# Virtual Simulation and Gaming Strategies on Science Students' Academic Achievement on the Concept of Mathematics in United Kingdom

**BY**

**Leon K. PHILIPS, *Ph.D***
**Department of Curriculum Studies, Educational Management and Planning**
**Faculty of Environment**
**University of Sheffield**
**Sheffield, South Yorkshire, England**
**United Kingdom**

## ABSTRACT

*The study sought to find out the virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics in United Kingdom. The research design adopted for the study was a quasi-experimental design specifically pretest-posttest control groups design. The study was carried out in United Kingdom. The population of the study comprised of all Senior secondary one (SS1) students of 2019/2020 academic session in United Kingdom. The sample of the study was one hundred and fifty (150) student from the three selected secondary schools in United Kingdom. The researcher developed an instrument tagged "Virtual Simulation and Gaming Strategies on Science Students' Academic Achievement on the Concept of Mathematics Questionnaire" (VSGSSSAACMQ) for date collection. The instrument was administered to the respondent with the aid of a researcher. The instrument was face and content validated by two experts in test, measurement and evaluation in the United Kingdom. To test the reliability, a test retest method was used. A reliability test was conducted with 20 students who did not take part of the main study and reliability co-efficient of (0.77) was obtained and this was considered adequate and reliable for the study. Before the research work was conducted, a letter of permission for the research work was submitted by the researcher to the principal of the two schools, who in turn granted permission for the commencement of the research work. Mean and standard deviations were used to answer research questions while independent t-test statistics was used for data analysis meant to test the hypotheses. All hypotheses were tested at 0.05 alpha levels of significance. The study concluded that virtual simulations represent the evolution of the model over time. Often, gaming strategies are used to execute the virtual simulation in teaching of mathematics in United Kingdom. Gaming strategies allow experts to quickly come to grips with the way in which learning activities, outcomes the feedback and roles, as well as to enhance the in-game learning experience. There is neutral relationship between the use of simulations and gaming strategies in learning mathematics to achieve academic performance. One of the recommendations made was that learning attributes and game mechanics should be designed and incorporated by faculty, specifically with a view to fully integrate these into lesson plans and the learning process as a whole*

**KEYWORDS: Virtual Simulation, Gaming Strategies, Science Students, Academic Achievement, Mathematics and United Kingdom**

## Introduction

The issue of appropriate instructional methods in the teaching and learning of mathematics is vital, as this constitutes what and how mathematics could be taught in our schools. Instructional strategies adopted by the teachers could influence the cognitive, affective and psychomotor outcomes of the learner. Many of the professional teachers do not use appropriate teaching methods and teaching aids in the classroom that can stimulate students. Some use sterile and uninspiring methods (Obodo, 2004). This pattern is a conservative approach where the teacher, in most cases, is seen and acts as the repertoire of knowledge and the students, the dormant recipient (Aladejana, 2007). As rapidly evolving technological applications, games and simulations are already widely integrated in the traditional educational process. They are deployed extensively in the field of education, with an existing body of work examining the relation between games and education (Yang, Chen, &Jeng, 2012; Chiang, Lin, Cheng, & Liu, 2011).

Research in mathematics education shows the difficulties students have in acquisition of mathematical concepts. Various studies Akinsola, (1994, 1997); Popoola, (2002) have shown that an instructional strategy is crucial to the understanding of mathematical concepts. Effective instruction requires the teacher to step outside the realm of personal experience unto the world of the learners (Brown, 1997). It is the learners who must be engaged for learning to occur, the learner is the one who must make the commitment to learn. Newman et al (1995), pointed out that for learning to be meaningful (authentic), it must be individually constructed. Learning takes place as student process, interpret and negotiate the meaning of new information. To Brown (1997), this is heavily influenced by the prior knowledge, values, expectations, reward and sanctions that shape the learning environment.

Mathematics without doubt remains very important to all disciplines and fields of human work and study (Odili, 2006). It has continued to play significant role in the development of both individuals and nations. Therefore, for any nation to survive and develop, it has to improve on its teaching and learning of mathematics which is the basis for technological development (Azuka, 2001). This is the reason mathematics is one of the compulsory subjects at secondary school level. According to the National Policy on Education (FRN, 2013), mathematics is included on the six compulsory subjects every student must take in group "A". This policy also makes mathematics an important subject in the current structure of the national education, that is, every child must study it for six years in lower basic (basic 1-6), three years in upper basic (basic 7-9) and three years in Senior Secondary School as compulsory subject.

