors and hope that our readers will enjoy reading these contributions.

**Prof. Patrick C. Igbojinwaekwu**
**Editor-in-Chief**

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# EFFECTIVENESS OF GAMIFIED-BASED-ACTIVITY ON NIGERIA COLLEGES OF EDUCATION STUDENTS' ACHIEVEMENT IN NUMBER SYSTEM

**[1]JohnBosco O.C. Okekeokosisi**, **[2] Odunayo A. Bamisebi, [3]Felix J. Okoh**
[1, 3]Computer Education Department,
[2]Sharpstown High School,
[1, 3]School of Secondary Education (Science),
[2]Houston Independent School District, Houston, Texas, United States.
[1, 3]Federal College of Education (Technical), Asaba, Delta State, Nigeria.

## Abstract

*This study explored effectiveness of gamified-based-activity on Nigeria* colleges of education *students' achievement in Number System. Two research questions and two hypotheses guided the study. The design was quasi-experimental research. The population comprised of all regular Nigeria Certificate in Education (NCE) undergraduate students admitted for in 2023/2024 academic session. 121 students formed the sample size which was drawn using stratified sampling technique to select only NCE regular students whose subject combinations is computer science education based from 5 federal and 5 state colleges in south east and south south Nigeria. Number System Achievement Test (NSAT) was used for instrument for data collection. The reliability of the instrument was established using Kuder-Richardson Formular 20. The reliability coefficient of NSAT was found to be 0.85. The research questions were answered using Mean with Standard Deviation while the null hypotheses were tested using ANCOVA. Results showed that the gamified-based-activity enhanced students' academic achievement in number system. Also, there was significant influence on gender on students' academic achievement in number system. Based on the findings, the researchers recommended among others that lecturers should always be attentive to know when students are carried away by class activities.*

**Keywords:** Gamified-Based-Activity (GBA), Gender, Achievement

## Introduction

Academic achievement connotes accomplishment of desired learning outcomes. It is determined by method of instruction, learning environment and the learner (Okekeokosisi, 2024). Okekeokosisi, Alison, Boh and Joe-Obasi (2024) defined academic achievement as progress one make to reach a height either through effort or skill which is determined by the scores or grades that students-learners get in an examination or test. It is equally seen as a test used to assess learners' extent of learning a particular course after receiving instruction on course content. Thus, higher grades are usually an indicator of better academic achievement when effective application of strategies, classroom management, effective use of instructional materials and continuous evaluation are done during instructional delivery.

Tertiary education encompasses all formal post-secondary learning. It is also known as higher education. Oytun (2024) described higher education as schools that offer advance learning programs and prepare students for the world of work and the ability to think critically. Tertiary education is the education given after secondary education in Colleges of education, Polytechnics, Monotechnics, Universities and other institutions offering correspondence courses (FRN, 2013). According to the document, the goal of tertiary education encompass the development of relevant high level manpower, development of intellectual capability of individuals and acquisition of physical and intellectual skills. Others are to promote and encourage scholarship as well as community service. Tertiary educational institutions pursue these goals through teaching, research, generation and dissemination of knowledge which they achieve through a variety of programmes such as certificate, diploma, undergraduate and post-graduate courses.

Teaching-learning in Nigeria tertiary institutions like colleges of education so far has not met the expectations of the stated goals and objectives due to a number of factors such as limited infrastructure, poor funding, poor staffing, poor record keeping, socio-political interference and poor teaching strategies-methods. These problems have resulted in graduating unskilled individuals who cannot compete globally. This pitiable and unacceptable conditions has necessitated the need for the present study.

In computer science, number systems are used to represent numerical values and data internally. It is a writing system for denoting numbers logically using digits or symbols (Prepbytes, 2023). Sathyabama (2024) defined number system as the technique to represent numbers in the computer system architecture. It involves representing and

manipulating numerical data using different bases. The most common number systems are decimal (base 10), binary (base 2), octal (base 8) and hexadecimal (base 16). These number systems are taught progressively from upper basic in primary school as computer science to senior secondary as basic science and technology in junior secondary and as computer studies / data processing in senior secondary respectively. Learners' achievement in external examination like WAEC, NECO and internal college computer education departmental courses is not encouraging. This could be seen from Chief examiners report on computer studies – data processing of WAEC May/ June from 2021 -2024 and from semester moderators report on number system from 2021 – 2024. Furthermore, numerous studies carried out in computer studies – data process in which number system is a course with its credit unit in computer science education option had attributed inappropriate use of teaching methods – strategies to inconsistence of learners' achievement in the course (Okekeokosisi & Okigbo, 2023; Okekeokosisi, Boh & Okoh, 2025). The reports suggested that teaching number system should be hands-on, encourage to improvise for in-depth knowledge, understanding, easy recall and to retain. This would necessitate self-reliance, skill development and creative learners.

