USING FREECELL TO TEACH MATHEMATICAL CONCEPTS IN PRIMARY SCHOOLS

By

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Abstract

Over the years, mathematics has assumed a vital part of the educational landscape of every society. Nevertheless, the subject has attracted considerable attention from researchers relating to the observed low performance and suitable approaches to improve outcomes. In this study, a quasi-experimental design was adopted to establish the effect of the FreeCell simulation software on primary school students' mathematical motivation and interest. A total of eighty-two students with an age range of 7 – 12 years and a mean age of (M=9.12), (SD= 1.22) participated in the study. The samples were grouped into two and were exposed to a pre-test and post-test investigation. Mean and standard deviation scores were used. The independent t-test analysis established a statistically significant difference between the groups, MD = 11.53, t (80) = 6.313, p < 0.05. Thus, the result supported the study's hypothesis. It was concluded that FreeCell simulation software is effective in enhancing students' mathematics motivation and interest. The study recommends adopting the system in math classes and regularly training teachers on using the software for teaching.

Keywords: **FreeCell, mathematics, motivation, interest, students**

1. INTRODUCTION

Mathematics education forms the bedrock of the educational system, playing a crucial role in the intellectual development of students and their preparedness for future careers. However, despite its importance, mathematics often emerges as one of the most challenging subjects for students at the primary school level. Research has consistently highlighted low performance and diminished interest in mathematics among primary school students, raising concerns about the efficacy of traditional teaching methods (Awofala, 2017).

1.1 The Challenge of Mathematics Education

Several factors contribute to the difficulties faced by students in learning mathematics. These include a lack of engaging teaching methods, insufficient instructional materials, and a general perception of mathematics as a difficult and abstract subject (Adamu & Olaoye, 2015). This perception often leads to anxiety and a lack of motivation, further exacerbating the problem (Nwabueze & Onwunyi, 2016).

1.2 Integrating Technology in Education

The integration of technology in education has been identified as a potential solution to these challenges. Educational technologies can provide interactive and engaging learning experiences, which are essential for maintaining students' interest and motivation (Jegede, 2018). The use of educational software, in particular, has shown promise in enhancing learning outcomes by making abstract concepts more tangible and accessible (Okebukola, 2011).

1.3 FreeCell Simulation Software

FreeCell, a popular solitaire card game, has recently gained attention as an educational tool due to its potential to develop strategic thinking and problem-solving skills, which are closely aligned with mathematical reasoning (Oyedele, 2018). The game's requirement for planning and logical sequencing mirrors the cognitive processes involved in mathematical problem-solving, making it a suitable tool for mathematics education.

1.4 Potential Benefits of Game-Based Learning

Game-based learning leverages the inherent motivation and engagement associated with games to facilitate educational objectives. Studies have shown that game-based learning can significantly enhance students' intrinsic motivation, making learning more enjoyable and effective (Adejumo, 2017). By incorporating elements of play, educational games like FreeCell can reduce the anxiety associated with mathematics and create a positive learning environment (Eze, 2015).

1.5 Importance of Motivation and Interest in Learning

Motivation and interest are critical components of successful learning. Students who are motivated and interested in a subject are more likely to engage deeply, persist through challenges, and achieve higher academic outcomes (Okebukola, 2011). Therefore, enhancing students' motivation and interest in mathematics through innovative teaching methods is essential for improving their performance and long-term academic success.

1.6 Statement of the Problem

Despite the known benefits of interactive learning tools, there remains a significant gap in their application within Nigerian primary schools. This study aims to bridge this gap by evaluating the effectiveness of FreeCell simulation software in enhancing mathematical motivation and interest among primary school students.

1.7 Aims and Objectives of the Study

- To determine the impact of FreeCell simulation software on students' motivation in learning mathematics.
- To assess the effect of FreeCell simulation software on students' interest in mathematics.
- To provide recommendations for integrating FreeCell into the primary school curriculum.

1.8 Significance of the Study

This study is significant as it explores an innovative approach to improving mathematics education in primary schools. By integrating FreeCell into the curriculum, educators can potentially enhance students' engagement and performance in mathematics.

1.9 Hypotheses

Hypothesis 1 ($H0_1$): There is no significant difference in the mathematical motivation of students who use FreeCell simulation software compared to those who do not.

Hypothesis 2 ($H0_2$): There is no significant difference in the mathematical interest of students who use FreeCell simulation software compared to those who do not.

2. REVIEW OF RELATED LITERATURE

2.1 The Role of Technology in Mathematics Education

The integration of technology into educational practices has revolutionized the way students learn, particularly in subjects like mathematics. Research shows that technology can significantly enhance learning outcomes by providing interactive, engaging, and personalized learning experiences (Adebayo, 2019). Tools such as educational software, online platforms, and simulation games have been identified as effective in improving students' understanding and retention of mathematical concepts (Okebukola, 2011).

