DEVELOPING ENTREPRENEURIAL LITERACY THROUGH CONTEXT-BASED SCIENCE AND MATHEMATICS TEACHING IN RURAL NIGERIAN SCHOOLS

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Abstract

This study examined the impact of context-based science and mathematics instruction on entrepreneurial literacy among secondary school students in rural areas of Zaria Education Zone, Kaduna State, Nigeria. A quasi-experimental design involving pre-test, post-test control groups was employed. A total of 200 SSII students from four public rural secondary schools were sampled using multistage random sampling. Two schools received context-based instruction infused with real-life entrepreneurial scenarios, while two others served as control groups taught using conventional methods. The Entrepreneurial Literacy Assessment Scale (ELAS) was used to collect data on students' entrepreneurial knowledge, attitudes, and skills. ANCOVA results showed a statistically significant difference in favor of the experimental group, $F(1, 197) = 45.14$, $p < .001$, with a large effect size ($\eta^2 = .189$), indicating that the context-based approach substantially improved entrepreneurial literacy. However, gender-based analysis revealed no significant difference between male and female students' scores, suggesting gender equity in learning outcomes. The study concludes that integrating context-based instruction into science and mathematics education enhances students' entrepreneurial thinking and real-world problem-solving capacity, especially in under-resourced rural settings. It recommends curriculum review, teacher training, and further research on scalable, inclusive entrepreneurial pedagogies in STEM education.

Keywords: Context-based instruction, Entrepreneurial literacy, Science and mathematics education, Rural schools, Gender, Nigeria, Secondary education

Introduction

In the evolving landscape of education and economic development, there is an urgent need to prepare students not only with academic knowledge but also with practical, entrepreneurial competencies that empower them to navigate real-life challenges (Aliyu e al., 2025). This is particularly relevant in rural Nigerian communities where formal employment opportunities are scarce and self-reliance is critical for survival and socio-economic mobility. Entrepreneurial literacy, which encompasses the knowledge, skills, attitudes, and values that enable individuals to identify opportunities, innovate, take initiative, and manage resources effectively, has emerged as a key 21st-century competence (Lackéus, 2015; Nwachukwu, 2020). Within this framework, three interrelated components are central: entrepreneurial knowledge (understanding concepts such as innovation, value creation, and financial planning), entrepreneurial attitudes (creativity, resilience, risk tolerance, and initiative), and entrepreneurial skills (problem-solving, opportunity recognition, teamwork, and resource management) (OECD, 2018; Fayolle, 2018).

Science and mathematics, by their very nature, are rooted in inquiry, critical thinking, and systematic problem-solving, foundations that align closely with entrepreneurial thinking (Aliyu e al., 2025). However, the conventional delivery of these subjects in Nigerian schools remains largely abstract, examination-driven, and disconnected from students' socio-economic realities, particularly in rural settings (Okebukola, 2021; Umeh & Eze, 2018). As a result, students often struggle to see the relevance of what they learn to the challenges and opportunities within their communities, leaving entrepreneurial potential untapped.

Context-based teaching has gained traction globally as an instructional strategy that situates learning within students' everyday experiences, making science and mathematics more relevant, engaging, and applicable (Gilbert, 2006; Bennett

et al., 2007). In this approach, abstract concepts are introduced and taught through familiar situations or local issues such as agriculture, small-scale trade, environmental sustainability, and health practices—contexts that rural students can easily relate to and potentially transform into entrepreneurial opportunities. Through this pedagogical lens, learners are encouraged to apply scientific and mathematical knowledge in designing low-cost technologies, managing resources, conducting experiments tied to farming or commerce, and analyzing data for decision-making in real-world situations (Achor & Agbo-Egwu, 2015).

While a growing body of research emphasizes the integration of entrepreneurship into STEM education as a pathway to innovation, employability, and resilience (Oviawe, 2017; Blenker et al., 2014), much of this scholarship has been concentrated in urban or higher education contexts (Okolie et al., 2020; Okoye & Okwelle, 2021). Few empirical studies have systematically examined how context-based science and mathematics instruction can develop entrepreneurial literacy in rural Nigerian schools, despite the urgent need to address rural youth unemployment and underdevelopment. This gap is significant because rural learners face unique challenges—including limited access to resources, exposure to fewer entrepreneurial role models, and a curriculum that is often detached from their lived realities.

Therefore, this study investigates the effectiveness of context-based instruction in fostering entrepreneurial literacy among secondary school students in rural Nigeria. Specifically, it examines whether teaching science and mathematics through locally relevant contexts enhances students' entrepreneurial knowledge, attitudes, and skills (ELAS). Anchored in constructivist and experiential learning theories, this study contributes to the growing discourse on embedding entrepreneurship into STEM education. By addressing an underexplored rural context, it offers insights into how context-based pedagogy can be leveraged to bridge educational inequality, promote self-reliance, and support sustainable community development.

