



Enhancing mathematics and financial literacy among secondary school students in Ondo west LGA, Ondo state, Nigeria: a game-based learning approach

Akintewe B.N. and Akinremi B.V.

Department of Mathematics Adeyemi Federal University of Education, Ondo State, Nigeria
akintewebn@aceondo.edu.ng

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Abstract

A critical look through the Nigerian school's curriculum from primary through to tertiary level, shows there is no niche carved out for financial literacy, and this has kept even learned people who are high earners trapped by the shackles of financial ignorance. It is in view of this problem that this research was undertaken to ascertain the source, and level of Mathematics and financial literacy among senior secondary school II Students from randomly selected schools in Ondo West Local Government Area of Ondo State, Nigeria. A pretest was administered at the first contact with the 300 students from 10 different schools and after three teaching sessions on elements of financial literacy and gaming, a post test was administered on 294 students to evaluate the difference in students' performance. The students under the guidance and supervision of the Research Team played the standard monopoly after each class session to further reinforce the financial concepts learnt in the class. Monopoly is a multiplayer financial themed board game that teaches saving, and investments. The findings revealed that parents are the primary source of financial literacy for secondary school students, while a game-based learning approach effectively enhances financial literacy and mathematics skills, and that learning outcomes are influenced by factors like location and gender. It is recommended that financial literacy and gaming should be incorporated into the Nigerian secondary school curriculum. This will nurture an independent and well-grounded future generation who have smart money management skills and can confidently navigate their path through life.

Keywords: Financial literacy, mathematics literacy, secondary education, curriculum development, game-based learning.

Introduction

In today's fast-paced and ever-evolving world, a solid foundation in mathematics and financial literacy is critical for students to make informed life decisions and navigate the complexities of twenty-first-century financial systems. The Ondo West Local Government Area in Ondo State, Nigeria, is no exception to the increasing demands of these competencies among its youth. As part of an educational strategy to meet these demands, a game-based learning approach to enhance the teaching and learning of mathematics and financial literacy in secondary schools within the region has been adopted by researchers. Sole¹ provided evidence that financial literacy and mathematics underscore the fact that mathematical skills enhance financial literacy. Salas- Velasco *et al*² identified three effective ways of delivering financial education, including cross-curricular approaches, which support the paper's advocacy for integrating financial principles within mathematics classes. Another study by Sagita *et al*³, titled "Promising research studies between mathematics literacy and financial literacy through project-based learning", proved that mathematics literacy served as a pivotal cognitive factor influencing financial literacy skills. The authors conducted a biometric analysis to survey the relationship between mathematics and financial

literacy, citing works such as Singh & Dhir and Aidi Ahmi to authenticate their methodological approach in analyzing published literature on this topic. The OECD Recommendation on Financial Literacy⁴ defines financial literacy as a combination of awareness, knowledge, skill, attitude, and behavior necessary to make sound financial decisions and achieve individual financial well-being. Financial literacy is an indispensable skill, especially among young people. According to Lusardi and Oggero⁵, thirty-three percent (33%) of adults worldwide are financially literate. This implies that approximately 3.5 billion adults globally, most of whom are in developing economies, lack an understanding of fundamental financial concepts.

Traditional pedagogical methods face challenges in retaining student interest and in engaging with complex mathematical and financial concepts⁶. Game-based learning has emerged as a promising solution to bridge this gap, utilizing the natural appeal of games to foster a deeper and more active learning process Hwa⁷. Games in education have been shown to not only increase engagement but also encourage a first-hand approach to learning, allowing students to apply theoretical knowledge in simulated real-world scenarios^{8,9}.

Furthermore, research shows that when students actively participate in learning through interactive methods, they develop a stronger grasp of complex concepts¹⁰. One notable GBL tool, Monopoly game, has demonstrated significant potential for teaching financial literacy skills in an interactive format¹¹. Monopoly games simulate real-world economic principles, allowing players to experience budgeting, decision-making and investment strategies personally¹². The game's structure encourages players to apply basic math skills, as they determine rent, manage money, and make strategic financial decisions, thereby reinforcing both mathematical and financial literacy concepts Charlenne and Adrian¹¹. Scholars have noted that monopoly can improve students' financial knowledge, practical reasoning, and critical thinking skills, helping them internalize lessons that would otherwise be confined to theoretical learning¹³. In a classroom setting, this tool can also stimulate peer interaction and collaborative learning, fostering a more dynamic and engaging educational experience¹¹.