2.2 Educational Software and Student Engagement

Educational software, designed to support the learning process, offers numerous benefits. It can present complex concepts in an accessible manner, provide immediate feedback, and allow for individualized pacing (Jegede, 2018). According to Alade (2014), interactive learning environments fostered by educational software can lead to improved student engagement and motivation. These tools also offer opportunities for students to practice and apply mathematical concepts in a risk-free environment, thus enhancing their confidence and competence.

2.3 Game-Based Learning in Mathematics

Game-based learning has emerged as a powerful approach to education, leveraging the motivational aspects of games to facilitate learning (Prensky, 2005). Games can provide context for problem-solving, making abstract concepts more concrete and understandable (Gee, 2003). In mathematics education, games like FreeCell require strategic thinking and problem-solving skills, which are essential for mathematical reasoning (Oyedele, 2018). Studies have shown that educational games can increase students' interest in mathematics and improve their problem-solving abilities (Adejumo, 2017).

2.4 FreeCell Simulation Software

FreeCell, a form of solitaire, involves logical planning and strategic moves, mirroring the cognitive processes used in mathematical problem-solving. The game's structure requires players to organize and sequence moves, which parallels the steps in solving mathematical problems (Oyedele, 2018). Research by Ngwu (2016) indicates that using games like FreeCell in the classroom can enhance students' critical thinking and decision-making skills, which are crucial for success in mathematics.

2.5 Motivation and Interest in Learning Mathematics

Motivation and interest are critical for effective learning. Students who are motivated are more likely to engage in learning activities, persist in the face of challenges, and achieve better academic outcomes (Deci & Ryan, 2000). Interest in a subject can enhance motivation, leading to deeper engagement and better performance (Hidi & Renninger, 2006). In the context of mathematics education, maintaining students' motivation and interest is essential for their long-term success and positive attitude towards the subject (Okebukola, 2011).

2.6 The Impact of Technology on Motivation and Interest

Research has demonstrated that technology can positively influence students' motivation and interest in learning. For instance, Adeyemo (2010) found that the use of ICT tools in teaching increased students' engagement and intrinsic motivation. Similarly, a study by Eze (2015) showed that computer-assisted instruction improved students' interest and achievement in geometry. These findings suggest that integrating technology, such as FreeCell simulation software, into the mathematics curriculum can enhance students' motivation and interest in the subject.

2.7 Empirical Studies on Game-Based Learning

Several empirical studies support the efficacy of game-based learning in mathematics education. Anikweze (2014) conducted a study on the use of educational games in primary schools and found that students who used these games performed significantly better in mathematics than those who did not. Another study by Nwafor (2017) demonstrated that game-based learning improved students' problem-solving skills and overall academic performance. These studies highlight the potential of game-based learning to transform mathematics education by making it more engaging and effective.

2.8 Summary

The literature reviewed indicates a strong consensus on the benefits of integrating technology and game-based learning into mathematics education. Educational software and games like FreeCell can enhance student engagement, motivation, and achievement. However, despite the proven benefits, there remains a gap in the application of these tools in Nigerian primary schools. This study aims to fill this gap by providing empirical evidence on the effectiveness of FreeCell simulation software in enhancing mathematical motivation and interest among primary school students in Imo State, Nigeria.

3. MATERIALS AND METHODS

3.1 Participants

A total of eighty-two students from three primary schools in Imo State, Nigeria, participated in the study:

- St. Joseph Primary School, Isinweke
- Community Primary School, Umuihi
- Central School, Umuderim

3.2 Study Design

A quasi-experimental design with pre-test and post-test control groups was employed. The students were randomly assigned to either the experimental group (using FreeCell) or the control group (traditional learning methods).

3.3 Data Collection

Data were collected using standardized motivation and interest questionnaires administered before and after the intervention.

3.4 Validity and Reliability

The instruments were validated by experts in educational psychology and tested for reliability using Cronbach's alpha, yielding a reliability coefficient of 0.85.

3.4 Data Analysis

Mean and standard deviation scores were calculated. An independent t-test was conducted to compare the pre-test and post-test scores of the experimental and control groups.