Statement of the Problem

Despite the acknowledged importance of entrepreneurship in national development, most Nigerian secondary schools, particularly in rural areas, continue to deliver science and mathematics content in abstract, theory-driven formats that have little connection to the learners' environments or livelihoods. This disconnect leaves students ill-equipped to apply scientific and mathematical knowledge to real-world problems or develop innovative and entrepreneurial mindsets. The situation is more critical in rural settings where poverty, limited access to technology, and a lack of job opportunities heighten the need for practical, context-driven education that promotes self-reliance. While context-based instruction has been globally recognised for its potential to make learning more meaningful and relevant, its implementation in Nigerian classrooms, especially in rural areas, remains minimal and under-researched. Thus, there is a need to investigate whether teaching science and mathematics using locally relevant, context-based approaches can improve students' entrepreneurial literacy. This study, therefore, aims to address this gap by evaluating the impact of context-based science and mathematics instruction on the development of entrepreneurial knowledge, attitudes, and practical skills among secondary school students in rural Nigerian schools.

Objectives of the Study

The study aims to:

1. Determine the effect of context-based science and mathematics instruction on students' entrepreneurial literacy in rural Nigerian secondary schools.
2. Examine whether there are gender differences in the entrepreneurial literacy of students exposed to context-based instruction.

Research Questions

The study is guided by the following research questions:

1. What is the difference in entrepreneurial literacy between students taught science and mathematics using context-based instruction and those taught using conventional methods?
2. Is there a significant gender difference in the entrepreneurial literacy of students exposed to context-based instruction?

Null Hypotheses

The following null hypotheses were formulated and tested at a 0.05 level of significance:

H_{01}: There is no significant difference in entrepreneurial literacy between students taught science and mathematics using context-based instruction and those taught using conventional methods.

H_{02}: There is no significant gender difference in the entrepreneurial literacy of students taught using context-based instruction.

Theoretical Framework

This study is grounded in two complementary theories: Constructivist Learning Theory and Experiential Learning Theory (ELT).

Constructivist Learning Theory, advanced by scholars such as Piaget and Vygotsky, posits that learners actively construct knowledge through prior experiences and interactions with their environment (Vygotsky, 1978). In science and mathematics education, constructivism emphasises student-centred approaches that promote inquiry, problem-solving, and critical thinking, skills that are also foundational for entrepreneurial competence. When taught through context-based methods, science and mathematics become tools for exploring and addressing real-life challenges, enabling learners to build knowledge that is meaningful and transferable to entrepreneurial settings.

Experiential Learning Theory (Kolb, 1984) extends constructivist ideas by emphasising the cyclical nature of learning through experience. Kolb's four-stage model, concrete experience, reflective observation, abstract conceptualisation, and active experimentation, is particularly relevant to entrepreneurship education, where authentic problem-solving and hands-on practice are central. In this study, embedding instruction in local contexts (e.g., agricultural measurement problems or market-based budgeting tasks) provides students with direct experiences, opportunities for reflection, conceptual understanding, and application in entrepreneurial scenarios.

Taken together, these theories provide a strong foundation for the study. They suggest that context-based science and mathematics instruction can enhance entrepreneurial literacy by engaging learners in hands-on, locally relevant, and practical experiences that foster the knowledge, skills, and attitudes required for entrepreneurship.

Literature Review

Entrepreneurial literacy has emerged as a vital component of the global education agenda, recognised as a critical 21st-century skill that fosters innovation, financial independence, and socio-economic development. Lackéus (2015) defines entrepreneurial education as the process of equipping learners with the capacity to create value for others, solve authentic problems, and develop self-efficacy. In Nigeria, however, many science and mathematics classrooms remain rigidly exam-oriented and largely disconnected from students' lived realities (Okebukola, 2021; Oviawe, 2017).

Context-Based Teaching (CBT) has been identified as a transformative pedagogy that makes learning more meaningful by linking academic content with real-life applications. According to Gilbert (2006) and Bennett et al. (2007), this approach enhances students' engagement, interest, and retention of knowledge by situating abstract concepts within familiar situations. Achor and Agbo-Egwu (2015) demonstrated that rural students taught physics through community-related examples exhibited improved problem-solving skills and practical application abilities. Similarly, Nwachukwu (2020) found that embedding mathematics instruction in local contexts not only demystified the subject but also fostered entrepreneurial skills such as estimation, budgeting, and resource optimisation.

In terms of gender dynamics, several studies suggest that context-based and entrepreneurship-focused instruction can help reduce gender disparities in STEM education. For instance, UNESCO (2018) and Osisioma and Nzewi (2018) argue that inclusive and practical teaching strategies in science and mathematics boost girls' interest and performance, particularly when connected to real-world social or economic activities. By showing learners how STEM knowledge can address everyday challenges, such as calculating profit margins in small-scale businesses or managing natural resources, entrepreneurial literacy becomes more concrete, relatable, and accessible to both genders.