This research is rooted in the belief that education should not only be informative but also transformative, especially about equipping students with skills that are essential for their futures^{14,15}. The introduction of educational games is anticipated to revolutionize the approach to teaching mathematics and financial literacy by presenting these subjects not only as academic requirements but also as vital, usable knowledge that can influence students' daily lives and long-term financial well-being^{16,17}. By implementing this game-based approach, it is hoped to address existing educational challenges, including student disengagement¹⁸. This study examines changes in students' attitudes toward math, improvements in financial understanding and the effectiveness of game-based learning in promoting real-world application skills³. The findings from this research may offer valuable insights into how game-based learning, specifically using monopoly games, can be an effective, scalable, and resource-efficient approach to improving financial and mathematical literacy in similar educational settings.

This learning approach thus contributes significantly to the educational development of secondary school students in Ondo West, ensuring that they are better prepared to meet the challenges of the modern economy with confidence and competence. With the introduction as the foundation, the subsequent sections delve into the objectives of the research, the methodology for implementation and assessment, the expected outcomes, and the broader impact this initiative may have on the educational terrain of the Ondo West LGA and, potentially, the wider region.

Problem statement: In the Ondo West Local Government Area of Ondo State, Nigeria, secondary school students face significant challenges in acquiring and applying knowledge in mathematics and financial literacy. The traditional methods of teaching these critical concepts often fail to engage students fully, leading to a lack of interest, low retention rates and

suboptimal performance in examinations. Furthermore, the abstract nature of mathematical concepts and the conspicuous absence of financial literacy in schools' curricula can make these subjects seem inaccessible and irrelevant to a sizeable number of students. This disconnection poses a considerable barrier to developing the necessary skills for practical life management and for understanding the financial mechanisms that govern their everyday lives, which are becoming increasingly important in Nigeria's evolving economy.

Purpose of the study: Addressing the educational gap in mathematics and financial literacy is not just a matter of improving academic performance; it is about equipping young people with the competencies required for personal financial empowerment and for the economic development of the community at large. The integration of game-based learning into the curriculum is justified by its potential to enhance student engagement through interactive and immersive experiences. The rationale for adopting this approach is supported by research that suggests that educational games can promote motivation, encourage active learning and cater to diverse learning styles. Moreover, games can provide immediate feedback and allow students to understand the consequences of their decisions in a risk-free environment, which is particularly valuable for financial literacy education. The introduction of game-based learning is anticipated to address these educational challenges effectively. By aligning educational content with enjoyable gameplay, this innovative approach promises to make learning more relatable and practical, thereby fostering not only academic success but also long-term behavioral change in how students perceive and manage financial matters. This study is justified as a timely intervention to pivot away from rote learning toward a more dynamic, firsthand and engaging educational experience for the students of the Ondo West LGA. Through this, it aims to create a scalable and sustainable model that can be replicated to strengthen educational systems and improve financial literacy rates among young populations in similar contexts.

The main purpose of this study is to enhance mathematics and financial literacy using a game-based learning approach among secondary school students in the Ondo West Local Government Area, Ondo State, Nigeria. Specifically, the study intends to do the following: i. To investigate the sources from which students acquire financial literacy knowledge. ii. To evaluate the differences in learning outcomes between male and female students, as well as between students in public and private schools. iii. To examine the role of school location (urban vs. rural) in the effectiveness of the game-based learning approach. iv. To assess the impact of a game-based learning approach on students' academic performance in mathematics and financial literacy. v. To explore the preferences, engagement levels and challenges (e.g., cheating behaviors) associated with the implementation of game-based learning among secondary school students.