Teaching strategy – method that could stimulate and engage learners either individually or as group is gamified-based-activity. Gamified-based-activity is the application of typical elements of game playing to other areas of activity. It is could be linked to gamification. Kapp (2012) refers gamification as the act of converting different everyday actions into game-based activities which can be reached by using game mechanics in a graphical designed environment with the purpose to engage and to motivate a person in a particular activity. It is the application of quizzes, simulation and self-assessment tools in order to encourage students to actively participate, leading to better achievement, knowledge retention and practical skill development (Buckley & Doyle, 2017). Christopoulos and Mystakidis (2023) asserted that gamification is the strategic application of game design principles, mechanics and elements into non-game environment. It is an engagement and encouraging participation that is away from traditional learning activities. Such activities integrates badges, leaderboards, set of rules for play, competition and challenges into the curriculum to make learning more interactive and enjoyable (Ezzeh, 2025). This strategy promotes students immediate feedback, progress bars, badges, teacher response, peer feedback and allows them to easily track their progress towards academic goals. Gamification is an Artificial intelligent application package developed by Nick Pelling in 2002. The developed

package by Nick Pelling has reward systems that is sophisticated with games for fast motivation, easy learning, engagement, fun, better achievement and retention. The researchers would adopt the use of ludo game application package since it possess the futures of gamification. Ludo game application package is a software that could be installed in learners' mobile phone, lap top or desktops or computers in the computer laboratories. Ludo game has its origin in Indian as Paschisi game in the sixth century. The game uses a cubic die with a die cup and patented as 'Ludo' in England in 1896 by Alfred Coller. Coller eventually patented the game and sold it as 'Royal Ludo'. The word ludo was derived from a Latin word meaning 'I play'. The players take turns rolling the dice and the one who gets the first 6 on their die gets to start the game.

The adopted ludo game application package is fun driven, engaging, motivating, interactive learning tool which aids in stimulating learners, active involvement, for memory development and for creativity. It could come as imagination of a real life situation along with interaction during teaching-learning. In this type teaching process, the teacher initiates, guides and directs classroom talk- discussions with students. Riyadini and Basikin (2024) defined classroom interaction pattern use in teaching as a collaborative exchange of thoughts, feelings, or ideas between the teacher- lecturer and students. Initiating interactions is needed to support engagement and as a way to test whether students can follow the activities and materials being studied for better achievement. It is an essential criteria of classroom pedagogy that is teacher constructed idea which is on-going and involves responsive actions by the learners (Adesina & Babawale, 2024). The interactions between teachers, students, learning materials and the environment offer the fundamental basis for efficient classroom management. It is crucial for teachers to have a well-designed plan in order to facilitate the teaching and learning process (Hoque, 2016). This gave credence to the theory of Edward Deci and Richard Ryan of 1985. The theory states that individuals are intrinsically motivated to pursue growth and fulfilment when their basic psychological needs are met. This encourages learners' involvement in the learning process either individually or as a group, supports competition, goal orientations, goal striving, builds healthy classroom interaction, promotes discovery, supports gender friendly and stimulates learning (Grenier, Gagne & O'Neill, 2024).

**Statement of the Problem**

Number system is a course taught in computer science education department, pure computer science department, mathematics department and engineering department could be linked to share the same course – subject content to computer studies and data processing. These linkage could have be useful instrument for national technological development, but the rate at which students succeed in the course nor the subjects is quit alarming. This has been a bone of contention to the society, researchers, examination bodies and institutions of learning. Hence, the problem of the study is 'what would be the effect of GBA on students' achievement in number system?'

**Purpose of the Study**

The purpose of the study was to find out effectiveness of gamified-based-activity on Nigeria tertiary students' achievement in number system. Specifically, the study determined;

1. the difference in the mean achievement scores of students taught number system using gamified-based-activity (GBA) compared to those taught using conventional-based-strategy (CBS).
2. the difference in the mean achievement scores between male and female students taught number system using gamified-based-activity.

**Research Questions**

The study attempt to answer the following research questions;

1. What is the difference in the mean achievement scores between students taught number system using gamified-based-activity (GBA) and those taught using conventional-based-strategy (CBS)?

2. What is the difference in the mean achievement scores between male and female students taught number system using gamified-based-activity (GBA)?

**Hypotheses**

The following hypotheses were tested at 0.05 level of significance.

**$H0_1$:** There will be no significant difference in the mean achievement scores between students taught number system using gamified-based-activity (GBA) and those taught using conventional-based-strategy (CBS).

**$H0_2$:** There will be no significant difference in the mean achievement scores between male and female students taught number system using gamified-based-activity (GBA).