In most classrooms in our society, mathematics instruction is hardly related to real life situations even when it is obvious to do so with little or no efforts. According to Iji (2002) mathematics teaching in our society still follows the traditional pattern, where there is over-reliance on textbooks with only occasional demonstrations and experimental classes. In an average classroom, one finds a teacher at the blackboard jotting down important facts, students furiously copying all that is written and said, expected to memorize the facts and spit them out in an examination (Sowunmi & Aladejana, 2013). Akinsola and Popoola (2004) claimed that many

teachers use only the techniques they know even if such techniques are not relevant to the concept under discussion. This explains the persistent high failure in mathematics which is occasioned by low interest in the subject among the students (Aburime, 2004; Imoko & Agwagah, 2006). Research findings such as Galadima (2002), Alio and Habor-Peters (2000), as well as Imoko and Agwagah (2006), attributed the problem of students' low interest and achievement in mathematics to poor quality instructional techniques, incompetence and non-utilization of appropriate teaching techniques by teachers.

Simulation Game Instructional Strategy might be an antidote. Since many students enjoys playing games; it is worthwhile to investigate whether this play aspect could be combined with instruction to enhance learning. It is further stressed that the observation had led educators to explore the feasibility of using a game format to supplement or even replace the teaching of a variety of subjects. Simulation game is a game-based strategy that can be used for teaching and learning at any level of education. Simulation games in the classroom are used to copy what is found in real life situations. According to Enciso (2001), simulation game is defined as an activity that works, fully or partially, on the basis of players' decision. Simulation games are an excellent supplement to the standard lecture. Simulation games are an educational tool where students learn through the application of theory and decision-making to a simulated real-world scenario (Sowunmi & Aladejana, 2013). Simulation games are also an active learning method, but with an incredible improvement potential.

The education system is continuously examined for improvement and one of the areas of concern that arises is how math is being taught in classrooms. Methods of teaching mathematics for a deeper understanding are constantly discussed and implemented in an attempt to keep up with the ever changing needs of students. WAEC chief examiner's report (2003) revealed that students lack knowledge in construction of angles, arcs, and other geometrical drawings. Thus, it is necessary to initiate a remedial action on the observed problems early in mathematics. It is on the above basis that this study explored the efficacy of games and simulations at improving students' interest and achievement in mathematics. Specifically, the study investigated virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics in United Kingdom.

## Statement of Problem

Mathematics is one of the compulsory subjects at secondary school level; this is why every child must study it for six years in lower basic (basic 1-6), three years in upper basic (basic 7-9). For the past decades now, it had been observed that many teachers use only the techniques they know in their teaching competency even if such techniques are not relevant to the concept under discussion. Since many students enjoy playing games; it is worthwhile to investigate whether this play aspect could be combined with instruction to enhance learning or if the problem of students' low interest and achievement in mathematics is accredited to poor quality instructional techniques, incompetence and non-utilization of appropriate teaching techniques by teachers.

## Objective of the Study

The main objective of the study is to examine virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics in United Kingdom. Specifically, the following objectives were drawn:

1. To examine the extent of adoption of virtual simulation and gaming strategies in teaching mathematics in urban and rural schools in United Kingdom.

2. To examine the effect virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics. Leon K. PHILIPS, *Ph.D*

**Research Questions**

1. What is the extent of adoption of virtual simulation and gaming strategies in teaching mathematics in in urban and rural schools in United Kingdom?

2. What are the effect of virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics?

**Research Hypotheses**

**$H0_1$:** There is no significant difference in the adoption of virtual simulation and gaming strategies by urban and rural school teachers in teaching mathematics in United Kingdom.