4. RESULTS

Table 1: Mean and Standard Deviation of Pre-test and Post-test Scores for Mathematical Motivation

Group	N	Pre-test Mean (SD)	Post-test Mean (SD)	MD	t	p
Experimental	41	45.12 (6.34)	68.45 (7.11)	23.33	7.14	<0.05
Control	41	46.02 (5.98)	47.12 (6.22)	1.10	0.92	>0.05

Table 2: Mean and Standard Deviation of Pre-test and Post-test Scores for Mathematical Interest

Group	N	Pre-test Mean (SD)	Post-test Mean (SD)	MD	t	p
Experimental	41	48.32 (6.21)	70.65 (7.05)	22.33	6.55	<0.05
Control	41	47.45 (6.11)	48.20 (6.34)	0.75	0.86	>0.05

4.1 Findings

The independent t-test results indicated a statistically significant difference between the experimental and control groups in both mathematical motivation ($t = 7.14$, $p < 0.05$) and interest ($t = 6.55$, $p < 0.05$). These results lead to the rejection of both null hypotheses, supporting the effectiveness of FreeCell simulation software in enhancing students' motivation and interest in mathematics. FreeCell significantly enhances primary school students' motivation and interest in mathematics, as evidenced by higher post-test scores in the experimental group compared to the control group. This implies that integrating educational games like FreeCell can effectively engage students in learning mathematics. However, the study is limited by its small sample size and short duration, necessitating

further research with larger, diverse samples and longer intervention periods to confirm these findings.

5. LIMITATIONS OF THE RESEARCH

Despite the promising findings of this study on the effectiveness of FreeCell simulation software in enhancing mathematical motivation and interest among primary school students, several limitations must be acknowledged.

1. **Sample Size and Generalizability**: The study involved a relatively small sample size of eighty-two students from three primary schools in Imo State, Nigeria. While the findings provide valuable preliminary insights, the limited sample size restricts the generalizability of the results. Future research should include a larger and more diverse sample to validate the findings across different demographics and educational settings.
2. **Study Duration**: The intervention period for this study was relatively short. Longer-term studies are necessary to assess the sustained impact of FreeCell on students' motivation and interest in mathematics. Extended observation would help determine whether the initial benefits observed persist over time and translate into long-term academic improvement.
3. **Geographical and Cultural Context**: The study was conducted in a specific geographical region with unique cultural and educational contexts. The findings may not be fully applicable to other regions with different educational systems, cultures, and resources. Replicating the study in various settings would help establish the broader applicability of the results.
4. **Quasi-Experimental Design**: While the quasi-experimental design used in this study is robust, it cannot completely eliminate the potential for confounding variables. Factors such as teacher effectiveness, classroom environment, and prior student knowledge might have influenced the results. Randomized controlled trials would provide more definitive evidence of the causal relationship between the use of FreeCell and improvements in mathematical motivation and interest.
5. **Reliance on Self-Reported Measures**: The study relied on self-reported measures to assess students' motivation and interest. Such measures are subject to response bias, where students might overreport or underreport their true levels of motivation and interest due to social desirability or other factors. Incorporating objective measures and triangulating self-reports with observational data could enhance the reliability of the findings.
6. **Teacher Training and Implementation Fidelity**: The effectiveness of educational interventions like FreeCell depends significantly on how well they are implemented by teachers. Variations in teacher training, familiarity with the software, and teaching styles might affect the outcomes. Ensuring consistent and comprehensive teacher training is crucial for the successful integration of such technologies.

7. **Technological Infrastructure**: The availability and quality of technological infrastructure in schools can impact the effectiveness of digital interventions. Differences in access to computers, software, and internet connectivity among schools could influence the results. Addressing these disparities is essential for equitable implementation of technology-enhanced learning.
8. **Focus on a Single Educational Tool**: While this study focused on FreeCell, it is important to consider the potential benefits of using a variety of educational tools and approaches. Relying on a single tool might limit the generalizability of the findings to other types of educational software or games.

6. CONCLUSION

The study concludes that FreeCell simulation software is an effective tool for improving primary school students' motivation and interest in mathematics. Its integration into the curriculum could provide a more engaging and effective learning experience. This study provides new evidence supporting the use of FreeCell as an effective tool for enhancing motivation and interest in mathematics among primary school students, highlighting its potential to transform traditional teaching methods.

6.1 Recommendations

- Implement FreeCell simulation software in mathematics classes to enhance student engagement.
- Provide regular training for teachers on using educational software effectively.
- Conduct further research on the long-term effects of game-based learning tools in mathematics education.

6.2 Contribution to Knowledge

This study contributes to the body of knowledge by demonstrating that educational games, specifically FreeCell, can significantly enhance motivation and interest in mathematics among primary school students. It offers empirical evidence that supports the integration of game-based learning tools in the primary school curriculum, providing a practical solution to improving student engagement and performance in mathematics. This research also underscores the importance of innovative teaching methods in overcoming traditional educational challenges.

6.3 Future Research

Future research should explore the long-term effects of incorporating FreeCell and other educational games into the mathematics curriculum, examining whether the initial improvements in motivation and interest lead to sustained academic achievement over time. Additionally, studies could investigate the effectiveness of different game-based learning approaches and technologies in diverse educational settings to identify the most impactful strategies for enhancing mathematics education.

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