Research questions: i. What sources of information do students rely primarily on to learn about financial literacy? ii. What are the differences in learning outcomes between male and female students' pretest and post-test scores? iii. How does the performance of students in public schools compare to that of those in private schools before (pretest) and after (post-test) the intervention? iv. What are the differences in learning outcomes between students in urban and rural schools according to the pretest and post-test? v. What are the students' preferences, engagement levels, and challenges associated with the game-based learning approach?

Significance of the study: The use of games as a learning tool promotes the practical application of mathematical and financial precepts in real-world scenarios. This approach can help students develop critical thinking, decision-making and prepare them for future challenges. The study highlights how game-based learning engages students across different academic levels and backgrounds, creating an inclusive environment that boosts participation and confidence among all learners. By providing insights into the effectiveness of game-based teaching, this study serves as a resource for teacher training and development. It also offers empirical evidence to support policy reforms that advocate for innovative teaching methods in schools. Observations of unethical practices, such as cheating during games, underscore the need to integrate lessons on honesty, fairness, and ethical behavior into educational programs. This contributes to character building alongside academic development. Financial literacy is a critical life skill. By demonstrating the effectiveness of game-based learning in enhancing financial education, this study supports to equip students with the knowledge and skills needed for responsible financial decision-making in adulthood.

Methodology

Research Design: The research involves a pretest and post-test procedure. The pretest measurement instrument is a questionnaire with sections A, B, and C to elicit information on bio data, source of financial literacy and level or extent of math and financial literacy assessment questions respectively. The post-test, however, consists of sections A for demographic information and B, which has twenty (20) items assessment questions same as the ones in the pretest to measure the literacy levels after the intervention.

The first visit to each school creates an avenue to meet the target group, interact, communicate the research objective and thereafter conduct a pretest. A second visit is then scheduled for the following week to teach a pre-prepared course content to cover foundations of financial literacy, advanced financial concepts and practical financial skills. This class session of forty minutes is followed by a game session of an hour using the standard monopoly game. A third and final visit is then planned for teaching, gaming and administration of the post-test.

The entire fieldwork per school is expected to cover a period of about one hour forty minutes per week for three consecutive weeks. The results from the pretest and post-test are then summarized for further analysis and discussions to establish whether the intervention is effective or not. The check put in place to ensure the reliability of the observations is that the questions meant to measure the level of literacy remain the same for both the pretest and the post-test across all schools and participants.

The course content being taught is to create some level of awareness and financial consciousness, while monopoly game on the other hand is a practical route to learn important mathematical skills (during money transactions), financial skills (investments, risk, mortgage, taxes, interest, and bankruptcy among others) and even social skills (cooperation, character, speculation, etc.). The incorporation of course content and monopoly game in the study is to play a complementary role in enhancing mathematics and financial literacy among secondary school students in Ondo west, Nigeria.

Participants: The Nigerian secondary school system is divided into two sections of; Junior and Senior secondary schools and both have levels I, II and III. This research consists of 300 randomly selected participants from 10 schools in senior secondary II classes comprising of Art, Commercial and Science students. The 10 schools involved in the project were randomly selected from the Ondo West Local Government Area of Ondo State, to include all boys' schools, all girls' schools, coeducational schools, day schools, boarding schools, private schools, public schools, urban and rural schools.

Data collection methods: Surveys to ascertain students' source and level of financial literacy were accessed via the pretest and post-test results. On the observational level, the excitement and involvement displayed by the students while they were playing the game was intriguing. The seriousness attached to the game by the students could be likened to a real-world activity of acquiring real-time wealth through savings and investments while paying taxes.

300 students took part in the pretest but at the point of administering the post test, 6 students were absent due to ill health or some other reasons, necessitating the results of findings being based on 294 participants. Interestingly, fifteen students in some of the ten schools involved in the project were found to be dishonest while performing financial transactions that characterize the game of Monopoly.

Data Analysis Techniques: In this study, the data was analyzed via the Statistical Package for the Social Sciences (SPSS)¹⁹ version 27. Percentage score, and ANOVA analysis were performed. The results were interpreted in accordance with established statistical conventions, and the findings presented in accordance with APA style guidelines.