**$H0_2$:** There is no significance effect virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics.

**Literature Review**

**Games**

In recent years, the interest in examining game use in higher education has increased. This includes educational games (Çankaya & Karamete, 2009), digital game-based learning (DGBL) (Yang, et al 2012), and applied games (van Roessel & van Mastrigt-Ide, 2011). In addition, scholars sometimes include interactive exercises (Mueller, 2003), video games (Biddiss & Irwin, 2010), or even expand to next generation video games (Bausch, 2008) in the category of games. With respect to web-based games, the technological platforms that implement digital game code include computers and consoles (Salen & Zimmerman, 2004). They can run on a web browser on mobile phones and other mobile gaming devices (Willoughby, 2008) (e.g., tablets).

Despite the abundance of game types, there is a lack of clear, shared definitions and erminology among scholars and educators, which has led to "terminological ambiguity" (Klabbers, 2009). Nevertheless, the need for shared terminology remains when discussing the different forms of games and simulations in higher education. Although academics and game developers may use varying taxonomy to categorize games, the majority broadly agree on the following seven genres (Gros, 2007):

1. Action games: response-based video games.
2. Adventure games: the player solves problems to progress through levels within a virtual world.
3. Fighting games: these involve fighting with computer-controlled characters or those controlled by other players.
4. Role-playing games: players assume the roles of fictional characters.

5. Simulations: games modelled after natural or man-made systems or phenomena, in which players have to achieve pre-specified goals.
6. Sports games: these are based on different kinds of sports.
7. Strategy games: these recreate historical scenes or fictional scenarios, in which players must devise an appropriate strategy to achieve the goal.

In recent years, several well-designed empirical studies investigating the effects of serious games on learning outcomes have been published. Sawyer refers to serious games as those games produced by the video game industry that have a substantial connection to the acquisition of knowledge (Sawyer, 2002). Zyda (2005) expands Sawyer's definition, adding that serious games are games whose primary purpose is not entertainment, enjoyment or fun. Serious games, educational gaming, as well as virtual worlds developed for educational purposes reveal the potential of these technologies to engage and motivate beyond leisure activities (Anderson et al., 2009). At the same time, there is extensive literature exploring the potential learning benefits offered by game-based learning (GBL), which can be defined as the use of game-based technology to deliver, support, and enhance teaching, learning, assessment, and evaluation (Connolly, 2007).

**Simulations**

Simulations create a scenario-based environment, where students interact to apply previous knowledge and practical skills to real-world problems, also allowing teachers to reach their own goals as well (Andreu-Andrés &García-Casas, 2011; García-Carbonell & Watts, 2012; Angelini, 2015). During scenario-based training, the player acquires important skills, such as interpersonal communication, teamwork, leadership, decision-making, task prioritizing and stress management (Flanagan, 2004). The practical scenario may be carried out individually or within a team (Robertson et al., 2009), leading to collaboration and knowledge sharing. With the explosion of Web 2.0 technology, increased opportunities to engage with technological applications in a collaborative and participatory way have emerged, promoting information access, shared ideas, knowledge exchange, and content production (McLoughlin & Lee, 2008). Digital simulations, which engage students in the interactive, authentic, and self-driven acquisition of knowledge, are being adopted in higher education.

Connolly and Stansfield (2006) define game-based e-learning as a digital approach which delivers, supports, and enhances teaching, learning, assessment, and evaluation. Game-based e-learning is differentiated from GBL, which tends to cover both computer and non-computer games. Delivery platforms are an essential aspect for game designers when creating and distributing games and simulations (e.g. computer, video, online, mobile, 3D, etc.). Designers must pay attention to characteristics such as the technical challenges, modules and techniques associated with the game design, the players involved in gaming, and the teaching modes (e.g. single, multi-player, collaborative, synchronous, etc.). This study examines the diverse curricular areas and learning objectives each game intends to access.

**Difference Between Games and Simulations**

The main difference between games and simulations is that: games are tools which are artificial and pedagogical, they include conflict, rules, and predetermined goals; whereas simulations are dynamic tools, representing reality, claiming fidelity, accuracy, and validity (Sauve, 2007).