Although existing literature highlights the effectiveness of context-based instruction and entrepreneurship education independently, there remains a scarcity of empirical studies that integrate both approaches within science and mathematics, particularly in rural Nigerian settings. This study, therefore seeks to bridge this gap by examining how context-based STEM instruction influences the development of entrepreneurial literacy (knowledge, skills, and attitudes) across gender.

Methodology

This study adopted a quasi-experimental pre-test, post-test control group design involving intact classes. The design was considered appropriate since random assignment of individual participants was not feasible in the natural school setting. The population of the study comprised all Senior Secondary II (SSII) students in public secondary schools located in rural communities within Zaria Education Zone, Kaduna State, Nigeria. The population was approximately 5,624 students across 18 rural-based senior secondary schools. The sample size consisted of 200 SSII students drawn from four co-educational public secondary schools through a multistage sampling procedure. At the first stage, purposive sampling was used to select schools located in rural areas with comparable infrastructural conditions. At the second stage, two schools were randomly assigned to the experimental group and two to the control group, while intact classes from each selected school were used for the study. The experimental group received science and mathematics instruction using context-based teaching strategies that integrated real-life entrepreneurial scenarios such as agricultural estimations, market transactions, and environmental data interpretation. Instructional content was aligned with the Nigerian Senior Secondary School Curriculum but delivered through locally relevant experiences and problem-based learning approaches. The control group, however, was taught using traditional teacher-centred methods, focusing on textbook examples and rote learning.

The instrument for data collection was the Entrepreneurial Literacy Assessment Scale (ELAS), developed and validated by the researchers. The ELAS comprised three subscales:

I. Entrepreneurial Knowledge (10 items)

II. Entrepreneurial Attitudes (10 items)

III. Entrepreneurial Skills (10 items)

The items were structured on a 4-point Likert scale. The instrument was subjected to face, content, and construct validity by experts in science education and entrepreneurship. A pilot test conducted with 30 students from a similar school outside the study zone yielded a Cronbach's alpha reliability coefficient of 0.83, indicating high internal consistency. Data collection was carried out in two phases: pre-test (to establish baseline equivalence between groups) and post-test (to measure the effect of the intervention) over a six-week instructional period. For data analysis, descriptive statistics (mean and standard deviation) were used for initial exploration, while inferential statistics were employed to test the hypotheses. Specifically, Analysis of Covariance (ANCOVA) was used to test for significant differences between the experimental and control groups while controlling for pre-test scores and an Independent samples t-test was used to determine gender differences in entrepreneurial literacy outcomes. All hypotheses were tested at the 0.05 level of significance using SPSS version 26.

Data Analysis and Interpretation

Research Question 1:

What is the difference in entrepreneurial literacy between students taught science and mathematics using context-based instruction and those taught using conventional methods?

Table 1: Mean and Standard Deviation of Students' Post-Test Entrepreneurial Literacy Scores by Group

Group	N	Mean Score	Std. Deviation
Experimental Group	100	72.84	6.35
Control Group	100	61.32	7.11

Table 1 shows that the students exposed to context-based instruction (experimental group) had a higher mean score (M = 72.84, SD = 6.35) compared to those taught with conventional methods (M = 61.32, SD = 7.11). This suggests a potential positive effect of the context-based instructional strategy on entrepreneurial literacy.

Hypothesis 1 (H_{01}):

There is no significant difference in entrepreneurial literacy between students taught science and mathematics using context-based instruction and those taught using conventional methods.

Table 2: ANCOVA Summary of Post-Test Entrepreneurial Literacy Scores Controlling for Pre-Test

Source	SS	df	MS	F	p-value	Partial η^2
Pre-test	442.75	1	442.75	6.53	.011*	.032
Group	3058.12	1	3058.12	45.14	.000***	.189
Error	13218.34	197	67.09			
Total	25278.61					

After controlling for the pre-test scores, the ANCOVA result in Table 2 reveals a statistically significant effect of instructional method on entrepreneurial literacy, $F(1, 197) = 45.14$, $p < .001$. The partial eta squared ($\eta^2 = .189$) indicates a large effect size. Therefore, the null hypothesis (H_{01}) is rejected. This means that context-based instruction had a significant positive impact on students' entrepreneurial literacy.

Research Question 2:

Is there a significant gender difference in the entrepreneurial literacy of students exposed to context-based instruction?

Table 3: Mean and Standard Deviation of Entrepreneurial Literacy Scores by Gender (Experimental Group Only)

Gender	N	Mean Score	Std. Deviation
Male	48	72.18	6.80
Female	52	73.44	6.05

Table 3 shows that female students had slightly higher entrepreneurial literacy scores (M = 73.44) than male students (M = 72.18), though the difference appears marginal.