Results and Discussion

The Table-2 shows the results of a survey on sources of financial literacy among senior secondary school students. The results revealed that the most common source of financial literacy are parents, with 54.8% of the students reporting that they learned about financial literacy from their parents. This is followed by the curriculum, books, online sources and friends in decreasing order of percentage representation. This implies that parents are the primary source of financial literacy for senior secondary school students. Schools play a secondary role in teaching financial literacy, as evidenced by using the curriculum as a source. Books and online resources form a smaller proportion of students, but they may still be important resources for those who are interested in learning more about financial literacy. Friends are the least common source of financial literacy, which suggests that students may not be talking to their friends about personal finance.

Analysis of Variance (ANOVA): Pre-test and Post-test Analysis: This section presents the analysis and interpretation of the data collected from the study. The results of the Two-Way Analysis of Variance (ANOVA) are examined to determine the influence of gender, location, and school type on students' financial literacy before and after the intervention. The pre-test

results provide insight into students' academic performance before the intervention, highlighting the influence of gender, location, and school type on learning outcomes. The ANOVA results show that the overall model is statistically significant ($F = 50.673$, $p = .000$), indicating that at least one of the independent variables had a significant effect on pre-test scores. Among the three factors, only location was found to be significant ($F = 106.907$, $p = .000$), showing that students from different locations had varying levels of academic performance before the intervention. This suggests that environmental factors and educational resources available in different locations may have contributed to disparities in students' initial academic abilities. In contrast, gender did not significantly influence pre-test scores ($F = 3.463$, $p = .064$), suggesting that male and female students performed at comparable levels before the intervention. Similarly, school type did not show a significant effect on students' performance ($F = 1.733$, $p = .189$), implying that there was no substantial difference in the initial academic performance of students from public and private schools. Additionally, none of the interaction effects—Gender * Location ($F = .949$, $p = .331$) and Gender * School Type ($F = .396$, $p = .529$)—were significant, indicating that the combined effects of gender and location, as well as gender and school type, did not influence pre-test scores in any meaningful way.

Table-1: Randomly selected schools that participated in the study.

Name of School	Type	System	Ownership	Location
St. Helen's Unity School, Ondo	Girls School	Boarding	Public	Urban
St. Joseph College, Ondo	Boys School	Day	Public	Urban
Holy Flocks Gram Schl, Ayeyemi,	Coeducational	Day	Public	Rural
Ilu Nla/Bagbe Comm. High School	Coeducational	Day	Public	Rural
Igbado Community High School	Coeducational	Day	Public	Rural
La Salle College, Ondo	Coeducational	Boarding	Private	Urban
Adeyemi Demonstration Sec School	Coeducational	Day	Private	Urban
Top Class College, Ondo	Coeducational	Day	Private	Urban
Life Veneration College, Ondo	Coeducational	Day	Private	Urban
Diocesan Comp High Schl. Ondo	Coeducational	Boarding	Private	Urban

Table-2: What sources do you use to learn about financial literacy?

Sources	Parents	Curriculum	Books	Online	Friends
Frequency	146	67	24	24	7
Percent (%)	54.8	25.2	9	9	2

Table-3: Tests of Between-Subjects Effects (Dependent Variable: Pre-Test).

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	673.421 ^a	5	134.684	50.673	.000
Intercept	10750.369	1	10750.369	4044.683	.000
Gender	9.205	1	9.205	3.463	.064
Location	284.148	1	284.148	106.907	.000
School_Type	4.607	1	4.607	1.733	.189
Gender * Location	2.521	1	2.521	.949	.331
Gender * School_Type	1.054	1	1.054	.396	.529
Location * School_Type	.000	0	.	.	.
Gender * Location * School_Type	.000	0	.	.	.
Error	770.791	290	2.658		
Total	15243.000	296			
Corrected Total	1444.213	295			

Table-4: Tests of Between-Subjects Effects (Dependent Variable: Post Test).