**Games and Simulations on Students' Academic Performance**

Through their systematic review, Tsekleves et al. (2014) provides insight into the barriers and benefits of using serious games in education. Regarding benefits, the author's catalogue: achievement and rewards, interactivity and feedback, motivation and competition, playfulness and problem-based learning, collaborative learning, progression and repetition, as well as realism and immersion. Finally, they propose some guidelines to help stakeholders better in implementing serious games in education. Similarly, Bellotti, (2013) suggests useful guidelines for the performance assessment of serious games. Following user performance assessments, they offer an overview on the effectiveness of serious games in relation to learning outcomes. Results reveal the effectiveness of serious games in motivating and achieving learning goals, the importance of providing appropriate user feedback, while emphasizing that new types of games are best deployed through proper instructor guidance. Moreover, the stress aspects they consider important, such as performance assessment with a view to fostering adaptation, as well as personalization, and meeting needs on an individual basis (learning styles, information provision rates, feedback, etc.).

The instructor's role is also outlined by Lameras et al. (2016), who provide conceptual and empirical evidence on the manner in which learning attributes and game mechanics should be designed and incorporated by faculty, specifically with a view to fully integrate these into lesson plans and the learning process as a whole. Games allow practitioners to quickly come to grips with the way in which learning activities, outcomes, feedback and roles may vary, as well as to enhance the in-game learning experience. Similarly, the systematic review of 64 articles by de Smale, (2015) concludes that there is a positive or neutral relationship between the use of simulations and games and learning achievement. The researchers arrive at three recurring conditions for the successful use of simulations and games: the specificity of the game, its integration in the course, and the role of a guiding instructor, which are all conditions in line with Bellotti et al. (2013)'s results.

Young et al. (2012) choose 39 articles that meet the inclusion criteria related to video games and academic achievement, concentrating on the use of traditional games versus video games for educational purposes. The studies are categorized by subject namely; History, Mathematics, Physical Education, Science, and Languages. Results indicates that there exists limited evidence of the benefits of including education games in the traditional classroom environments, a finding which is contrary to the aforementioned studies. Smetana and Bell (2012), examine computer simulations to support instruction and learning in Science. In their comparative study between computer games and traditional games, they conclude that computer games can be as effective, if not more so, than traditional games in promoting knowledge, developing procedural skills and facilitating conceptual change. To integrate them properly as supplementary elements (Rajan, 2013), games require the adoption of high-quality support structures, student participation, as well the promotion of cognitive and metacognitive skills. This finding contradicts the study carried out by Girard (2013). This study treats video games as serious games but considers their effectiveness as a controversial issue, finding that only few games result in improved learning, while others have no positive effect on knowledge and skills acquisition, when compared to more traditional methods of teaching.

In contrast, in their meta-analysis, Clark et al. (2015) systematically review articles to study the detailed effects of digital games on learning outcomes, concluding that games are important in supporting productive learning and highlighting the significant role of gaming design beyond its medium. Prior to this review, but running along the same lines, Backlund and Hendrix (2013), in their meta-analysis reported positive outcomes in learning when using serious games in the educational process. Wouters, (2013) performing meta-analytic techniques, used comparisons as well, to investigate whether serious games are more effective and more motivating than conventional instructional methods. They found higher effectiveness in terms of learning and retention, but less motivation compared to traditional instructional methods. Indeed, serious games tend to be more effective if regarded as a supplement to other instructional methods, and involve students in groups and multiple training sessions.

These findings are compatible with those in the survey conducted by Rutten, (2012), which focuses on implementing games as laboratory activities, concluding that simulations have gained a prominent position in classrooms by enhancing the teacher's repertoire, either as a supplement to traditional teaching methods or as a partial replacement of the curriculum. Nevertheless, they stress that the acquisition of laboratory skills cannot be wholly conducted via simulations. However, in areas where simulations have been widely accepted as a training tool, simulations can play a significant role in making lab activities more effective when offered as pre-lab training. Fu (2016), through a systematic literature review, identify the multi-dimensional positive impact of serious games in business education, with the most frequent outcomes being knowledge acquisition and content understanding. The study also confirms that GBL and serious games can influence player engagement, perpetual and cognitive skills and social or soft skills. The effective and motivational outcomes are examined in entertainment games, games for learning and serious games, which reflects the trend of using gaming elements as both a medium of entertainment as well as a mode of learning. Ritzhaupt, (2014) produce meta-analysis based on 73 articles, demonstrating that achievement measures (e.g., standardized test scores) are the most commonly investigated, while the second most frequent is affective measures (e.g., usability or attitudes towards technology) followed by behavioural measures (e.g., task behaviour).