## Method

The study adopted quasi-experimental design specifically, the pre-test, post-test, non-equivalent control group was used. The study was carried out in South East and South South Federal and State Colleges of Education in Nigeria. Colleges of Education used for the study are accredited to offer admission in school of secondary education (science) for at least 8 years. School of secondary education (science) houses subject combinations specialization for broader knowledge. This ascertain the aim of establishing colleges of education in Nigeria. The population consist of all regular Nigeria Certificate in Education (NCE) undergraduate students admitted for in 2023/2024 academic session and are currently in year two. The choice of using year two regular NCE undergraduate students was because they have acramatized to the college norms and environment for a year. Thus, the researchers made use of 121 NCE students as its sample size. The sample size was drawn using stratified sampling technique to select only NCE regular students whose subject combinations is computer science education based from 5 federal and 5 state colleges in south east and south south Nigeria. Ten out of seventeen (17) federal and state colleges in the south east and south south was used because they have been accredited to start up computer science education as a specialty housing subject combinations under school of secondary education (science) and had graduated a set in the stated discipline – subject combination specialty. Disproportionate stratified sampling random sampling was used to select 10 federal and state colleges in the south east and south south geo-political zones of Nigeria. Intact classes from the 10 colleges was used in this study. The intact classes were randomly assigned to experimental and control groups using a flip of a coin. The credit unit assigned to the course was taken cognizance of. The instrument used for data collection was a 50-item multiple choice Number System Achievement Test (NSAT) extracted from senior secondary certificate examination (SSCE) computer studies past questions. The extracted questions on number system was compiled and adopted by the researchers as instrument for the study. The instrument was validated by three experts. The reliability of the instrument was established using Kuder-Richardson Formular 20. The reliability coefficient of NSAT was found to be 0.85.

The experiment was conducted in two phases. Phase 0ne and Phase two. Phase one was the briefing of the research assistants who were the regular computer lecturers from the sampled schools. In the experimental group, the research assistant was briefed on the use of GBA using the lesson plans developed by the researchers while the research assistant of the control group was given the lesson plans on CBA and then asked to teach as usual. In Phase two, the treatment process commenced with the administering of the pretest (NSAT) to both the experimental and control groups. The teaching process in both groups lasted for four weeks in which for each new week a selected concept from the course content was taught to the two groups. In the last week of the teaching, a posttest (reshuffled NSAT) was administered again to the research participants of the two groups. The two administered tests (pretest and posttest) were collected, scored, and recorded by the researchers. Data from the tests were analyzed using Mean and Standard deviation in answering the research questions and t-test was used in testing the null hypotheses at 0.05 alpha levels. In taking decisions, null hypothesis was rejected if the Probability (P) value is less than or equal to the level of significance (0.05), if otherwise, the null hypothesis was not rejected.

## Results

**Research Question 1:** What is the difference in the mean achievement scores between students taught number system using gamified-based-activity (GBA) and those taught using conventional-based-strategy (CBS)?

**Table 1: Pretest and Posttest achievement mean scores of students taught number system using gamified-based-activity (GBA)**

**(Norm = 50)**

| Source of Variation | N | Pretest Mean | Posttest Mean | Gained Mean |
|---|---|---|---|---|
| GBA | 70 | 28.26 | 62.51 | 34.25 |
| CBS | 51 | 26.16 | 32.12 | 5.96 |

In Table 1, it was observed that the students taught computer studies using number system using gamified-based-activity (GBA) had pretest mean score of 28.26 and posttest mean score of 62.51 with gained mean 34.25 in their achievement. While those taught using conventional-based-strategy (CBS) had pretest mean score of 26.16 and posttest mean score of 32.12 with gained mean 5.96. With posttest mean scores of

62.51 for GBA which is above the norm of 50 gamified-based-activity is effective in enhancing college students' achievement scores in number system

**Research Question 2:** What is the difference in the mean achievement scores between male and female students taught number system using gamified-based-activity (GBA)?

**Table 2: Pretest and Posttest achievement mean scores of male and female students taught number system using gamified-based-activity (GBA) (Norm = 50)**

| Source of Variation | N | Pretest Mean | Posttest Mean | Gained Mean |
|---|---|---|---|---|
| Male | 36 | 29.44 | 55.14 | 25.70 |
| Female | 34 | 27.00 | 70.32 | 43.33 |

Table 2 was observed that the male secondary students taught computer studies using gamified-based-activity (GBA) had pretest mean score of 29.44 and posttest mean score of 55.14 with gained mean 25.70 in their achievement while the female students taught using gamified-based-activity (GBA) had pretest mean score of 27.00 and posttest mean score of 70.32 with gained mean 43.33. With posttest gained mean scores of 43.33 for female students as against 25.70 for male students GBA is more effective in enhancing female college students' achievement scores in number system.

**$H0_1$:** There will be no significant difference in the mean achievement scores between students taught number system using gamified-based-activity (GBA) and those taught using conventional-based-strategy (CBS).