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2068.495 ^a	5	413.699	52.750	.000
Intercept	31254.341	1	31254.341	3985.174	.000
Gender	44.706	1	44.706	5.700	.018
Location	930.507	1	930.507	118.647	.000
School_Type	10.244	1	10.244	1.306	.254
Gender * Location	80.230	1	80.230	10.230	.002
Gender * School_Type	93.599	1	93.599	11.935	.001
Location * School_Type	.000	0	.	.	.
Gender * Location * School_Type	.000	0	.	.	.
Error	2274.369	290	7.843		
Total	44694.000	296			
Corrected Total	4342.865	295			

The post-test results provide a comparative perspective on how the intervention influenced students' performance. The ANOVA results reveal that the overall model remains statistically significant ($F = 52.750$, $p = .000$), confirming that the intervention and the independent variables influenced students' post-test scores. Unlike the pre-test results, gender became a significant factor in post-test performance ($F = 5.700$, $p = .018$), indicating that male and female students responded differently to the intervention. This suggests that the teaching method or instructional approach used in the intervention may have been more effective for one gender group than the other. Location remained a significant factor ($F = 118.647$, $p = .000$), reinforcing the idea that students from different locations continued to exhibit differences in learning outcomes even after the intervention. However, school type did not significantly influence post-test scores ($F = 1.306$, $p = .254$), meaning that students from public and private schools performed similarly after the intervention, just as they did in the pre-test.

One of the most notable differences between pre-test and post-test results is the emergence of significant interaction effects in the post-test. The interaction between Gender * Location became statistically significant ($F = 10.230$, $p = .002$), indicating that the influence of gender on students' performance varied depending on their location. Similarly, Gender * School Type was also significant ($F = 11.935$, $p = .001$), suggesting that the relationship between gender and academic performance was influenced by the type of school attended.

Table-5: Comparison of Pre-Test and Post-Test Results.

Factor	Pre-Test Significance	Post-Test Significance	Change Observed?
Gender	Not significant ($p = .064$)	Significant ($p = .018$)	Became significant after intervention
Location	Significant ($p = .000$)	Significant ($p = .000$)	Still significant
School Type	Not significant ($p = .189$)	Not significant ($p = .254$)	No change
Gender * Location	Not significant ($p = .331$)	Significant ($p = .002$)	Became significant
Gender * School Type	Not significant ($p = .529$)	Significant ($p = .001$)	Became significant

Table-5 shows the comparison of the pretest and post-test results. It reveals that the intervention had a significant impact on gender differences, as gender became an important factor in post-test performance. Location remained a critical determinant of academic performance before and after the intervention. The interaction effects in the post-test suggest that gender influences performance differently depending on both location and school type.

Discussions: The study revealed the students' sources of financial literacy. These findings indicate that parents are the primary source of financial literacy for senior secondary school students. The use of the curriculum revealed that schools play a secondary role in teaching financial literacy. A smaller proportion of students use books and online resources which are still important resources for those who are interested in learning more about financial literacy. Friends are the least common source of financial literacy. This finding aligns with Mandell's²⁰ study, which also identified parents as primary sources of financial knowledge among teenagers. However, studies such as Lusardi and Mitchell²¹ emphasized the increasing role of formal education in shaping financial literacy.

The findings of this study provide valuable insights into the effectiveness of the Instructional and gaming intervention in enhancing mathematics and financial literacy among secondary school students. The significant impact of location on student performance before and after the intervention is consistent with the findings of Smith and Brown²², who highlighted that students in urban areas often outperform their rural counterparts due to access to better educational resources. This suggests that despite the intervention, students in rural areas may still face structural disadvantages that hinder their learning outcomes.

The emergence of gender as a significant factor in the post-test aligns with Williams and Adams²³, who argue that instructional strategies can influence male and female students differently. The observed improvement in one gender group over the other shows that the intervention may have resonated better with their learning preferences, possibly due to engagement levels and competitive elements embedded in the learned content and game.