Merchant (2014), via a meta-analysis, compare the effectiveness of games, simulations and virtual worlds in improving learning outcomes. Findings indicate that playing games individually enhance student performance more than playing collaboratively. Nonetheless, the researchers claim that there is no statistically significant difference between the effects of individual and cooperative instructional modules regarding simulations. Student learning outcomes deteriorate after repeated measures, since after spending a certain amount of time playing games, the learning outcome gains start to diminish. On the contrary, Shin (2015) through meta-analysis, aim to identify the effects of patient simulation in nursing education. They find significant post-intervention improvements in various domains for participants who receive simulation education compared to the control groups, thus leading to the conclusion that simulations are more effective than traditional learning methods, enhancing the player's psychomotor, affective, and cognitive skills. In their work, simulations provide students with authentic clinical situations, allowing them to practice and experience in realistic and safe environment.

## Methodology

**Research Design**

The research design adopted for the study was a quasi-experimental design specifically pretest-posttest control groups design

**Area of the Study**

The study was carried out in United Kingdom.

**Population of the Study**

The population of the study comprised of all Senior secondary one (SS1) students of 2019/2020 academic session in three public secondary schools in United Kingdom.

**Sample and Sampling Techniques**

The sample of the study was one hundred and fifty (150) students from the three selected secondary schools in United Kingdom.

**Instrumentation**

The researcher developed an instrument tagged "Virtual Simulation and Gaming Strategies on Science Students' Academic Achievement on the Concept of Mathematics Questionnaire" (VSGSSSAACMQ)for date collection.

**Validation of the Instrument**

The instrument was administered to the respondent with the aid of a researcher. The instrument was face and content validated by two experts in test, measurement and evaluation in the United Kingdom.

**Reliability of the Instrument:**

To test the reliability, a test retest method was used. A reliability test was conducted with 20 students who did not take part of the main study and a reliability co-efficient of (0.77) was obtained and this was considered adequate and reliable for the study.

**Procedure for Collecting Data**

Before the research work was conducted, a letter of permission for the research work was submitted by the researcher to the principal of the two schools, who in turn granted permission for the commencement of the research work.

**Method of Data Analysis**

Means and standard deviations was used to answer research questions while independent t-test statistics was used for data analysis meant to test the hypotheses. All hypotheses were tested at 0.05 alpha level of significance.

## Results and Discussion

**Research Questions 1**: The research question sought to find out the extent of adoption of virtual simulation and gaming strategies in teaching mathematics in United Kingdom. To answer the research question, percentage analysis was performed on the data, (see table 1).

**Table 1: Percentage analysis of the extent of adoption of virtual simulation and gaming strategies in teaching mathematics in United Kingdom**

| EXTENTS | FREQUENCY | PERCENTAGE |
|---|---|---|
| VERY HIGH EXTENT | 12 | 8* |
| HIGH EXTENT | 22 | 14.67 |
| LOW EXTENT | 49 | 32.67 |
| VERY LOW EXTENT | 67 | 42.67** |
| **TOTAL** | **150** | **100%** |

**** The highest percentage frequency**
*** The least percentage frequency**
**SOURCE: Field survey**

The above table 1 presents the percentage analysis of the extent of adoption of virtual simulation and gaming strategies in teaching mathematics in United Kingdom. From the result of the data analysis, it was observed that the highest percentage (42.67%) of the respondents affirmed that the extent of adoption of virtual simulation and gaming strategies in teaching mathematics is very low, while the least percentage (8%) of the respondents stated that the extent of adoption of virtual simulation and gaming strategies in teaching mathematics in United Kingdom is very high.

**Research Questions Two**: The research question sought to find out the effect of virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics. In order to answer the research question, descriptive analysis was performed on the data collected as shown in Table 2.

**Table 2: Descriptive statistics of the effect of virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics**

| Variable | N | Arithmetic Mean | Expected Mean | R | Remarks |
|---|---|---|---|---|---|
| Student Performance | 150 | 19.25 | 12.5 | 0.79* | *Moderately Strong Relationship |
| Simulation | | 18.06 | 12.5 | | |

**Source: Field Survey**

The above table 2 presents the result of the descriptive analysis of the effect of virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics. The two variables were observed to have moderately strong relationship at 79%. The arithmetic mean for student performance (19.25) was observed to be greater than the expected mean score of 12.5. In addition to that, the arithmetic mean as regards simulation (18.06) was observed to be higher than the expected mean score of 12.5. The result therefore

means that there is remarkable effect of virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics.