**Table 3: ANCOVA on the achievement mean scores of students taught number system using gamified-based-activity (GBA) and those taught using conventional-based-strategy (CBS).**

| Source of variation | SS | df | MS | Cal. F | Pvalue | P ≤ 0.05 |
|---|---|---|---|---|---|---|
| Corrected Model | 27441.444 | 2 | 13720.722 | 53.590 | | |
| Intercept | 24694.245 | 1 | 24694.245 | 96.450 | | |
| Achievement1 | 180.935 | 1 | 180.935 | .707 | | |
| Instructional Methods | 26451.420 | 1 | 26451.420 | 103.313 | 0.000 | S |
| Error | 30211.845 | 118 | 256.033 | | | |
| Total | 356564.000 | 121 | | | | |
| Corrected Total | 57653.289 | 120 | | | | |

Table 3 indicates that at 0.05 level of significance, 1df numerator and 118df denominator, the calculated F is 103.31 with Pvalue of 0.000 which is less than 0.05. Therefore, the first null hypothesis is not accepted. So, the difference in the mean achievement scores of college students taught number system using gamified-based-activity (GBA) and those taught with conventional-based-strategy (CBS) is significant.

**$H0_2$:** There will be no significant difference in the mean achievement scores between male and female students taught number system using gamified-based-activity (GBA).

**Table 4: ANCOVA on the achievement mean scores of male and female students taught number system using gamified-based-activity (GBA)**

| Source of variation | SS | df | MS | Cal. F | Pvalue | P ≤ 0.05 |
|---|---|---|---|---|---|---|
| Corrected Model | 4412.171 | 2 | 2206.085 | | | |
| Intercept | 31212.757 | 1 | 31212.757 | | | |
| Achievement1 | 380.432 | 1 | 380.432 | | | |
| Gender | 4254.564 | 1 | 4254.564 | 12.014 | 0.001 | S |
| Error | 23727.315 | 67 | 354.139 | | | |
| Total | 301702.000 | 70 | | | | |
| Corrected Total | 28139.486 | 69 | | | | |

Table 4 points that at 0.05 level of significance, 1df numerator and 67df denominator, the calculated F is 12.01 with Pvalue of 0.001 which is less than 0.05. Therefore, the second null hypothesis is not accepted. So, the difference in the mean achievement scores of male and female college students taught with GBA is significant.

**Discussion**

The analysis in Table 3 x-rayed significant difference that exist between the mean achievement scores of college students taught number system using gamified-based-activity and those taught using conventional based activity. The result was in favour of the gamified-based-activity group (experimental) as shown in their mean scores and P-value. Study conducted by Ozturk and Korkmaz (2020) found that games when properly infused into the lesson improve students' achievement, encourage co-operative learning skills and increase students' attitude in learning social studies. This research reports tends to support the research findings of Svanberg and Bergh (2023) who conducted a study on effects of gamification in a teacher education program from

2010 to 2020. The findings revealed that game elements significantly improves students' achievement in their final written examination. It equally gave credence to the findings of Adeoye (2023) who carried out a study on influence of gamification elements on students' academic performance. The study revealed positive learning outcome using game elements.

On the other hand, the analysis in Table 4 shows that male and female college students taught with GBA has significant difference. This can be attributed to the fact that the male students are easily carried away by various activities employed during the instructional process. This study agrees with the findings of Mwihia (2020) that there was significant difference in academic achievement among students by gender. Recent study conducted by Laoli, Waruwu, Ndraha and Zebua (2023) on gender points at significant difference among college students. Such significant difference could exist as a result of many factors such as teaching environments, teachers attitude, lack of background knowledge, poor economy, students' resistance behaviors like; not participating in the course, not being interested in the course, not taking care of friends, seeking attention, not respecting the teacher, not all the students have motivation to follow the teacher's instruction (Laoli et al, 2023). This study looks more interest to other studies on gender which found out no significantly influence on students' academic achievement - performance.

## Conclusion

This study could provide lecturers with information and awareness on innovative instructional approaches that could boost students' achievement, engagement and motivation while learning. It could also serve as an eye-opener for lectures in other fields of learning to explore and adopt better instructional approaches to improve learners' achievement. Applying gamified-based-activity in a curriculum could help provide a more inclusive activity through its effect on students' sense of competition, interaction and motivation. Training of teachers on the use of gamified-based –activity should be integrated into our educational sector.

**Recommendation**

The following recommendations were made;

1. Students should be exposed, encouraged and motivated to learn using gamified-based –activity
2. The school management should abolish the creation of gender stereotype in classes so as to enable both male and female students thrive in their academics
3. Lecturers should always be attentive to know when students are carried away by class activities.
4. Lecturers in other fields of study should reiterate their commitment on classroom instruction delivery that would improve students' learning outcome for skill and cognitive development.

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