The lack of significant effects of school type on both pre-test and post-test scores aligns with García and Torres²⁴, who assert that when instructional strategies are standardized, differences between public and private schools tend to diminish. However, the significant interaction effects between gender and location, as well as gender and school type, suggest that the intervention was more effective for certain subgroups, supporting Patel and Kumar's²⁵ argument that interventions should be context-specific to address varying student needs.

Based on observations, the students demonstrated elevated levels of active participation during the game sessions. They consistently showed enthusiasm and eagerness to engage in the activities, indicating that the game-based learning approach effectively captured their interest. The researchers observed that the students preferred the game-based learning approach to traditional teaching methods. This preference suggested that the interactive and dynamic nature of the games resonated more with the students, making the learning process enjoyable and relatable. The direct aspect of the games significantly motivated the students.

They found the process engaging and exciting, as it allowed them to apply practical skills in a competitive yet enjoyable environment. The combination of fun and competition enhanced their intrinsic motivation to learn. The games fostered a sense of healthy competition and collaboration among the students. They not only worked individually to achieve goals but also interacted with their peers, enhancing their teamwork and communication skills.

While the games were well received, approximately 5% of the students attempted to cheat during the money game. This observation highlights an opportunity to integrate lessons on ethics, honesty, and the importance of fair play into the game design and debriefing sessions. This approach encouraged the students to apply mathematical and financial concepts in real-world scenarios. This practical application helped improve their understanding and retention of the topics, highlighting the potential of game-based learning to bridge theoretical knowledge and real-life application. The game-based learning strategy engaged all the students, regardless of their academic ability. The interactive nature of the activities created an inclusive environment where even less academically confident students could participate and excel. The games helped to build a more positive and vibrant classroom atmosphere. Students were more willing to express themselves, ask questions and contribute to discussions, leading to improved teacher–student and peer-to-peer relationships.

Conclusion

The study investigated the effectiveness of a game-based learning approach in enhancing mathematics and financial literacy among secondary school students in the Ondo West Local Government Area, Ondo State. The findings revealed that parents are the primary source of financial literacy for secondary school students, while content instruction complemented with a game-based learning approach effectively enhances financial literacy and mathematics skills, and that learning outcomes are influenced by factors like location and gender.

Summary of findings: This study explored the sources of financial literacy among senior secondary school students and the impact of instructional and gaming interventions on their mathematics and financial literacy. The research found that parents are the primary source of financial literacy, followed by schools, books, and online resources, while friends are the least common source. The study also revealed that location and gender significantly impact student performance, with urban students outperforming rural counterparts and differing responses to instructional strategies between genders. While school type had no significant effect, interaction effects between gender and location, as well as gender and school type, highlighted the need for context-specific interventions.

Observations during the intervention revealed that students showed elevated levels of active participation, and a preference for game-based learning over traditional methods. The

interactive and competitive nature of the games motivated students to foster teamwork and communication skills and made learning enjoyable and relatable. However, a small percentage of students attempted to cheat, indicating an opportunity to integrate lessons on ethics and fair play. The game-based approach improved the understanding and retention of learned concepts, engaged students regardless of academic ability, and fostered a more vibrant classroom atmosphere.

Recommendations: i. Policy makers should formally integrate game-based learning into the school curriculum to promote active learning and improve outcomes in mathematics and financial literacy. ii. The government should pay special attention to improving the performance of public schools and rural students by providing better resources, training teachers, and enhancing infrastructure. iii. Teachers should incorporate lessons on honesty, fairness, and ethical decision-making into game-based activities to address observed issues such as cheating. iv. Given the significant role that parents play in financial literacy, schools should involve parents through workshops and collaborative activities that reinforce financial education at home. v. Educators should receive training on facilitating game-based learning effectively to maximize student engagement and learning outcomes while addressing potential challenges.

Areas for further investigation: i. Future research should explore the long-term effects of game-based learning on academic performance and financial literacy retention. ii. Educational planners should investigate and examine how game-based learning can be scaled and adapted to other subjects, school types and regions with varying socioeconomic conditions. iii. Further studies could assess the impact of game-based learning on students' behavioral and ethical development, especially in competitive settings. iv. Research could explore how parental involvement can be optimized to complement school-based financial education.

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