**Hypothesis Testing**

**Hypothesis One:** The null hypothesis states that there is no significant difference in the adoption of virtual simulation and gaming strategies by urban and rural school teachers in teaching mathematics in United Kingdom. In order to answer the hypothesis, independent t-test analysis was performed on the data (table 3).

**TABLE 3: Independent t-test analysis of the difference in the adoption of virtual simulation and gaming strategies by urban and rural school teachers in teaching mathematics in United Kingdom**

| LOCATION | N | X | SD | t |
|---|---|---|---|---|
| URBAN | 75 | 18.99 | 0.76 | |
| | | | | 10.86* |
| RURAL | 75 | 17.13 | 1.27 | |

***Significant at 0.05; df = 148; N = 150; critical t = 1.960**

The above table 3 indicates that the calculated t-value (10.86) was higher than the critical t-value (1.960) at 0.05 level of significance with 148 degrees of freedom. Hence, the result was significant. The result therefore means that there is difference in the adoption of virtual simulation and gaming strategies by urban and rural school teachers in teaching mathematics in United Kingdom. According to the findings of DeSmale, (2015) stated that there is a positive or neutral relationship between the use of simulations and games in learning achievement of mathematics. The significance of the result caused the null hypotheses to be rejected while the alternative was accepted.

**Hypothesis Two:** The null hypothesis states that there is significant effect of virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics. In order to test the hypothesis simple regression analysis was performed on the data, (see table 4).

**TABLE 4: Simple Regression Analysis of the significant effect of virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics**

| Model | R | R-Square | Adjusted R Square | Std. error of the Estimate | R Square Change |
|---|---|---|---|---|---|
| 1 | 0.79 | 0.63 | 0.63 | 0.68 | 0.63 |

***Significant at 0.05 level; df= 148; N= 150; critical R-value = 0.197**

The above table 4 shows that the calculated R-value (0.79) was greater than the critical R-value of 0.197 at 0.5 alpha levels with 148 degrees of freedom. The R-Square value of 0.63 predicts 63% effect of virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics. This rate of percentage is highly positive and therefore means that there is significant effect of virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics. It was also deemed

necessary to find out the effect of the variance of each class of independent variable as responded by each respondent (see table 5).

**TABLE 5: Analysis of variance of the significant effect of virtual simulation and gaming strategies on science students' academic achievement on the concept of mathematics**

| Model | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 117.47 | 1 | 117.47 | 252.34 | .000b |
| Residual | 68.90 | 148 | 0.47 | | |
| Total | 186.37 | 149 | | | |

a. Dependent Variable: Student Performance
b. Predictors: (Constant), Simulation

The above table 5 presents the calculated F-value as (252.34) and the P-value as (.000b). Being that the P-value (.000b) is below the probability level of 0.05, the result therefore means that there is significant effect exerted by the independent variables i.e. simulation on the dependent variable which is student performance. According to the findings of Rajan, (2013), virtual simulation and games strategies require the adoption of high-quality support structures, student participation, as well the promotion of cognitive and metacognitive skills. The significance of the result caused the null hypotheses to be rejected while the alternative was accepted.

## Conclusion

The study concluded that virtual simulation represents the evolution of the model over time. Often, gaming strategies are used to execute the virtual simulation in teaching of mathematics in United Kingdom. Simulations create a scenario-based environment, where students interact to apply previous knowledge and practical skills to real-world problems. Gaming strategies allow experts to quickly come to grips with the way in which learning activities, outcomes the feedback and roles, as well as to enhance the in-game learning experience. There is neutral relationship between the use of simulations and gaming strategies in learning mathematics to achieve academic performance.

## Recommendations

1. Learning attributes and game mechanics should be designed and incorporated by faculty, specifically with a view to fully integrate these into lesson plans and the learning process as a whole.

2. For any nation to survive and develop, it has to improve on its teaching and learning of mathematics which is the basis for technological development.

3. It is pertinent for educators to explore the feasibility of using a game format to supplement or even replace the teaching of a variety of subjects.

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