Hypothesis 2 (H_{02}):

There is no significant gender difference in the entrepreneurial literacy of students taught using context-based instruction.

Table 4: Independent Samples t-Test on Gender and Entrepreneurial Literacy Scores

Gender	N	Mean	Std. Dev.	t	df	p-value
Male	48	72.18	6.80			

Female	52	73.44	6.05	-0.94	98	0.349

The independent samples t-test result shows no statistically significant difference in entrepreneurial literacy between male and female students taught using context-based instruction ($t = -0.94$, $p = 0.349$). Therefore, the null hypothesis (H_{02}) is retained. This implies that both male and female students benefited equally from the instructional intervention.

Discussion of Findings

The findings of this study reveal that the use of context-based science and mathematics instruction significantly enhances the entrepreneurial literacy of students in rural Nigerian secondary schools. This aligns with the assertions of Gilbert (2006), Bennett et al. (2007), and Achor & Agbo-Egwu (2015), who argue that embedding real-life contexts into instruction not only makes learning more relevant but also increases its practical application, especially in resource-constrained settings. The statistically significant difference in post-test scores between the experimental and control groups suggests that students who learn through real-world, entrepreneurial tasks are better positioned to acquire and apply entrepreneurial knowledge, attitudes, and skills.

The findings also support the theoretical underpinnings of Constructivist and Experiential Learning Theories. As Vygotsky (1978) and Kolb (1984) emphasized, learning becomes more meaningful when students are actively engaged in tasks that mirror their environments. By using familiar contexts like local markets, small-scale farming, or family-based budgeting scenarios, students were able to construct knowledge that was both academically grounded and practically useful. This supports Nwachukwu (2020) and Osisioma & Nzewi (2018), who advocated for a curriculum that fosters innovation and self-reliance through contextually meaningful STEM activities.

Interestingly, no significant gender differences were observed in entrepreneurial literacy outcomes, suggesting that context-based teaching strategies are inclusive and equitable. This supports studies by UNESCO (2018) and Umeh & Eze (2018), which emphasize the potential of context-based and entrepreneurial approaches to narrow gender gaps in STEM education. The use of shared, relatable experiences appeared to benefit both male and female students equally, providing a powerful argument for scaling such pedagogies in rural and underserved settings.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Policy Integration: The Nigerian Educational Research and Development Council (NERDC) should revise the science and mathematics curricula to explicitly integrate entrepreneurial competencies through context-based teaching strategies. For example, topics such as ratios and proportions in mathematics could be taught through local market price comparisons, while chemical reactions in science could be linked to small-scale soap or fertilizer production.
2. Teacher Training: Continuous professional development programs should be organized for science and mathematics teachers on the design and implementation of context-based instructional strategies. Training should include practical workshops on how to incorporate entrepreneurial projects—such as budgeting for school farming projects in mathematics or designing simple energy-saving devices in physics—into classroom teaching.
3. Resource Development: Educational stakeholders, including NGOs and local government education authorities, should support the development of instructional materials that reflect students' immediate environments and promote entrepreneurial learning. For instance, workbooks could include exercises on calculating profits from small trading businesses or experiments involving locally available raw materials like cassava, shea butter, or clay.
4. Gender-Inclusive Pedagogy: Since no gender differences were observed, educators are encouraged to apply these strategies across all-gender classrooms to ensure equity in entrepreneurial skills development. Teachers should consciously provide equal opportunities for both boys and girls to lead entrepreneurial group tasks such as managing class cooperatives or presenting innovative project solutions.

5. Further Research: Similar studies should be conducted across other regions and subjects (e.g., agricultural science, economics, and vocational studies) to further validate the effectiveness of context-based instruction in developing real-world competencies among diverse student populations..

Limitations of the Study

Despite the strengths of this study, several limitations should be acknowledged. First, the research was conducted within a specific geographical context, rural public secondary schools in Zaria Education Zone, Kaduna State—which may limit the generalizability of the findings to other regions with different socio-economic or cultural conditions. Second, the duration of the intervention was relatively short (six weeks), which may not have been sufficient to capture long-term effects of context-based teaching on entrepreneurial literacy. Third, the study relied primarily on self-report measures through the Entrepreneurial Literacy Assessment Scale (ELAS). While the instrument demonstrated strong reliability and validity, self-reported responses are subject to potential bias such as social desirability effects. Finally, the quasi-experimental design, which used intact classes rather than random assignment of individual students, may have introduced confounding variables beyond the control of the researchers. Future studies could extend the intervention over a longer period, incorporate additional objective measures of entrepreneurial competencies, and replicate the research across diverse educational and cultural settings to strengthen external validity and provide deeper insights.

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